Deliverable 6.4.6: Showcase Climate and Energy Policy Ontology

For paper: Climate Policy in Practice

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Silvia Weko[1][https://orcid.org/0000-0002-8180-7046], Germán Bersalli[1][https://orcid.org/1111-2222-3333-5555], Aksornchan Chaianong[1][https://orcid.org/0000-0003-3817-2062], Ioannis Milioritsas[1][https://orcid.org/0009-0004-5193-0862], Johan Lilliestam[1][https://orcid.org/0000-0001-6913-5956]

[1] FAU Nuremberg-Erlangen School of Business, Economics and Society, Lange Gasse 20, 90403 Nürnberg

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General Information

Summary

The academic paper “Climate Policy in Practice: Which Instruments Do Governments Use, and Which Ones Do Researchers Study?” uses the Climate and Energy Policy Ontology (CEPO) developed by NFDI4Energy to categorize different types of climate policy instruments and measure whether the instruments that are most widespread in the real world are being studied to the same extent in the academic literature. We find that most academic work focuses on a small sub-set of economic policy instruments (especially carbon taxes, emissions trading and feed-in tariffs). However, there is relatively less work on other economic instruments that are more difficult to measure, and even less on regulatory policy instruments. These insights would not have been possible without using the Climate and Energy Policy Ontology because it has detailed and mutually exclusive definitions of policy instruments, and is interoperable with policy datasets. To enable better communication with non-expert ontology users, a simplified version is also published on the Climate Policy Atlas website and can be easily visualized and searched.

Deliverable within NFDI4Energy

The Climate and Energy Policy Ontology (CEPO) is an interoperable ontology for climate and energy policy instruments integrated into the OEP Family and developed in collaboration with the Energy-Related Reference Ontologies (ENERO) Foundry. We also provide a visualization of the CEPO which is easier to understand for non-ontology experts on the Climate Policy Atlas website. The overarching policy ontology and metadata are developed in Task Area 4. In Task Area 6 use cases and show case are collected.

Deliverable (Showcase description)

Internal Documentation

Title: Climate Policy in Practice: Which Instruments Do Governments Use, and Which Ones Do Researchers Study?
Authors: Germán Bersalli, Aksornchan Chaianong, Ioannis Milioritsas, Johan Lilliestam, Silvia Weko
Contact person: Silvia Weko, silvia.weko@fau.de
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Abstract: The climate crisis has led to increased engagement from governments around the world to mitigate emissions. At the same time, academia has increasingly focused on how this can be done as quickly and lively debates have emerged on the effectiveness of different policies at reducing emissions and their costs. Yet, academics are often constrained by a lack of cross-country, comparable and detailed information on policies. This raises the question whether the existing academic debate on policy instruments is skewed towards evaluating certain policies. We therefore examine which policy instruments governments actually use, and which instruments tend to be studied. The research reveals blind spots in the current academic research on how different instruments impact emissions and decarbonization, for example, on regulatory instruments, which may be due to a lack of cross-national and machine-readable data. This demonstrates the importance of systems to harmonize the collection and analysis of climate policy data, such as the Climate and Energy Policy Ontology (CEPO).

Link: Link to the ontology draft is here - https://doi.org/10.5281/zenodo.15583093 ; Link to CEPO repository: https://github.com/OpenEnergyPlatform/ClimateEnergyPolicyOntology ; Link to easy-to-use version on website: https://climatepolicyatlas.org/ontology.html

NFDI4Energy input: NFDI4Energy Deliverable 4.5.1.1: Draft Climate Policy Ontology: https://doi.org/10.5281/zenodo.15583093.

Energy research: To understand which policy instruments are studied and which ones are implemented, we use the Climate and Energy Policy Ontology (CEPO) to identify potential policy instruments that are studied in the literature. While several attempts at gathering and publishing climate policy instrument data exist, they do not share a unified or even an explicit ontology on climate policy instruments. This means that climate policy data lacks interoperability and cannot be combined across sources – hindering researchers from being able to analyze policy. This, in turn, limits empirical knowledge as research is often limited to the few cases with good data availability; multi-case and cross-temporal policy instrument analysis is rare. We therefore create a climate policy instrument ontology which includes various instruments governments use to lower greenhouse gas emissions. Our ontology of potential policy instruments is based on the Open Energy Ontology (OEO), and typologies that institutions use to gather climate policy data from Climate Policy Database (CPDB) and Climate Policy Radar (CPR). Using this draft ontology we conduct a systematic literature review in Scopus, to identify which kinds of instruments are most often researched. These are then compared to data on climate and energy policies from CPDB.

Meta level: Our ontology demonstrates the importance of systems to harmonize the collection and analysis of climate policy data, which are currently lacking. In addition, it reveals blind spots in the current academic research on how different instruments impact emissions and decarbonization, for example on regulatory instruments, which may be due to a lack of cross-national and machine-readable data given the lack of comparable categorizations through ontologies.

Enhancement: We have been in close communication with stakeholders from research through academic conferences (European Consortium for Political Research, NFDI4Energy) and with database developers including Climate Policy Radar and Climate Policy Database to develop an ontology that makes sense for everyone. We have also now been approached by NGOs who are interested in using the resulting data. We use this opportunity to discuss the importance of infrastructures to provide FAIR data, also for the social sciences that study energy and tend not to place the same emphases on interoperability.

Lessons learned: Having an interoperable ontology is very complex, as there are as many definitions and ideas about policy instruments as there are academics. It is nevertheless a very important exercise, so as to make data actually useable for more than a few researchers. There are serious limits to trying to use AI to categorize policy instruments and doing this by hand will still be important. In either case, however, clear definitions and relations are needed.

Brief sections for the website

The Showcase's Starting Point in Energy System Research

Which climate policy instruments do governments use, and which ones have been academically studied? A research article by NFDI4Energy members uses the NFDI4Energy Climate and Energy Policy Ontology (CEPO) to test this question. The ontology is used to code and analyze a global database of policy effectiveness studies (1990–2024) and compare research patterns with real-world policy implementation. The paper finds that studies focus disproportionately on a small subset of economic instruments such as carbon taxes and emissions trading systems, while many widely-implemented regulatory instruments remain largely unevaluated. Research is also heavily skewed towards a limited set of developed countries and China, leaving most jurisdictions with implemented policies empirically unexplored. By mapping the literature onto a structured policy instrument ontology, we show that these research gaps are not random but aligned with specific branches of the instrument space – particularly regulatory instruments. This highlights the need for improved data infrastructures built on clear, interoperable policy ontologies to enable cumulative, comparable, and systematic evaluation of climate policy.

Motivation and Research Requirements

While several attempts at gathering and publishing climate policy instrument data exist, they do not share a unified ontology on climate policy instruments. This means that climate policy data lacks interoperability and cannot be combined across sources – hindering researchers from being able to analyze policy. This, in turn, limits empirical knowledge as research is often limited to the few cases with good data availability; multi-case and cross-temporal policy instrument analysis is rare. We needed an ontology which was both granular and interoperable with the high-level climate policy databases (CPDB and CPR) to be able to assess the academic literature in some detail and then compare it to the policy instruments that exist.

NFDI4Energy Solution

The Climate and Energy Policy Ontology (CEPO) is an ontology for climate and energy policy instruments integrated into the OEO Family and developed in collaboration with the Energy-related reference ontologies (ENERO) Foundry. This ontology is at once detailed and interoperable with typologies that institutions use to gather climate policy data from Climate Policy Database (CPDB) and Climate Policy Radar (CPR). Using this ontology to categorize data and academic articles, we show that under-conceptualized instruments are also less-studied, and that there is an overwhelming focus on a few countries and instruments (particularly OECD countries and carbon pricing). In order

to show the ontology to users who are not accustomed to OWL/Github, we have also created an online tool to visualize the ontology, making it more accessible to researchers from the social sciences and potential policy users.

(potential photo, if interested, from visualization website:)