Here we explore a new database, Overton, as one potential way to measure reach and impact of the +Policy Network at Virginia Tech and to assess the reliability and validity, ease of use, interpretability of categories, and strengths and limitations of the database.

+Policy Network Policy Impacts

An assessment of member policy impacts from 2017-2023

Isabel Bradburn, Mahmut Sami Gurdal, & Anne-Lise Velez

Study Aim and Overview

In this study we explore a new database, Overton, as one potential way to measure reach and impact of the +Policy Network at Virginia Tech. The database links academic products with international policy documents, yielding a kind of simplified policy citation index. The study was undertaken in the summer of 2024 and was guided by the following questions:

- How reliable and valid is the Overton database?
- How easy is it to use?
- How useful/informative are the Overton coding categories?
- What are the strengths of the system?
- What are its limitations?

Background

Evidence-based or evidence-informed policymaking is an aspiration of many social scientists and was recently codified into law in the United States to guide federal investments (Foundation of Evidence-Based Policymaking Act of 2018; Haskins & Margolis, 2014)[i]. Research that may yield policy implications and disseminating results to public and policy audiences is considered one "broad societal impact" for the National Science Foundation, with other research funders expressing similar interest. Faculty members are often curious whether any of their research is noticed or taken up by decision-makers. Until relatively recently, however, establishing links between original research and public programming and policy has not been easy to do, and few tools were available that did not require extensive manual literature searches.

The refinement of machine-learning, data mining and bibliographical tools, coupled with the now common online availability of a variety of policy and policy-related documents, have made it increasingly feasible to survey references within these documents and establish links between "evidence" and policy sources. In 2022, we learned of a nascent linkage effort being developed to do for the European Union (Dotti, 2021)[ii], which ultimately became the Overton database. Fortuitously, the University Libraries had acquired a site license in May, 2024 for the recently-available database, that included consultation with Overton staff.

Network stakeholders are aware of several other policy databases that also reference academic research, such as *Policy Commons*, *the PAIS Index*, the *Policy File Index*, and *WestLaw*. The purpose of this report is to explore the strengths and limitations of the Overton database, rather than to compare it to others. A corollary assumption is that Overton samples some but not all of policy documentation, so that any citation numbers reflect a conservative estimate of potential Network impact. Comparisons would be useful, and may represent a future extension of this initial work, but is not the objective of this report.

The +Policy Network. The +Policy Network formed in 2017 as a *Strategic Growth Area* under former Provost Thanassis Rikakis as part of Virginia Tech's *Destination Area* initiative. The structure consisted of a core group of stakeholders, led by two faculty members and a program

manager, and had a three-part mission, reflecting the tripartite goals of the University: research, education, and outreach. Affiliate membership was based on responses to a campus-wide survey about interest in the SGA. Over time, leadership evolved to include a Director and Faculty Co-Lead, a stakeholder board, and affiliates. Affiliates include those who participated in any Policy activities, expressed interest in the Network or self-nominated (essentially, asked to join).

Funding for the +Policy Network – renamed in 2023 from *Policy Destination Area* – moved from the Provost's Office to the Institute of Society, Culture and Environment (ISCE) in fall, 2020. ISCE's mission is to "to enhance Virginia Tech's capacity and status in the social sciences by catalyzing innovative, interdisciplinary, and translational research and scholarship." Exploring the Overton database as a potential measure is one way to assess both impact and global reach.

Method

Sample. For the purposes of this study, we defined "membership" as any role within the +Policy Network as of May, 2024. We also restricted citation years to completed calendar years of the Network's existence (2017-2023), as it was probable that some members' research from years prior to formation of the Network might be cited, but could not reasonably be associated with any Network influence. Thus, we operationalized "impact" as:

> *The reach and volume of policy documents citing work from the May 2024 +Policy Network membership from 2017-2023*.

In May, 2024, the Network had 230 members (leadership, stakeholders, and affiliates). This number reflected only current membership as of that date.

Overton Database. Overton is a United Kingdom start-up, owned by Open Policy Ltd. and founded in 2019 to help *"users find, understand, and measure their influence on government policy."* The Overton system takes a very broad definition of policy documents as **"**documents written primarily for or by policymakers that are published by a policy focused source". As of August 15, 2024, the database covers documents from 2,287 policy sources, including governments (188+ countries), IGOs, think tanks and "other" entities for a total of more than 15 million policy documents (https://app.overton.io/policy_sources.php). According to the website, the system "always tries to collect:"

- *Working papers, reports, case studies, policy briefs, testimony, clinical guidelines and government documents*
- *Publications of interest to a policy audience that have a clear, publicly available link to a downloadable version*[1]

[1] Overton Database, https://www.socialsciencespace.com/sagepolicyprofiles/sage-policy-profiles-terms-and-conditions/. Retrieved April 23, 2024.

Overton uses Crossref, a "global metadata communications" platform that creates and hosts open infrastructure to link research products. Occasionally Overton will fail to match documents not indexed in Crossref or that are in a series, but the system reports >95% "recall," or a 5% failure to match articles or researcher to documents if they exist.[2]

Procedures**.** Based on advice from University Librarians Rachel Miles (Research Impact Coordinator) and Emily Mazure (Research Impact Librarian), and Overton Representative Inesia Adolph, we used a Scopus ID to DOI (Digital Object Identifier) to POLICY DOCUMENT linkage approach. Scopus was the most comprehensive academic researcher index, according to the librarians, so we used that to find unique identifiers that could then be matched to publications through the DOI system. There are several reasons for using DOIs rather than names for matching:

- Names are vulnerable to variation, such as use of middle name or initial, suffixes (Jr.), hyphens, and other irregular usage across time or publications;
- The invariance of the DOI number, on the other hand, was a more reliable method, according to the Overton representative;
- Our exploration revealed that using a batch of names, we could not efficiently restrict the timeframe.

Librarians and their students used an API to match Scopus IDs to Network members (*N*=230), matching 182 names in our network (79%). Additional manual sleuthing added 17 more, leaving 30 members unlinked to a Scopus ID. The primary reasons for a lack of match seemed to be that a member was not a researcher – for example, a manual search revealed some members were administrative staff, Virginia Cooperative Extension agents, and assorted others. Several others could not be identified and may reflect former students.

Using the Scopus database[iii], we then matched the list of Scopus IDs to DOIs. Seven members had two Scopus IDs; both were included in the search. Typically, members had many DOIs associated with their Scopus IDs, as expected. One *un*expected result was that academic products without DOIs were also returned. Manual inspection revealed that these tended to be conference proceedings or presentations.

We next used the Overton system to match DOIs to policy documents. First, we restricted the years to 2017-2023. Then we entered the list of DOIs as a batch into the search engine. This returned citations linked to specific DOIs. We then sorted and cleaned the database.

Data Cleaning**.** The next set of steps involved manually checking each member's set of DOIs linked to a policy citation to ensure that the DOI-indexed product – overwhelmingly but not exclusively journal articles – was a valid data point. The great majority of matches were in fact valid. By far, the main reason for invalidity was that the Network member was not at Virginia

[2] https://www.crossref.org/; https://help.overton.io/article/how-are-scholarly-references-matched-in-policy-documents/, retrieved November 10, 2024.

Tech at the time of publication. Infrequently, the time range was out of bounds, or a Virginia Tech affiliation could not be found. In these cases, articles were removed from the final dataset.

Methods to check timing and affiliation included checking the university directory, PDFs of the publications, or in some cases, LinkedIn profiles and conducting Google searches to assess institutional affiliation at the time of publication. In cases where an author was not VT-affiliated or was affiliated with VT at one point but not listed as VT- affiliated at the time of publication, the publication was excluded from our count. If the author was an adjunct faculty member who was at the time of writing primarily affiliated with another sector or institution, they were also excluded from the final dataset.

Further data verification: "Case Studies". We also conducted in-depth manual examinations on five researchers within different topic areas to compare individual profiles to the aggregate results. We conducted two investigations per researcher, one using the same methodology as used in the aggregate searches (DOI-linked searches) and one using the investigator name, selected from an Overton list if duplicates existed. Once dates were bounded, results were reassuringly uniform, *with one important exception*. In the case of one researcher, two DOI-linked articles appeared in his individual searches (both DOI-linked and name) that had not been returned in the aggregate DOI-linked citation batch. This anomaly meant that we did not have the full universe of DOI-linked documents from which policy documents could cite.

The decision was made to re-run the entire procedure again, and to do so on the same day independently by two team members (I.B. and M.S.G.), thus enabling interrater reliability to also be calculated. For the initial draws, returns were 100 per cent reliable between the same researchers, from draws on July 30, 2024. Results reported in under "Findings" reflect the second draw, after the data were cleaned.

Authorship disaggregation and ways to compute "impact." As long as an author was a +Policy Network member at the time of publication, the product was a valid "count." However, the great majority of articles were co-authored, and sometimes more than one Network member might share a DOI – that is, they were co-authors on a paper cited in at least one policy document.

Given this, the team decided to create several ways of calculating impact. The first is what has been previously described: an aggregate count of policy citations associated with DOIs (articles or other academic products). The second focuses on +Policy Network members: how many citations were garnered by any product on which they were sole author or co-author. In order to attribute citation counts to individual Network members, as well as to the Network as a whole, we needed to tabulate the number of member authors per DOI.

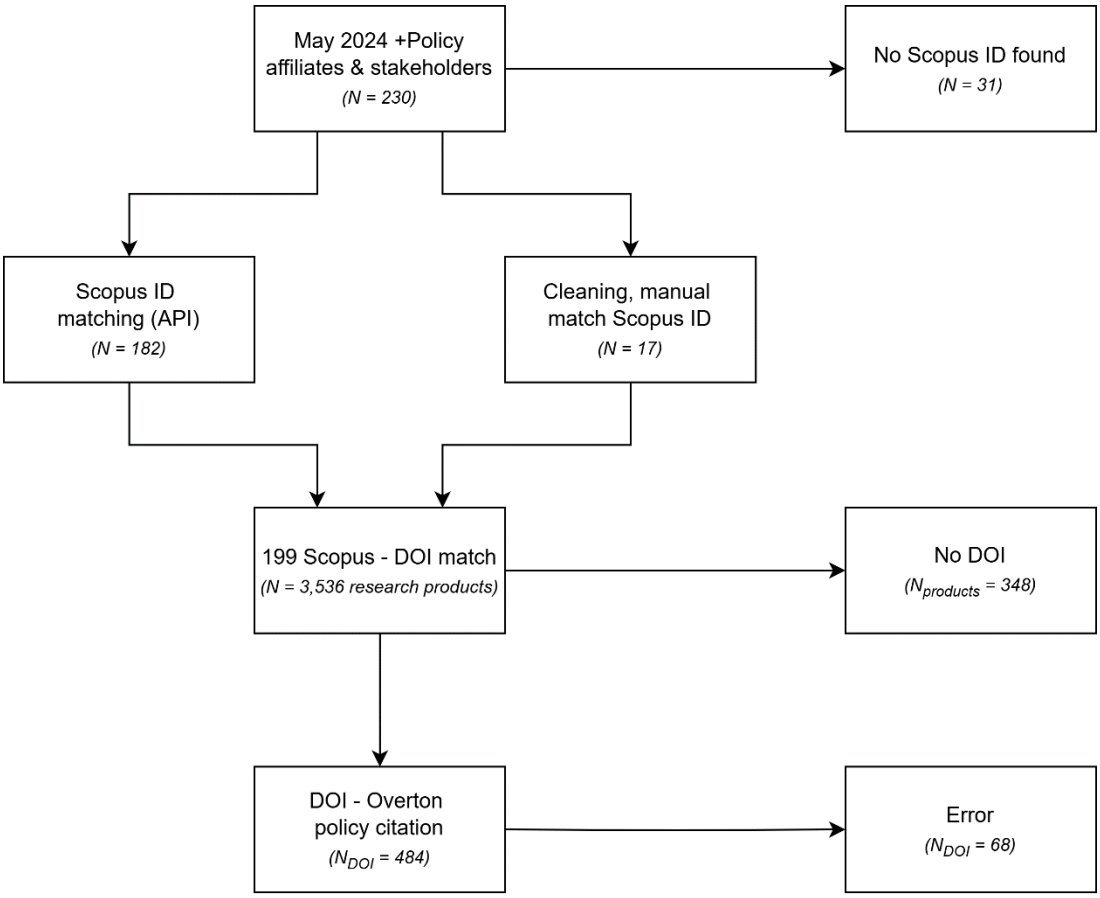
As a third potential index of impact and reach, as well as to better understand science teaming, we noted all Virginia Tech authors on any given paper, using a manual search process, and then created bibliometric networks to visualize individual researcher and team collaboration networks. We used *visNetwork* in conjunction with the open-source *R Studio* to map the strength of each unique collaboration between two authors – that is, how frequently they published

together, proportionally. A subsidiary Excel analysis examined the relative frequency (strength) of geographic policy citations (https://datastorm-open.github.io/visNetwork/).

Findings

Results are based on the second draw (July 30, 2024) and subsequent data cleaning. The process, with numbers returned, is illustrated in Figure 1.

Figure 1. *Literature search and selection process*



The Scopus-DOI search yielded 3,536 document citations for the select time period (2017-2023). Of these, 3,188 (91%) had actual DOIs (that is, were not conference proceedings or other products that were returned in the DOI search, but had no actual DOI). These DOIs resulted in 484 documents linked to a policy citation, representing 15% of the time-bound affiliate

documents. Database cleaning pared this number down to 416; that is, 86 percent of the DOI-POLICY CITATION links were deemed valid after cleaning. [3,4]

Because most affiliate articles had multiple authors, the list of Virginia Tech faculty and students on the cited works is larger than the universe of Network affiliates. In total, 392 unique authors who were listed as at Virginia Tech affiliates for author institutions at the time of publication had at least one article cited in a policy document as classified in the Overton database. Of the 392 VT authors with policy document citations, 98 (25%) were +Policy Network affiliates as of May, 2024. [5]

Results

The number of articles by +Policy Network members with at least one unique policy document citation ranged from a single citation to a high of 206 unique citations. Most common was a single work cited in a single policy document during the six-year period examined. Flipping the equation, the highest number of policy documents citing a single paper was 38, with a mean of 2.35 and median and mode of 1.

By researcher (as opposed to by article) who had at least one policy citation (*N*=392), the number of policy citations averaged 5.77, with a median of 2 (range, 1-206) and mode of 1. This sample includes +Policy Network members and all their Virginia Tech co-authors, and so might be thought of as the broadest affiliation with the Network, including direct (members) and indirect (co-authors) affiliations.

If we restrict this group with at least one policy citation to only Network members (*n*=98), the average number of policy citations and the median both increases substantially (mean, 13.14; median 7), while the mode remains 1. If we examine all +Policy Network members (*N*=230), that is, those with and without policy citations, the most common (modal) outcome was having no policy citations linked to member articles (DOIs). In this analysis, policy citations averaged 5.6,

[3] Documents that did not have DOIs included published conference proceedings and assorted grey literature.

[4] Search results reported here represent the third matching process, undertaken July 30, 2024. Two earlier matches had incomplete affiliate Scopus IDs, since the initial Scopus ID automated process undertaken by a student team under library supervision yielded 42 Network affiliates with unknown IDs. A manual search by our team uncovered an additional 17 IDs, which necessitated another matching search. Finally, during a case study verification check, one affiliate was found to be missing half of his citations uncovered when his unique DOI was entered into Overton (as opposed to being one of the full set of affiliate IDs). Thus, a third matching search was undetaken, with a fourth independent verification performed one hour later on the same day. Both searches identified the same number of matches along each step. This final run was checked for the case study affiliate and found to yield all of his citations. Cleaning: Documents were removed due to incorrect dates (4), the author was not at Virginia Tech at the time of publication (4), or no indication could be found that the authors were connected with Virginia Tech (1).

[5] At least four of the 392 were former +Policy Network affiliates who were no longer at Virginia Tech at the time of publication of the cited document, but because they co-authored with a current member, were included in the count.

while the median fell to 0 (range, 0-206). Consistent with this, 42% of Network members had an academic product with at least one policy citation in the Overton database.

It is clear that whichever sample we examine, the statistical distribution is highly skewed. Means are undoubtedly biased upward due to three extreme outliers (unique citation counts of 87, 101, and 206). Since all three extreme outliers were Network members, this can also account for the substantial increases in mean and median values when analyses were restricted to Network membership only within the group of researchers with at least one policy citation.

The box-and-whisker plot below illustrates the distribution for researchers with the wider Network affiliation (Figure 2). Its distribution is substantially non-normal, representing more of a binary system of a group with 0-1 citations, and another with everyone else (who also vary considerably).

Figure 2. *Distribution of Policy Citations for Researchers with at least one Citation, 2017-2023*

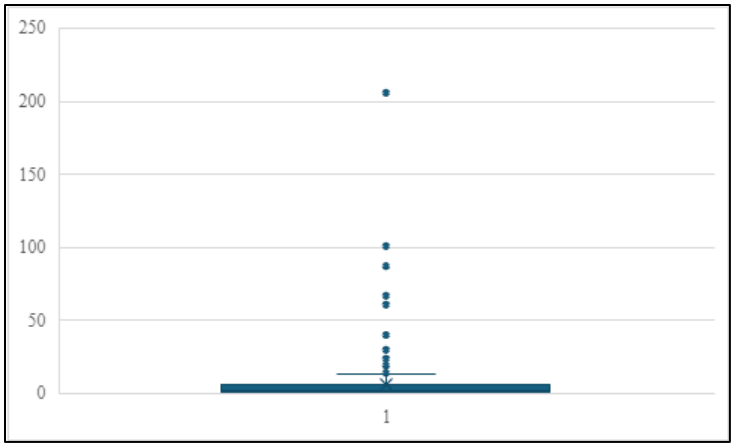


Figure 2. The thick line just above zero shows the median at 2; the mean is shown with the smaller horizontal line, at 5.77. Dots represent outliers above [3 standard deviations above the mean], the maximum being 206 policy citations. Data includes all researchers with at least one policy citation (*N*=392).

The article-to-policy citation "hit rate" is similarly lopsided, averaging 2.25 for +Policy Network members with at least one policy citation (*N*=98). The most common result was again, a single citation for a single article (DOI), with the highest being 8.42, and a median of 1.75.

Characteristics of policy documents citing +Policy Network affiliates

The Overton database provides some summary counts according to a list of variables, such as the provenance of policy documents (both locality and type of organization) and topics covered. Information provided below should be read as a rough estimate, given that the counts provided

refer to the uncleaned dataset Overton returned (*N*=484 articles). [6] The purpose was to explore these additional tools to determine whether or in what ways they might be of use.

Provenance of policy documents citing Network members' work: Place and Document Type. Network research was cited in 1,236 documents from 43 countries on six continents. Research was most commonly cited in International Government Organizations (IGOs) and U.S. documents (322 and 321 documents, respectively), followed by the United Kingdom (127); all other countries or regions represented fewer than 90, as shown in the map below.

Figure 3. *Policy Document Frequencies by Area and Country*

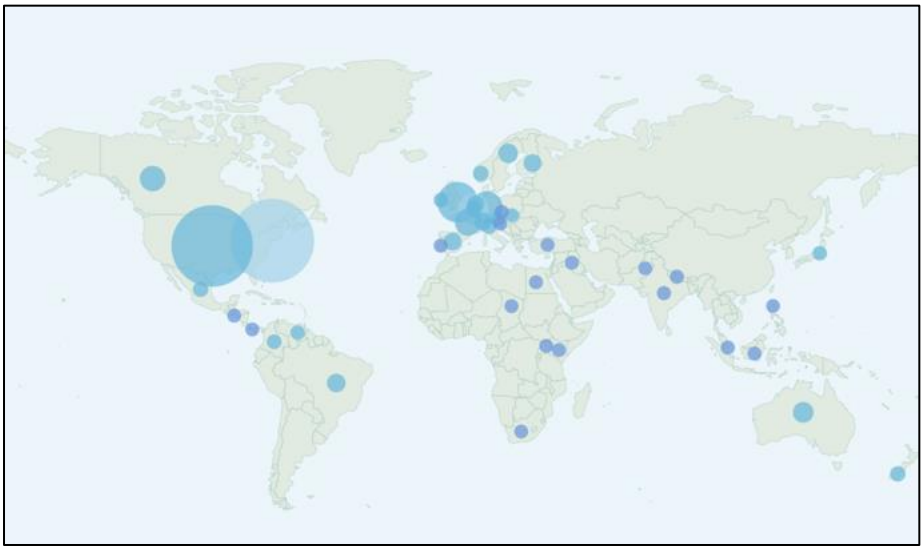


Figure 3. Screenshot from Overton summary report generated based on a set of original 484 DOI-linked documents authored by +Policy Network-affiliated faculty and students. (*N*=1,236 documents, August 8, 2024). Research is largely contributing to IGO (not shown) and U.S. policy documents, followed by Europe, Australia and Canada. Source: Overton Database, Policy document report - Overton (vt.edu)

Another way to visualize the reach of Network members' work across the globe is using bibliometric analyses. Red lines signify the most frequent connections between Network researchers' products and where they are being picked up in national and international policy documents, followed by yellow lines, as shown below. Here we can see that within Europe, the next-most frequent policy consumer of Network research (above), the larger countries of France and Germany as well as the European Union (EU) contribute most to this relation.

[6] We were not able to "feed" Overton the cleaned dataset in order for their system to generate more appropriate statistics. Doing so ourselves from exported Excel files may be feasible in a future endeavor, but requires more exploration.

Government documents were the most heavily represented type of policy document (528, or 43%), followed by think tanks (378, 31%), IGOs (295, 24%) and other (27, 02%).[7] These types represent many sectors (for example, government might encompass a government agency, law or legal research, regulations or guidance, and others – at least 8 subtypes) that can be counted by subtype. The precise offices or organizations ("policy source") are also reported (e.g., United National Development Programme, Government of Canada, World Bank, RAND). The chart below shows the distribution of aggregated policy sources.

Figure 4. *National frequency of policy document citations of +Policy members' research*

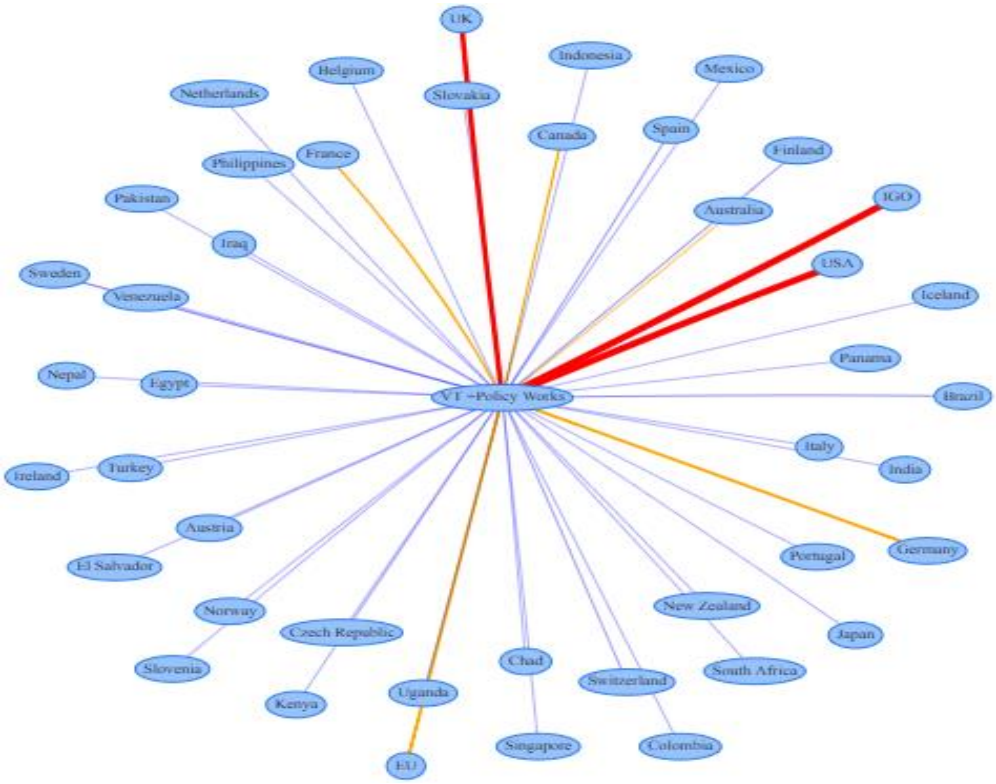


Figure 4. Connections between Network member and their Virginia Tech co-authors research policy documents cited from countries or IGOs are color-coded to reflect the citation frequency. Red lines represent citations exceeding 100, orange lines indicate citations between 30 and 100, and blue lines show citations below 30. Data Source: Overton. An interactive version of this figure can be accessed at https://mahmutgurdal.github.io/VT-PlusPolicy/CountryMap.html

[7] There is some fuzziness to these categorizations. For example, some white papers or reports produced by research organizations, such as RAND, were undertaken as part of a government contract on behalf of a U.S. agency, yet were classified as a think tank.

Figure 5. *Provenance of Policy Documents Citing +Policy Network Member Work, 2017-2023*

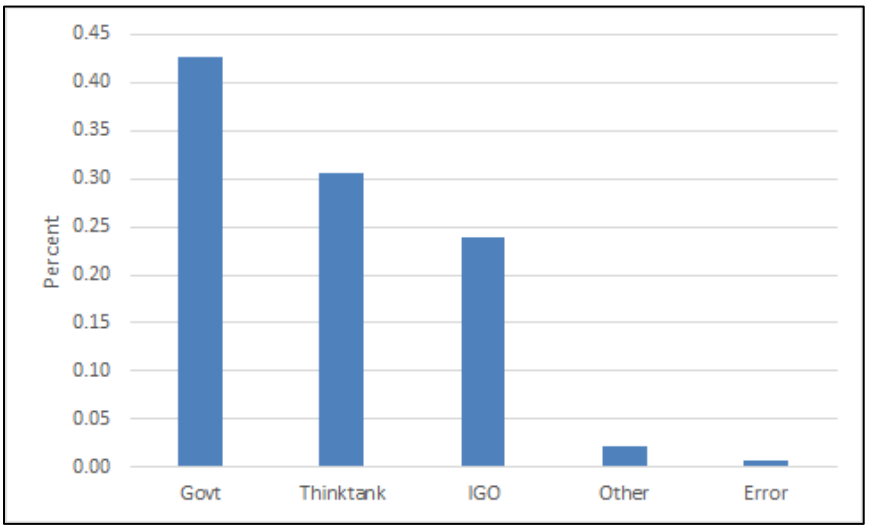


Figure 5. Chart drawn from Overton summary report generated based on a set of original 484 DOI-linked documents authored by +Policy Network-affiliated faculty and students. (*N*=1,236 documents, August 8, 2024). Data source: Overton. Govt = Government document; IGO = International Governmental Organization. Error refers to matches that could not be classified.

Relatedly, the type of document was categorized in at least six ways. *Publication*[8] was overwhelmingly the most common (87%), followed by *working paper* (10%) and *clinical guidance* (6%), followed by five other types.

Topics.

Overton classifies policy documents according to many, non-exclusive topics. Using this system, health was overwhelmingly the most common topic (607 documents, or 49%), which is not surprising given that the time period of interest covers the COVID global pandemic. The next most popular topics were risk (411, 33%), sustainability (402, 33%), economy (396, 32%), natural environment (393, 32%), climate change (382, 31%), agriculture (356, 29%) and "research" (329, 27%). All other topics were reflected in fewer than 300 documents. Because the classification system is not mutually exclusive, we cannot meaningfully add categories, but it is clear that environmental topics, together with health, are prominent topics in the policy ecosphere covered by Overton, at least in the context of Network members' research published from 2017-2023.

[8] Publication does not refer to peer-review or academic articles; a separate category, "Scholarly article," presumably does refer to academic publication.

Strengths of the Overton system

As of summer, 2024, Overton curates more than 15 million policy documents from across the world, using a range of document types and sourcing from heterogenous levels of governments, entities and organizations. The broad international reach is complemented by mostly accurate automated linkage found in our reliability tests. While we encountered some inconsistencies, such as non-VT researchers identified as within our scope or some omissions (i.e., no authors listed), the error proportion was small compared to accurate classification.

Overton states that they run regular data checks, such as searching for document duplication (https://help.overton.io/article/how-we-disambiguate-policy-documents/disambiguating), testing matching and citation accuracy, targeting >98% accurate matches and >80% "recall," (https://help.overton.io/article/how-are-scholarly-references-matched-in-policy-documents/) and augmenting automatic capture with manual search and checking operations, , thereby increasing confidence in the product.

Other strengths include forms of validity: the most common form of policy documents linked to +Policy Network and co-author researchers were government and think tank documents (rather than Blogs or Extension papers, for example). Moreover, useful detail about the policy document is provided, often including provision of the cited quote or page number from the policy document. Search results can be saved and exported in an Excel file (but see "limitations" as well). Batch files can be run simultaneously, making it feasible to examine reach or impact for groups as well as for individuals.

Limitations of the Overton system

From our explorations, the three main limitations of the system for purposes of Network impact metrics include: (1) unclear boundaries regarding the universe of policy documents; (2) data on policy provenance and other useful characteristics is size-constrained; and (3) data cleaning requirements to make exports useable. While policy documents include "everything from white papers, draft bills and transcripts from governments to things like policy briefs from think tanks, working papers from central banks and even clinical guidelines from health agencies" (https://www.overton.io/university-researchers/) it is not clear how inclusive and complete the Overton system is in identifying the documents especially across levels of government and geographic locations. In addition, it requires documents to be digitized, which likely occurs inconsistently in different locations and types of organizations. Constraints related to data/file size for export for impact metrics and analysis mean the current set-up of the system is often impractical for large group impact analyses across time.

While the ability to export data from the Overton system is useful, fairly extensive data cleaning is necessary for large blocks of DOI-POLICY DOCUMENT matches. Researchers must engage in either a time-consuming manual analysis or development of an automated process, which would

mean hiring or partnering with someone with algorithmic expertise. Other quirks of this database include occasional errors – for example, we found that when DOIs were submitted in a large batch, in at least one case, two policy citations were missing – and results changing at different time points, probably at least in part because the system is updated on a regular basis.

Conclusions and Next Steps

Overton is an evolving and improving system that holds significant potential for offering one way of measuring Network impact in the "real world" policy realm. For example, since project analysis completion in August, 2024, Overton has added a Beta "Policy Engagement" system and issued new guidance on how to best track impact and other use tools. With that said, it will be important to understand and characterize what omissions – systematic and ad hoc – the database has. For instance, it is not clear how extensively the database captures U.S. congressional testimony, or the equivalent in other countries. Network stakeholders and University librarians have suggested other types of policy databases, such as *Policy Commons* and *WestLaw*, that could be compared to Overton should resources permit further exploration.

Moving forward, conducting annual affiliate updates would probably be relatively efficient, since the batch would be smaller (only one year instead of six), and thus mitigate identified problems with file size constraints and reduce time for manual cleaning. A procedure would still need to be developed to analyze policy document characteristics from the exported data, as opposed to using Overton's generated report, as done in this report (due to the automated report containing uncleaned results). While initially time-intensive, a review of the export files suggests that with a smaller batch to review, once a procedure was created it would be relatively straightforward to implement.

The research team felt that the database might yield two useful products that could appeal to Network members: tailored reports that could be reported in the annual FAR, and information regarding ways to disseminate academic papers to maximize policymaker uptake. Both ideas will require additional study and experimentation, and might represent another summer project. For the first, a series of case studies, in which we iteratively design and consult closely with individual researchers in different fields, may be an optimal strategy to create a report template. A primary question is*: Does the automated Overton report suffice, or would Network members want another structure or additional information?*

The second long-term project outcome, determining whether we can model better dissemination patterns from the Overton data, would likely require further exploration of the system, perhaps in conjunction with analysis of the Altmetric database [9] that captures mainstream and social

[9] The team thanks Rachel Miles for this suggestion.

media posts. A useful deliverable would be an infographic, brief report and/or training workshop for Virginia Tech faculty and students.

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Suggested citation:

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Endnotes

[i] The Foundation for Evidence-Based Policymaking Act of 2018 (U.S.C., Public Law 115-411). https://www.congress.gov/bill/115th-congress/house-bill/4174/text; Haskins, R., & Margolis, G. (2014). *Show Me the Evidence: Obama's Fight for Rigor and Results in Social Policy*. Washington, D.C.: Brookings.

[ii] Dotti, N. (2021, October). *Evidence-informed Policy Making: What are the best structures to allow informing policymakers of the most important and accurate scientific data and knowledge, as well as have them utilise this?* Paper presented at the annual meetings of the Advancing & Evaluating the Societal Impact of Sciences Association. Brussels and online, October 13-15, 2021.

[iii] Scopus.com

APPENDIX A.

Details on cleaning for reported dataset

We successfully identified the Scopus IDs for 198 of 230 +Policy Network members within the VT Plus Policy network. Among these, 7 researchers were found to have two Scopus IDs, leading to a total of 205 Scopus IDs being used in our search process.

Using these IDs, we retrieved 3,536 publications from Scopus that were published between 2017 and 2023. Out of these, 3,188 publications were associated with DOI numbers, which were then used to conduct further research in the Overton database. In the initial phase, we discovered that 484 of these 3,188 publications had been cited by a policy work in the Overton database. Upon further examination, 2 of these 484 publications were excluded for not meeting our date criteria, resulting in a refined dataset of 482 publications. Additionally, 26 of these 482 publications lacked author information in the Overton database, which we manually supplemented. Furthermore, 66 of these publications were found to have no VT-affiliated author, leading to their exclusion and leaving us with 416 publications for continued analysis. Within these 416 publications, we identified a total of 392 distinct VT-affiliated researchers as authors, including 98 +Policy Network members.

APPENDIX B.

Researcher Networks

Although not part of the initial charge, we conducted a bibliometric analysis to examine researcher networks, to determine whether some teams or clusters of teams were more or less represented in Overton's collection of policy documents. Results are illustrated below.

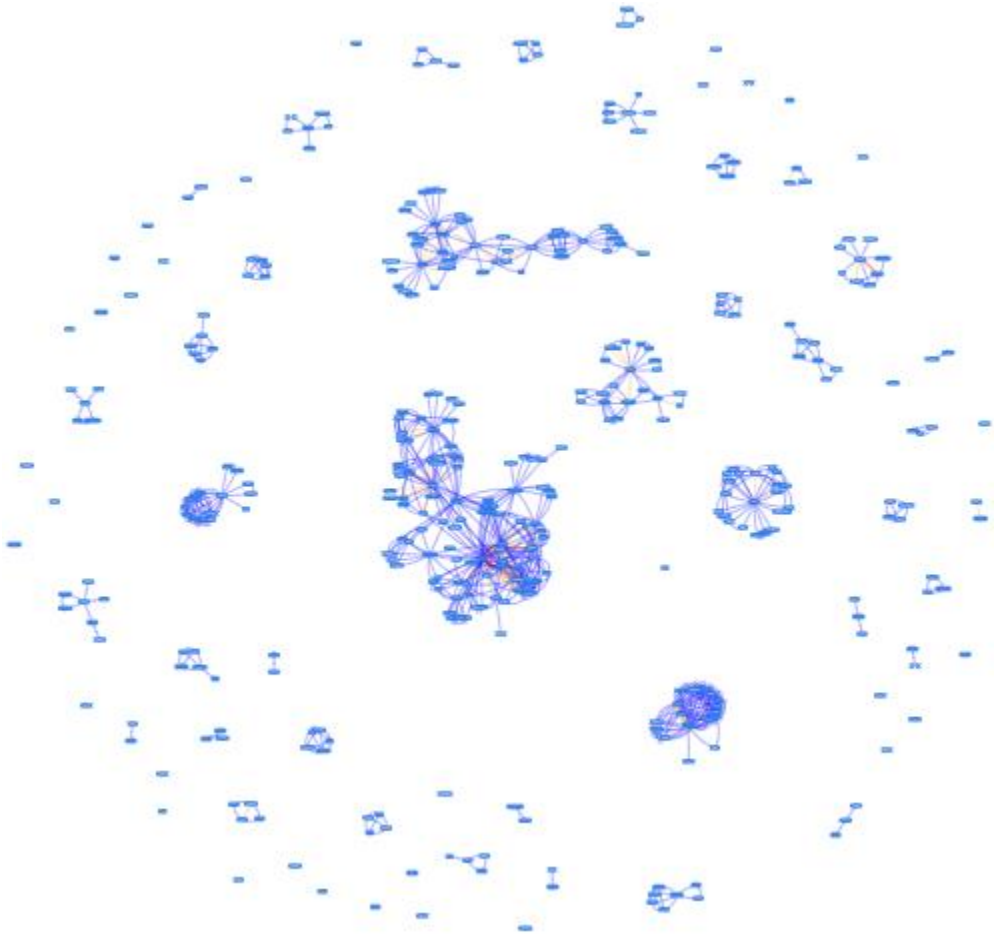

Figure 6. Visualization depicting collaborative between Network members and their Virginia Tech and other co-authors

Figure 6 illustrates the collaboration network among Virginia Tech researchers, specifically focusing on co-authorship relationships in their publications. Each node represents an individual researcher, and the connections between nodes indicate co-authorship on academic papers. In this visualization, line color between nodes indicates the frequency of co-authorship: red lines represent collaborations involving six or more co-authored papers, orange lines indicate between

two and six co-authored papers, and blue lines represent collaborations with two or fewer co-authored papers. To explore more in this area, an interactive version of the figure is available at: https://mahmutgurdal.github.io/VT-PlusPolicy/CollabMap.html.

Figure 7, below, illustrates one node for ease of comprehension. Professor Bill Hopkins represents the node, or center of this research network that includes six others in two different groups (left, with four colleagues, and right, with two).

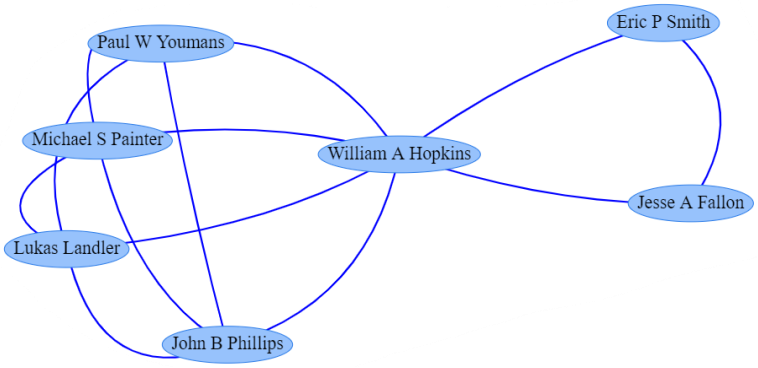

Figure 7. An example from the visualization of collaborative efforts among Virginia Tech researchers (Network member is at the center).