European Commission

JRC TECHNICAL REPORT

Modelling for EU Policy Support: Analysis of the Use of Models in European Commission's Impact Assessments in 2019-2022

Di Benedetto, A., Basyte Ferrari, E., Smits, P., Hardy, M.

2023

Joint Research Centre

How to cite this report: Di Benedetto, A., Basyte Ferrari, E., Smits, P. and Hardy, M., *Modelling for EU Policy Support: Analysis of the Use of Models in European Commission's Impact Assessments in 2019-2022*, Publications Office of the European Union, 2023, doi:10.2760/913901, JRC131798.

Contents

Abstract

The Better Regulation Agenda sets a clear commitment to a transparent and sound use of evidence for all EU policy making activities. Models play an increasing role in supporting the policy formulation phase. A good understanding of these models is crucial to make this process transparent for everyone: policy makers, stakeholders, and citizens. This analysis focuses on the trends regarding the use and the role of simulation models in the ex-ante policy impact assessments carried out by the European Commission. In this study, we analyse a total of 118 impact assessments carried out from January 2019 to May 2022 and published in the Register of Commission Documents. We also examine how the European Parliament is using the corporate model inventory of the Commission, MIDAS, by analysing the appraisals of Commission's impact assessments prepared by the European Parliamentary Research Service.

Authors

DI BENEDETTO Andrea, BASYTE FERRARI Egle, SMITS Paul, HARDY Matthew. European Commission, Joint Research Centre (JRC), Ispra, Italy

Executive summary

This analysis focuses on the trends regarding the use and the role of simulation **models** in support of the **EU policy cycle** in the **impact assessments** (IAs) carried out by the European Commission. The **Better Regulation Agenda** (European Commission 2015) sets a clear commitment to a transparent and sound use of evidence for all EU policy making activities. Nowadays, models, defined as analytical representation or quantification of a real-world system to make projections or to assess the behaviour of the system under specified conditions, play a key role in supporting the policy formulation phase. A good understanding of these models is crucial to make this process transparent for everyone: policymakers, stakeholders, and citizens.

The Commission's **Competence Centre on Modelling (CC-MOD)** promotes a responsible, coherent and transparent use of models at the European Commission. It operates the Commission-wide **Modelling Inventory and Knowledge Management System (MIDAS)** which gathers important features of the model use throughout the EU policy cycle. CC-MOD supports the policy departments of the Commission with the MIDAS model descriptions as requested by the Better Regulation Toolbox and analyses how models are used in the policy cycle.

In this study, we analyse a total of **118 IAs** carried **out from January 2019 to May 2022** and published in the Register of Commission Documents. This research aims at continuing investigating the trends in model use by the European Commission and at understanding the role of MIDAS.

Of the total dataset, **40 IAs (34 %) used models. This is in line with the trend identified in the previous study** on model use in IAs between 2003 and 2018 that shows models being increasingly used: from around 10% of the total IAs in the first years up to around 25-30% from 2015 onwards. We observed that **5 out of 18 IAs used models in 2019 (28%), 5/19 in 2020 (26%), 27/58 in 2021 (47%), and 3/23 in 2022 until May (13%)**. In total, we identified **39 models**, mostly **used for the assessment of policy options** and **baseline calculation**, in several **different policy areas, climate being the dominant one**.

We also examine to what extent and how the European Parliament is using MIDAS by analysing the appraisals of Commission's IAs prepared by the European Parliamentary Research Service. This analysis shows that MIDAS is being systematically used by the Service as an additional source of information on the models that underpin the IAs.

1   Introduction

The **Better Regulation** (BR) **Agenda** ([1]), adopted by the **European Commission** (EC) in 2015 ([2]), is the main framework for the current EU regulatory policy. This agenda, complemented by the **BR Guidelines** ([3]) **and Toolbox** ([4]), provides guidance throughout the policy cycle to ensure transparency and coherent use of evidence in support of the EU decision-making.

According to these guidelines, **impact assessments (IAs)** must clearly quantify the costs and benefits of a given policy scenario to the extent possible, and frequently models are chosen for this task. A good understanding of these models and their use is crucial to make this process transparent for everyone, policymakers, stakeholders and citizens. In this study, we aim at observing the key features and trends of the use of models in the time interval **2019-2022**.

This report has been prepared by the Commission's **Competence Centre on Modelling** ([5]) (CC-MOD) that contributes to the BR Agenda by promoting a responsible, coherent and transparent use of modelling for the EU policy cycle. The research has been facilitated by **MIDAS** ([6]), the **Commission-wide Modelling Inventory and Knowledge Management System** which is under the responsibility of CC-MOD. MIDAS contributes to the BR Agenda by enhancing the transparency of the use of models in support of policymaking and the traceability of their results.

The main purpose of this analysis is to investigate the trends on how **models** are used in support of **EC policies**, focussing on the policy formulation phase, therefore the attention is on ex-ante **IAs conducted by the European Commission.**

The methodology of our study is the one used in the previous analysis conducted by CC-MOD ([7]) to ensure consistency. The working definition of a model is reported in Box 1.

Box 1. Definition of model

A model can be defined as an analytical representation or quantification of a real-world system, used to make projections or to assess the behaviour of the system under specified conditions. Models typically include:

— Inputs, i.e., underlying data;
— Assumptions, which are represented as mathematical equations in programming language;
— Outputs;
— A specific spatial and temporal extent;
— Specific use to explore a policy question;
— The possibility to carry out uncertainty and sensitivity analysis.

Therefore, we can consider as operational definition a 'tool' that

— Offers a representation of a real-world system;
— Is able to assess its behaviour under specific assumptions, including policy assumptions;
— Is computer-based ([8]).

The remainder of this report is organised as follows. Section 3 of this report explains the methods used to perform the analysis, the results of which are presented in Section 4. The subsequent section compares the

---

([1])   https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how_en#:~:text=The%20Better%20Regulation%20agenda%20ensures,where%20it%20matters%20the%20most

([2])   Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on Better regulation for better results - An EU agenda, COM/2015/215 final.

([3])   Commission staff working document, Better Regulation Guidelines, SWD(2021)305, https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-andhow/better-regulation-guidelines-and-toolbox_en   (Accessed: 25/11/2022).

([4])   European Commission, *'Better regulation' toolbox – November 2021 edition*, https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-andhow/better-regulation-guidelines-and-toolbox_en   (Accessed: 25/11/2022).

([5])   https://knowledge4policy.ec.europa.eu/modelling/about_en

([6])   https://web.jrc.ec.europa.eu/policy-model-inventory/

([7])   European Commission, Joint Research Centre, Acs S., Ostaender N., Listorti G., Hradec J., Hardy M., Smits P., Hordijk L., *Modelling for EU policy support: impact assessments. Analysis of the use of models in European Commission impact assessments in 2003-2018*, Publications Office, 2019, https://data.europa.eu/doi/10.2760/748720.

([8])   European Commission, Joint Research Centre, MIDAS Team, Definition of 'model': background note, 2021, Commission-internal document, https://webgate.ec.europa.eu/connected/docs/DOC-248399 (Accessed: 25/11/2022).

outcomes of this analysis to the results of the previous study on model use in IAs between 2003 and 2018. Section 6 outlines results of the analysis on MIDAS use by the European Parliament. Discussion and concluding remarks are provided in Section 7.

2   Background

This section provides background information, concepts and references which will be used in the following chapters. These refer to:

⸺ Aim and structure of IA reports (sections 2.1 and 2.2);

⸺ MIDAS, the Modelling Inventory and Knowledge Management System of the European Commission (section 2.3);

2.1   Impact assessments for policy formulation

The **BR Guidelines and Toolbox** complement the BR Agenda and provide concrete guidance and information on the tools to be used to ensure robust evidence-based decision making throughout the policy cycle. IAs refer to the ex-ante analysis carried out in the policy formulation phase of the policy cycle. According to the BR Guidelines, 'Impact assessment is about gathering and analysing evidence to support policymaking. It involves verifying the existence of a problem, identifying its underlying causes, assessing whether EU action is needed, and analysing the advantages and disadvantages of available solutions' [9]. The IA reports have the role of clarifying the evidence and methodology behind the assessment, including data, previous studies, estimations, and models.

In 2002, the first guidelines on IAs were published and in 2003 the first IA was published [10].

2.2   Impact assessment reports

Our dataset is the list of IA reports published on **the official register of the European Commission** [11] during the time interval **January 2019 - May 2022**. These technical reports describe the results of the IAs that accompany the policy initiatives presented by the Commission. They aim at supporting quantitatively and qualitatively the initiative through the Commission's decision-making cycle.

2.2.1   Structure of IA reports

IAs reports need to follow the specific rules provided by the **BR Agenda**. The most important point is to support any conclusion with properly cited and explained evidence, such as the results of simulations or real data. When citing is not possible, scientists are required to clearly explain the reason. The report has a **specific structure** to follow, indicated by the Better Regulation Toolbox and presented in detail in Box 2. Following the **BR Guidelines**, an **Annex** must be dedicated to the description of the analytical methods used in the assessment, including models. This feature extremely facilitated our analysis which each time could start from this Annex in order to assess if models have been used or not throughout the report. This is a practical example of the importance of transparency in using models for policymaking.

Box 2. Structure of the IA report

'Section 1. Introduction: political and legal context

Section 2. What is the problem and why is it a problem?

Section 3. Why should the EU act?

Section 4. What should be achieved?

Section 5 What are the various options to achieve the objectives?

Section 6. What are the impacts of the different policy options and who will be affected?

Section 7. How do the options compare?

Section 8. The preferred option

Section 9. How would impacts be monitored and evaluated?

---

[9]   Commission staff working document, Better Regulation Guidelines, SWD(2021)305, https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-andhow/better-regulation-guidelines-and-toolbox_en   (Accessed: 25/11/2022), p.30.

[10]   European Commission, Joint Research Centre, Acs S., Ostaender N., Listorti G., Hradec J., Hardy M., Smits P., Hordijk L., *Modelling for EU policy support: impact assessments. Analysis of the use of models in European Commission impact assessments in 2003-2018*, Publications Office, 2019, https://data.europa.eu/doi/10.2760/748720.

[11]   https://ec.europa.eu/transparency/documents-register/

Mandatory annexes:

Annex 1: Procedural information

Annex 2: Stakeholder consultation – synopsis report

Annex 3. Who is affected by the initiative and how?

Annex 4. Analytical methods used in preparing the impact assessment' ([12])

Furthermore, BR Toolbox specifies information that should be provided in Annex 4 '[w]hen impact assessment analysis relies on modelling or other analytical methods' ([13]). Box 3 details these requirements.

Box 3. Information about models or other analytical methods to be provided in Annex 4 of the IA report

'A general description of the model(s)/method(s) used which addresses:

- — The developer of any model and its nature (public/private/open source);

- — Model/analytical structure and modelling/analytical approach with any key assumptions, limitations and simplifications;

- — Intended field of application;

- — Model/method validation, transparency and quality assurance, including the extent to which the model/method has been discussed with external experts, including peer review (please provide relevant references); in case of simulation models, information on accessibility of model documentation, accessibility and openness of code, inputs and outputs should also be included;

- — Information on intellectual property rights.

<...>

How the model/method has been applied in the impact assessment, in terms of:

- — Appropriateness of the model(s)/method(s) for the specific impact assessment study presented;

- — A concise description of the baseline(s) scenario used in any modelling exercise in terms of the key assumptions, key sources of macroeconomic and socio-economic data, the policies and measures the baseline contains and any assumptions about these policies and measures (such as the extent to which they are deemed implemented by the Member States, or their estimated impact following implementation).

- — The extent to which assumptions and input data have been discussed with external experts or Member States;

- — Explanation of the likely uncertainty <...> in the analytical results and the likely robustness of the results to changes in underlying assumptions or data inputs;

- — Explanation as to how uncertainty has been addressed or minimised in the analytical work with respect to the policy conclusions;

- — The steps taken to assure the quality of the analytical results presented in the impact assessment; and

- — Any further details on the performed analytical work, e.g. details on the modelling exercise including model configuration for the specific problem, input data and sources, other models involved, as well as the institution who ran the model' ([14]).

IA reports are published on EUR-Lex ([15]) as Staff Working Documents (SWD) of the European Commission, together with an IA summary and other documents accompanying the policy file. They can also be accessed on the Register of Commission Documents.

2.3   The Modelling Inventory and Knowledge Management System MIDAS

The **Modelling Inventory and Knowledge Management System** of the **European Commission, MIDAS** ([16]), is an inventory developed by **the Competence Centre on Modelling (CC-MOD),** run by **the Joint Research Centre of European Commission (JRC)**. This Centre was launched in 2017 to contribute to the BR Agenda by promoting a responsible, coherent and transparent use of models for the EU decision making. They have the role of gathering competences and practices in building and using models, connecting the different research groups and making these frameworks as compatible as possible. MIDAS was born exactly in this context to capture all the different models used by the European Commission and to make them easy to understand by policy makers, scientists, stakeholders and citizens.

MIDAS is a catalogue that contains detailed descriptions of models used to directly or indirectly support the policy cycle, developed by the EC scientists or third parties. These descriptions include information on **the main purpose of the model, model type, ownership and licensing, structure and approach, inputs, model parametrisation, and outputs.** MIDAS also documents the transparency of models with respect to the availability of their inputs, outputs, code, and documentation It also provides information about the model quality, including **Model Quality Assurance (MQA)**, an activity that is supported by the CC-MOD Team **SAMO** ([17]). MIDAS furthermore collects details about the EC departments and external institutes that are developing or actively running the models on behalf of the EC ([18]) and the publications describing the models and their use ([19]). In addition to the description of the model itself, MIDAS also provides information about the specific model contributions to IAs.

The procedure of the content collection for MIDAS involves interaction with modelling and policy teams. It can occur that a model mentioned in the impact assessment plays a minor role or actually is not considered to be a model in the context of MIDAS. In these cases there will be discrepancies between the IA reports and MIDAS.

From 2017, the **Better Regulation Toolbox** requests that any model used in IAs must be described in MIDAS and in this way makes this platform a powerful tool helping to put in practice the principles of the EC's BR Agenda. **Since 2019, a part of MIDAS database became accessible to the European Parliamentary Research Service** (**EPRS**) to support their appraisal of IAs prepared by the EC. **MIDAS is open to the public from December 2020. The public version of the database** includes models that have contributed to the Commission's IAs from July 2017 onwards. It can be easily accessed via the Joint Research Centre website ([20]). Currently (November 2022), it **includes information about 49 models and their contributions to 60 IAs.**

The section 6 presents findings showing that MIDAS is being extensively used by the EPRS, mostly as an additional source of information about models when their use is mentioned in the IA reports.

([15])   https://eur-lex.europa.eu/homepage.html
([16])   https://knowledge4policy.ec.europa.eu/modelling/topic/corporate-modelling-inventory-knowledge-management_en
([17])   https://knowledge4policy.ec.europa.eu/node/266_it
([18])   This information is available in the Commission-internal MIDAS version.
([19])   For a more detailed description of MIDAS, refer to European Commission, Joint Research Centre, Ostaender N., Acs S., Listorti G., Hardy M., Hradec J., Smits P., *Modelling Inventory and Knowledge Management System on the European Commission (MIDAS)*, Publications Office, 2019, https://data.europa.eu/doi/10.2760/900056.
([20])   https://web.jrc.ec.europa.eu/policy-model-inventory/

3 Methodology

In this report, we present the first set of results of an in-depth, systematic analysis of model use in EC IAs from **January 2019 to May 2022**. The analysis is mainly based on the previous study conducted by CC-MOD ([21]) concerning the models used in IAs published between 2003 and 2018.

The analysis aims at answering the following questions:

1. Preparatory work

    a. Which IAs carried out since 2019 mention models?

    b. Which of these models and thus IAs are relevant for our analysis? ([22])

2. Analysis

    c. How are models supporting IAs?

    d. Which policy areas use models?

    e. What type of models are used?

    f. Who owns these models?

    g. Who runs these models?

The remaining part of this section is dedicated to the methodology of the analysis conducted. The results are presented in Section 4.

3.1 Identification of IAs that use models

Firstly, we identified which IAs, published from January 2019 to May 2022, mentioned the use of models according to the model definition reported in Section 1. This model definition includes computer-based frameworks developed by internal scientists of the EC or by third parties such as national or international research institutes and private companies.

We analysed 118 IA reports individually, with a particular attention given to **Annex 4** which is dedicated to the analytical methods used in the IA.

3.2 Document search

All the information about IA reports has been extracted from the **Register of Commission Documents**. We started our analysis in 2019 since the previous IA reports have already been covered by the previous study ([23]).

The main challenge has been to identify models since no model acronym or clear reference was found in certain IA reports and the word 'model' has been used for different purposes. Usually, this happened to be the case for models developed by third parties and external consultancy companies. In these cases, the analysis was based on the information available in the rest of the IA report text.

From this search, **we obtained a dataset of 118 IAs, where 40 IAs were supported by 39 different models.**

3.3 Definition of the final set of IAs and models

The second step was to specify the role of a given model in an IA. In line with the previous study on the topic ([24]), we distinguished four different roles that a model can play in an IA:

1. **Supporting the problem definition**. This is usually found in the first part of the IA, where the context and the motivation for taking EU action in a specific area are described.

([21]) European Commission, Joint Research Centre, Acs S., Ostaender N., Listorti G., Hradec J., Hardy M., Smits P., Hordijk L., *Modelling for EU policy support: impact assessments. Analysis of the use of models in European Commission impact assessments in 2003-2018*, Publications Office, 2019, https://data.europa.eu/doi/10.2760/748720.

([22]) Only models that correspond to the working definition reported in Box 1 (p.3) are deemed relevant for our analysis.

([23]) European Commission, Joint Research Centre, Acs S., Ostaender N., Listorti G., Hradec J., Hardy M., Smits P., Hordijk L., *Modelling for EU policy support: impact assessments. Analysis of the use of models in European Commission impact assessments in 2003-2018*, Publications Office, 2019, https://data.europa.eu/doi/10.2760/748720.

([24]) *Ibidem.*

2. **Providing evidence on ex post evaluation** and fitness checks of existing policies that are relevant for the proposal the IA accompanies, and that are used in the IA.

3. **Providing evidence for the baseline scenario**. A baseline is a description of what may happen under a specific set of assumptions which at the time of making the projections were judged plausible; it provides a base for comparing the policy options and typically represents a 'no-policy-change' scenario.

4. **Contributing to the assessment of policy options**. This is the core of the IA, where different policy alternatives and their impacts are analysed.

The evidence base can include models referred to:

— directly in the text;

— indirectly via another IA or via a study mentioned in the IA, if the study makes an important contribution to the IA by providing quantitative evidence coming out of models used in the study.

Since models can contribute to the same IA by playing different roles at the same time, to make a coherent quantification we will use the notion of **model contribution**. This quantity represents the different ways certain models can contribute to an IA and will be used to represent the different uses described above.

4   Results

Out of a total amount of 118 IAs, 40 turned out to be supported by models. We identified **39 different models**, as defined in Section 1. 7 of these models did not have a specific name indicated in the IA reports, therefore, for the purpose of this analysis, we named them in the following manner: MODEL A/B/C/D/E/F/G. Not being able to identify model names in the IA reports, these models were not checked in MIDAS ([25]). Out of the remaining 32 models having their names specified, **21 models currently have descriptions on the public MIDAS website**, from where we obtained information on policy areas, model ownership, types and who runs these models.

Subsections 4.1 and 4.3 dedicated respectively to the model use and model contribution are based on the study performed on the text of the retrieved IA reports. The remaining subsections are based on information available in MIDAS.

4.1   Model use

Our analysis reveals that **40** out of the **118 (34%)** EC IAs carried out over the years 2019-2022 **were supported by models**. The use of models in support of IAs seems to rise over time: **the percentage of the IAs that used models in the period 2004-2018 was 16%, while for the interval 2015-2018, it increased to 27%** ([26]).

Our results show that **5 out of 18 IAs were supported by models in 2019 (28%)**, **5 out of 19 in 2020 (26%), and 27 out of 58 in 2021 (47%)** (Figure 1). In **2022 (until May)** the ratio resulted to be **3/23 (13%)**. The **peak in 2021** is likely due to the publication of the **Fit for 55 package** published on 14/07/2021 ([27]), targeting to cut emissions by at least 55% by 2030: all 12 IAs accompanying policy proposals of the package were supported by models (17 models in total).

**Figure 1**. Percentage of IAs using models over time

YEARS
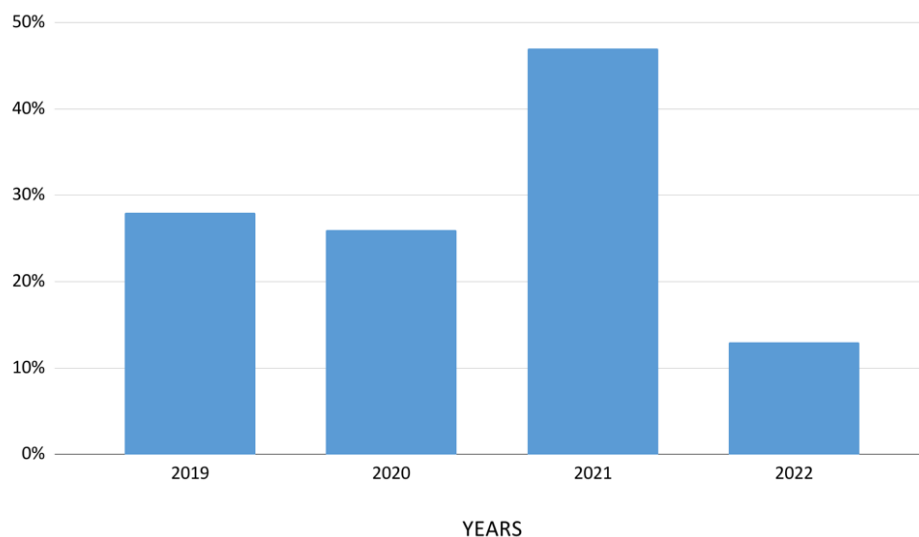
([25])   Note that the results are based on analysing exclusively the text of the IA reports without further exploring underlying study reports that may provide the model name.

([26])   European Commission, Joint Research Centre, Acs S., Ostaender N., Listorti G., Hradec J., Hardy M., Smits P., Hordijk L., *Modelling for EU policy support: impact assessments. Analysis of the use of models in European Commission impact assessments in 2003-2018*, Publications Office, 2019, https://data.europa.eu/doi/10.2760/748720.

([27])   https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en#documents

To identify which models are most frequently used to support IAs, we looked at the number of IAs each model contributed to (Figure 2). We found that, out of the **39 different models** that have been used in IAs, **27 (69%) were used only once**. The most frequently used models are **PRIMES**, used **in 25 IAs**, and **PRIMES-TREMOVE**, used in **12 IAs**. The group of models **GLOBIOM-CAPRI-G4M-GAINS-GEM-E3** shares a frequency of **around 10 IAs each**. Most of these models that dominate have been used in IAs related to **energy and climate.** This will be analysed more in detail in the next subsection.

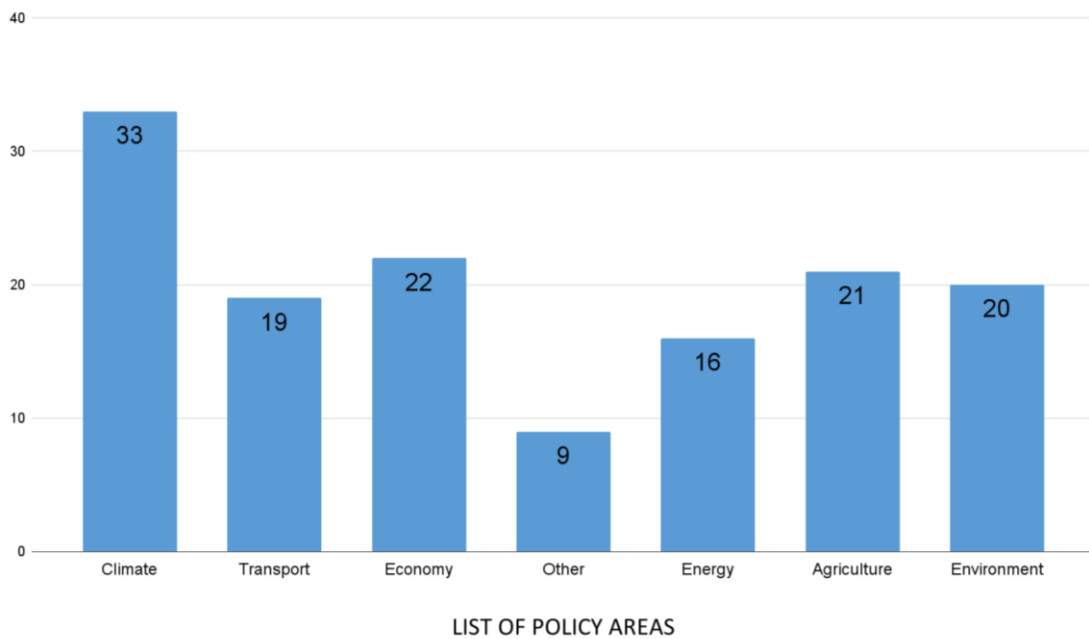**Figure 2**. Number of times a certain model was used to support an IA ([28])
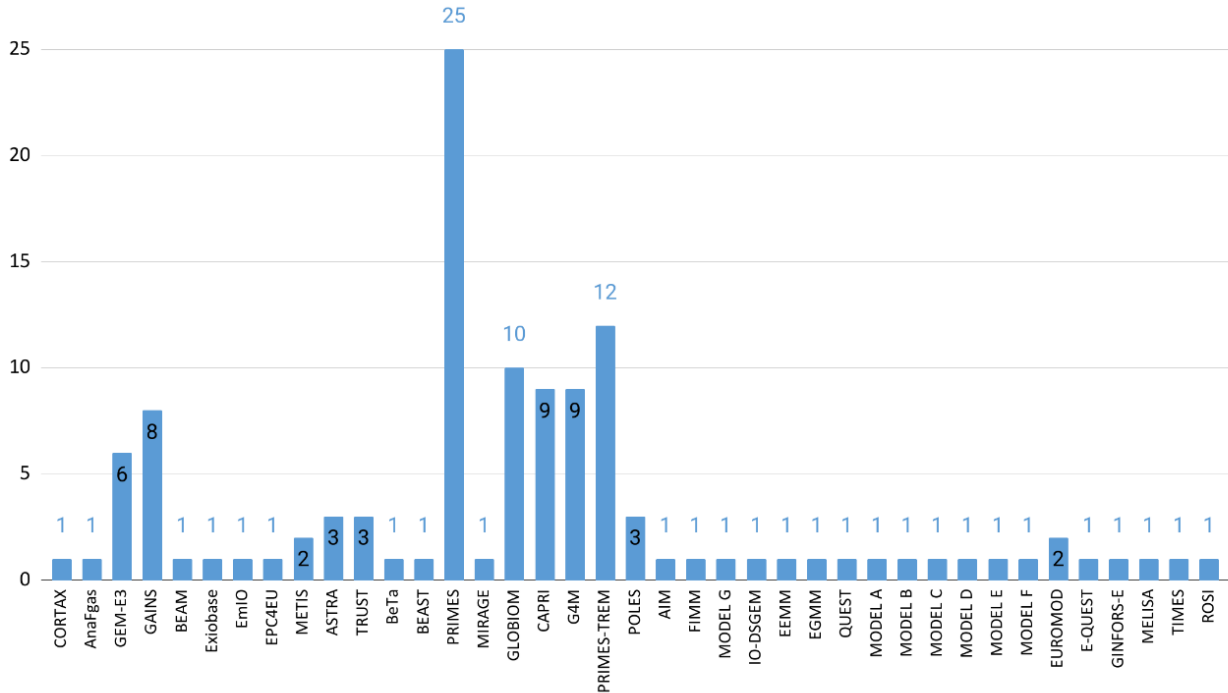
4.2   Policy area

In this section, we present the **policy areas** covered by the 21 models identified in MIDAS, based on the method adopted in this study. Models are mostly used in **the following policy areas**: **environment, economy, transport, energy, climate, agriculture** (Figure 3). It is important to consider that a single model can be assigned to different areas and IAs are considered more than once if they refer to several areas assigned to different models. For example, the IA SWD(2022)111 ([29]) mentions the use of models **PRIMES, GEM-E3** and **GAINS** that are assigned respectively to climate, energy, and transport. It appears that **climate** is the most common area where models are used in **33 cases**.

Figure 3. Frequency of policy areas covered by models used in IAs

---

([29])   Commission staff working document, Impact Assessment Report Accompanying the Documents Proposal for a Directive of the European Parliament and of the Council amending Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) and Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste and Proposal for a Regulation of the European Parliament and of the Council on reporting of environmental data from industrial installations and establishing an Industrial Emissions Portal, SWD(2022)111, https://eur-lex.europa.eu/legal-content/RO/TXT/?uri=SWD:2022:111:FIN.

4.3 Model contribution

We have also investigated how models are used to support IAs by looking at the frequency of the various roles they perform. For this, we use the notion of **model contribution**, described in Section 3. A model might contribute to the same IA more than once if used for different roles. Please note that in this analysis, we count not the roles of single models but the roles of the set of models used in an IA.

Out of the 40 IAs supported by models, there are **a total of 55 model contributions**. This means that some of the **39** models identified performed more than one role for the same IA.

We observe that models are predominantly **used for assessing policy options, with 38 model contributions (69%)** (Figure 4)**.** On the other hand, for the **baseline calculation** we have **12 contributions (22%)** and only **4 (7%) for problem definition**. Only once models have been used to provide quantitative evidence in relation to the ex-post evaluation of policies related to the IA. This was expected, given the general aim of the IA reports for ex-ante evaluations in the policy formulation phase. The **most common models** such as **PRIMES** or **GAINS** were predominantly used for both the **assessment of policy options** and the **calculation of baselines** ([30]).

Figure 4. Model contributions to IAs
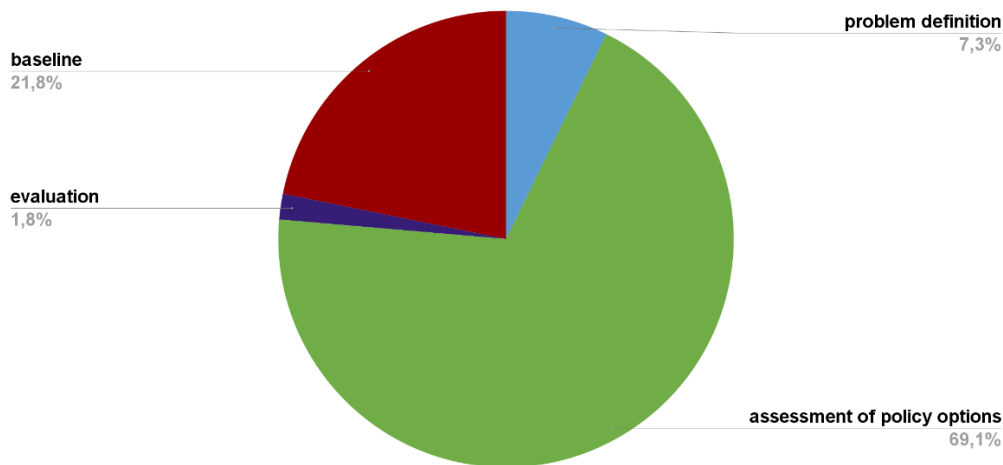
4.4 Model ownership

The information in MIDAS on the ownership of models clarifies which entity holds the Intellectual Property Rights or, more specifically, the copyright of the models and/or the computer code underpinning it.

The following are the **options** considered in MIDAS:

- EU ownership (European Commission)

- EU ownership (other than European Commission: e.g. European Parliament, European Central Bank, …)

- EU agencies' ownership

- Third-party ownership (commercial companies, Member States, other organisations, …)

- Co-ownership (EU & third parties)

- Public domain

([30]) These two models are part of the modelling framework used for the EU Reference Scenario which is a key analysis tool in the areas of energy, transport and climate action. It is being regularly updated every few years. See more https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en and https://energy.ec.europa.eu/data-and-analysis/energy-modelling/older-modelling-results_en

- Other

We observe that there have been **64 times (74%) models owned by third parties** were used in IAs during the period 2019-2022. Use of **models co-owned** by EU and/or other parties occurred **20 times (23%)** and **2 times (2%) models owned solely by the EU** were used. Figure 6 reports the frequency at which models with different model ownership contributed to an IA ([31]).

Figure 5. Number of times models of different owners have been used in IAs 2019-2022
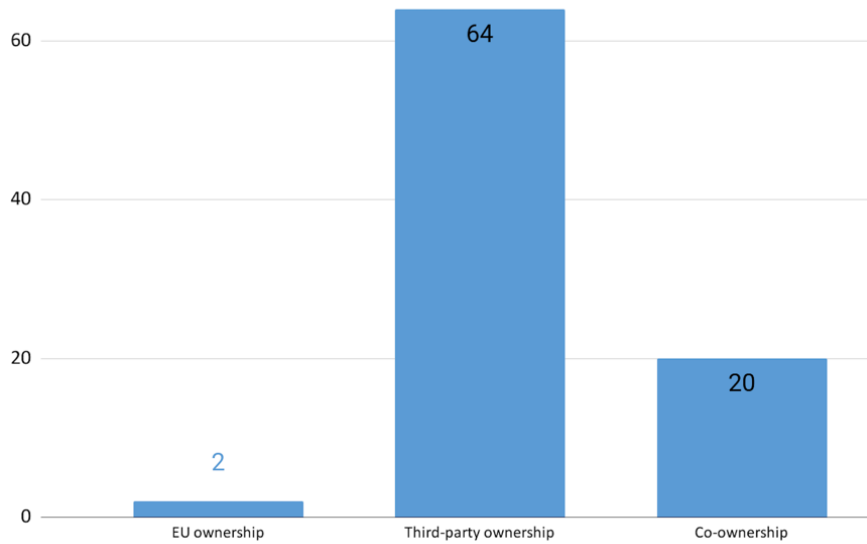
([31])   The total (86) represents the number of times a model publicly available on MIDAS was used in an IA during the period 2019-2022.

4.5   Who runs the models?

In MIDAS, it is also possible to find information on who runs the model contributing to an IA. Seeing the results on model ownership, models can be run either by the EC or by third parties. It should be emphasized that a model can be run at the same time by different entities for the same IA. Entities could be the EC itself, universities or other private or public institutions. Therefore, after identifying all these entities, we quantified how many times they contributed to an IA by running the models currently described in the public version of MIDAS (Figure 6).

The results show that **most frequently, models contributing to IAs were run by external entities** such as the **International Institute for Applied Systems Analysis (27 model contributions)** and the **National Technical University of Athens (31 model contributions).** This is partially linked to their use of the EU Reference Scenario ([32]) in many IAs underpinning climate, energy and transport policies to ensure coherency of the baseline. In 6 occasions models contributing to IAs were run by the European Commission.

Figure 6. Who runs the models used in IAs
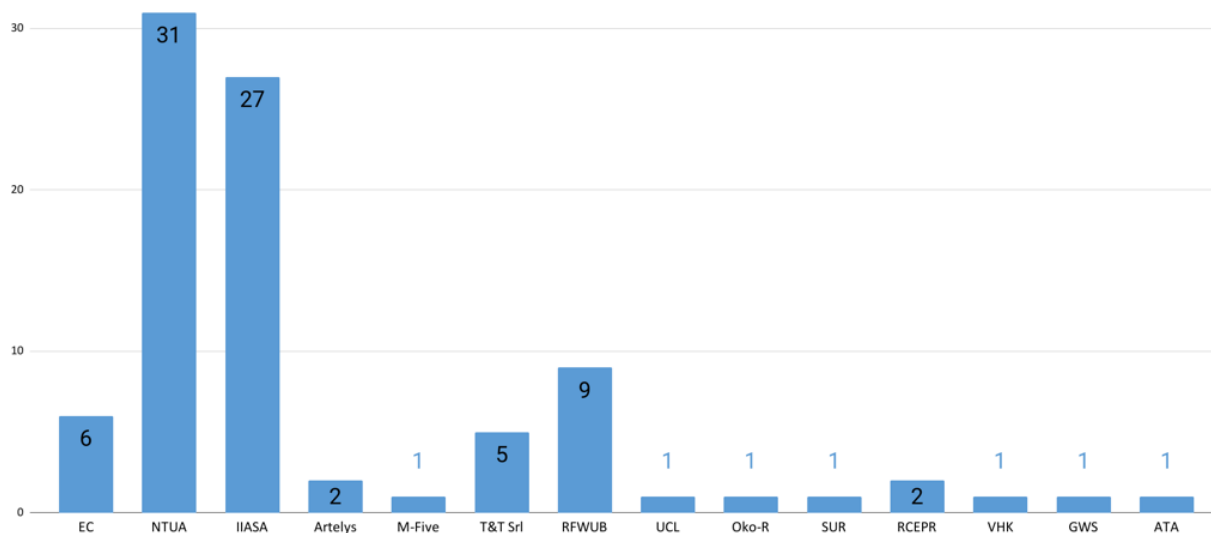
Abbreviations used are explained in Table 1

Table 1. Who runs the models used in Commission IAs

Who runs the models	Acronym	Frequency
European Commission	EC	6
National Technical University of Athens	NTUA	31
International Institute for Applied Systems Analysis	IIASA	27
Trasporti e Territorio Srl	T&T Srl	5
Öko-Recherche GmbH, Frankfurt/Main, Germany	Oko-R	1
Regional Centre for Energy Policy Research	RCEPR	2

([32])   https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en

Artelys	Artelys	2
M-Five	M-Five	1
Rheinische Friedrich-Wilhelms-Universität Bonn	RFWUB	9
University College London	UCL	1
Air Transportation Analytics	ATA	1
Sapienza University of Rome	SUR	1
VHK Van Holsteijn en Kemna BV	VHK	1
Gesellschaft für Wirtschaftliche Strukturforschung	GWS	1

4.6 Model type

Finally, we looked at the different **types of models** used to support IAs. This has been done by checking the model description in MIDAS and quantifying the frequency each model type is used in different IAs. The code list of the model types used in MIDAS is synchronized with the KnowSDGs platform where it is also possible to find the related definitions ([33]).

Given the long names used to describe models, abbreviations have been used that are shown in Table 2, together with the respective frequency in the analysed set of IA reports.

**Table 2**. Model types and how frequently they are used in different IAs

Model type	Acronym	Frequency*
Computable general equilibrium model	CGEM	8
Bottom-up simulation model	BUSM	23
Bottom-up partial equilibrium model	BUPEM	46
Bottom-up optimization model	BUOM	20
Top-down system dynamics model	TDSDM	3
Bottom-up macro simulation model	BUMSM	3
Top-down dynamic stochastic general equilibrium model	TDDSGEM	2
Top-down input output model	TDIOM	2

* The frequency each model type is used in different IAs. A model can be assigned more than one model type.

([33])   https://knowsdgs.jrc.ec.europa.eu/methodology-models

We observe that more than half of the models are defined as '**Bottom-up partial equilibrium model' with 46 uses (45%)** (Figure 7). The second most used type of model is the '**Bottom-up simulation model' with 23 uses (22%)**.

Figure 7. Types of models used in IAs
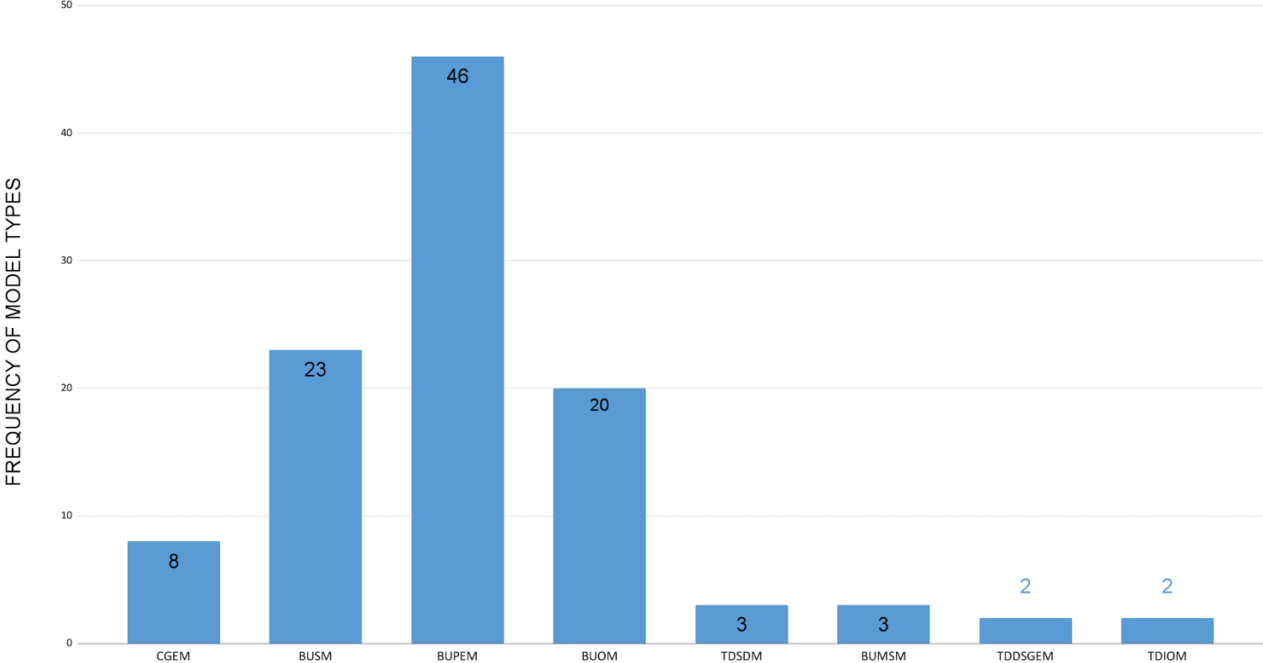
## 5   Comparison with the previous study on model use in Commission's IAs

In this section we compare our results with the previous study conducted by Arcs et al. on the IAs published from 2004 to 2018 ([1]).

We observe that in the period **between January 2019 and May 2022**, **39 models were used in 40 published IAs (or 34% of the total** of IAs published in this period). This shows a growing trend in using models in IAs in comparison to the previous analysis where they estimated that while overall **16% of the IAs published from 2004 to 2018 used models, in the period 2015-18, around 25-30% of IAs were supported by models.** As in the mentioned study, **more than half of these models were used only once**.

Again, likewise to 2004-2018, **some models dominate in use, with more than 10 contributions per model**. At the same time, **the most common policy areas remained the same**: environment (including climate), internal market, transport, and energy.

Finally, the results on **model contributions** are particularly similar to the previous ones shown in Figure 8.

Figure 8. Model contributions to IAs (% of IAs with models) 2004-2018
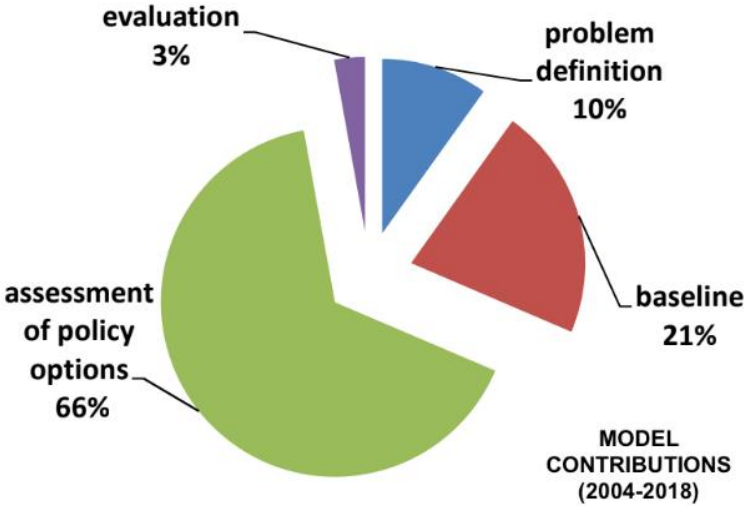
6   The impact of MIDAS

The European Parliamentary Research Service is the in-house research department and Think Thank of the European Parliament and carries out appraisals of the Commission's IAs accompanying the legislative proposals. 'Initial Appraisal' reports are short documents that focus on basic methodological strengths and weaknesses of the IA reports. Such systematic review of the quality and transparency of the Commission's IAs aims to support the Parliament's legislative and scrutiny work and ultimately contribute to better law-making.

In this section, we present the results of the first in-depth, systematic analysis of MIDAS use in the **EPRS appraisals of the** Commission's IAs from **14/03/2019** to **02/03/2022**. The starting date corresponds to the date when EPRS was given access to the information available in MIDAS. All the information has been extracted from the **EPRS web page.** Considering that **MIDAS is open to the EPRS since 2019**, this set of appraisals can give us a hint on the extent to which the inventory **contributes to the reviews of IAs**.

In total, we analysed a set of **41 EPRS reports**, published in the **past 3 years** ([34]). Of these, **34 reports** were defined as **'Initial Appraisals'** of the IAs accompanying policy proposals of the European Commission, therefore considered the dataset of this study.

We observed that **17 (50%) of the total amount of appraisals mentioned the use of models in the IAs under review** (Figure 9). In both years, 2019 and 2020, 50% of the appraisals mentioned models, while in 2021 the ratio is 36%. In 2022 before March, it resulted to be 100% (6/6).

The number of appraisals using models that mentioned MIDAS was also quantified, resulting to be **82% of the total (14 out of 17).** As observed in these appraisals, MIDAS is usually mentioned in the section on supporting data and analytical methods used in the IAs and is considered an additional source of information to get an overview of the models used in the IA. **3 appraisals** (SWD(2019)330, SWD(2021)266, SWD(2019)10) **that were reviewing IAs using models, did not mention MIDAS.** The IA SWD(2019)10 actually used a model run performed for another IA dating back to 2013. Indeed, the model used in the 2013 IA is described in MIDAS but not in the public version since the latter only includes IAs published from July 2017. The 2 other IA reports had not named the model used, thus it is likely that EPRS had not checked MIDAS because of this reason. Also, it is important to note that MIDAS was opened to the public at the end of 2020, thus mentioning MIDAS in their appraisals became more relevant once MIDAS became accessible to the wider public.

In only one case (SWD(2020)176), the authors of the appraisal explicitly mentioned that they could not find information about the models used in the IA under review in the interinstitutional version of MIDAS. This was due to a slight timing misalignment, i.e. the description of the model contribution to this IA was not yet in MIDAS at the time when the EPRS was preparing the appraisal.

Figure 9. Use of MIDAS by the EPRS in their appraisals of EC IA reports

---

([34])   https://www.europarl.europa.eu/thinktank/en/research/advanced-search?textualSearch=&publicationTypes=BRIEFING&policyAreas=EXIMAS&startDate=02%2F01%2F2019&endDate=&firstCameToPage=false
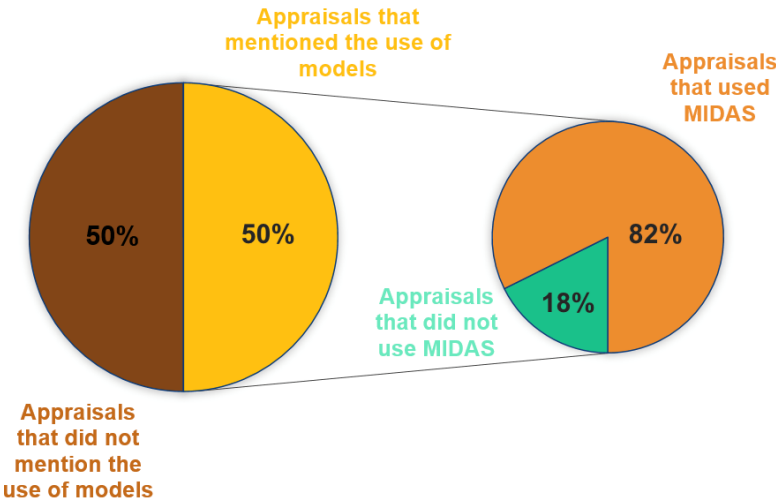
7 Conclusion

With this report we showed how the model use in support to the policy formulation phase of EU policy cycle evolved in the past 4 years. The purpose of this work has been to continue analysing trends in model use in IAs based on the previous work conducted by CC-MOD. The final intent is to promote a more transparent, coherent, and efficient use and development of models.

The analysis is based on the information available in the IA reports extracted from the Register of the Commission Documents and from MIDAS.

We analysed how models are used in the **118 Commission's IAs** published **between January 2019 and May 2022** by examining each IA report, with a particular focus on **Annex 4** where details about the methodology are usually provided.

We found that 5 out of 18 IAs were supported by models in 2019 (28%), 5 out of 19 in 2020 (26%), and 27 out of 58 in 2021 (44%). In 2022, the ratio resulted to be 3/23 (22%). Overall, we observed that a total of **39 models were used in 40 IAs (34% of the total IAs)**. **21 of these 39 models are** identifiable **in MIDAS**. When comparing these data with the results on the time period 2004-2018, we **observe a positive trend: the percentage of IAs that used models equals to 16% in the period 2004-2018, 27% for the interval in 2015-18, and 34% in 2019-2022.**

The most frequently used models were **PRIMES (25 contributions to IAs) and PRIMES-TREMOVE (12 contributions)**. Models contributed for **69%** of the time **to assessing policy options**, **22%** to building a **baseline**, **7%** to **problem definition** and only **2% to making an ex-post evaluation**. In addition, more than half of the models were used only in one IA.

Thanks to the information available in MIDAS, additional information enriched the analysis. **Different policy areas** were covered by the models, **the most recurrent** one being **climate**. Most of the model contributions considered for the models available in MIDAS were done by models that could be identified with the type '**Bottom-up partial equilibrium model**' **(45%)**. **Three quarters of the model contributions** considered were done **by models owned by third parties** (74%)**.**

These results confirm most of the trends identified in the analysis of the model use in the period 2004-2018 and, in particular, **a continuous increase of the proportion of IAs that rely on modelling**.

Finally, the role of MIDAS in the EU policy cycle emerges clearly since our analysis showed that for almost all IAs using models (except for one IA that did not name the model used) and published after MIDAS was opened to the public, **EPRS referenced MIDAS as an additional source of information**. The EPRS sees MIDAS as a useful tool to better understand how model results are underpinning policy proposals. MIDAS is an example of the Commission's intention to open up scientific evidence to public scrutiny ([35]). As such, it can also be promoted as didactic tool serving interested communities, including the academic institutions and science-for-policy networks in the Member States.

([35]) Communication from the Commission to the European Parliament, the Council, the European and Social Committee and the Committee of the Regions on Better regulation: Joining forces to make better laws, COM/2021/219 final.

References

Commission staff working document, Better Regulation Guidelines, SWD(2021)305, https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-andhow/better-regulation-guidelines-and-toolbox_en (Accessed: 25/11/2022).

Commission staff working document, Impact Assessment Report Accompanying the Documents Proposal for a Directive of the European Parliament and of the Council amending Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) and Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste and Proposal for a Regulation of the European Parliament and of the Council on reporting of environmental data from industrial installations and establishing an Industrial Emissions Portal, SWD(2022)111, https://eur-lex.europa.eu/legal-content/RO/TXT/?uri=SWD:2022:111:FIN.

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on Better regulation for better results – An EU agenda, COM/2015/215 final.

Communication from the Commission to the European Parliament, the Council, the European and Social Committee and the Committee of the Regions on Better regulation: Joining forces to make better laws, COM/2021/219 final.

European Commission, *'Better regulation' toolbox – November 2021 edition*, https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-andhow/better-regulation-guidelines-and-toolbox_en (Accessed: 25/11/2022).

European Commission, Joint Research Centre, *Acs S., Ostaender N., Listorti G., Hradec J., Hardy M., Smits P., Hordijk L., Modelling for EU policy support: impact assessments. Analysis of the use of models in European Commission impact assessments in 2003-2018*, Publications Office, 2019, https://data.europa.eu/doi/10.2760/748720.

European Commission, Joint Research Centre, Listorti G., Basyte Ferrari E., Acs S., Munda G., Rosenbaum E., Paruolo P., Smits P., *The debate on the EU Better Regulation Agenda: a literature review*, Publications Office, 2019, https://data.europa.eu/doi/10.2760/46617.

European Commission, Joint Research Centre, Marques, A., Hradec, J. and Rosenbaum, E., *Baseline assumptions in EC impact assessments: significance, analysis and recommendations*, Publications Office, 2018, https://data.europa.eu/doi/10.2760/982695.

European Commission, Joint Research Centre, MIDAS Team, *Definition of 'model': background note,* 2021, Commission-internal document, https://webgate.ec.europa.eu/connected/docs/DOC-248399 (Accessed: 25/11/2022).

European Commission, Joint Research Centre, Ostaender N., Acs S., Listorti G., Hardy M., Hradec J., Smits P., *Modelling Inventory and Knowledge Management System on the European Commission (MIDAS)*, Publications Office, 2019, https://data.europa.eu/doi/10.2760/900056.

Golberg, E., '"Better Regulation": European Union Style', *Harvard Kennedy School, Mossavar-Rahmani Center for Business and Government, M-RCBG Associate Working Paper Series* (98), 2018.

Interinstitutional Agreement between the European Parliament, the Council of the European Union and the European Commission on Better Law-Making (OJ L 123/1 13.04.2016, ELI: http://data.europa.eu/eli/agree_interinstit/2016/512/oj).

Listorti, G., Basyte-Ferrari, E., Acs, S., and Smits, P., 'Towards an Evidence-Based and Integrated Policy Cycle in the EU: A Review of the Debate on the Better Regulation Agenda', *JCMS: Journal of Common Market Studies*, No 58, 2020, pp. 1558-1577, https://doi.org/10.1111/jcms.13053.

List of abbreviations

BR   Better Regulation

CC-MOD Competence Centre on Modelling

EC   European Commission

EPRS   European Parliament Research Service

IA   Impact assessment

JRC   Joint Research Centre

MIDAS   Modelling Inventory and Knowledge Management System

MQA   Model Quality Assurance (MQA)

List of figures

List of boxes

24

List of tables

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

Publications Office
of the European Union