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TWINRD
ECODIGITAL FUTURES

MACROECONOMIC MODELLING OF R&D FOR THE TWIN TRANSITION

D2.2 | R&D Data Methodology

Author(s)	**Pierre Le Mouël, Jean-Patrick Le Mouël (SEURECO), Baptiste Boitier (SEURECO), Paul Zagamé (SEURECO) and Iannis Reuter (SEURECO)**
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Coordinator	**Leonidas Paroussos (E3-Modelling)**
E-mail	**paroussos@e3modelling.com**

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Executive Summary

This technical report describes the methodology that was developed to produce the TWINRD R&D datasets available on the TWINRD project community's repository on Zenodo, including:

1. R&D data for 45 countries (27 EU Member States and 18 non-EU countries), covering 25 sectors (NACE, rev. 2) within Manufacturing Industry (excluding C33) plus sector J62 (Computer Programming), for the period 1995-2022. The initial R&D data are the official figures from EUROSTAT, PREDICT, OECD, and OECD_STAN, merged and completed by SEURECO.

2. R&D data for 45 countries (27 EU Member States and 18 non-EU countries), covering 25 sectors (NACE, rev. 2) within manufacturing (excluding C33) plus sector J62 (computer programming), spread across 38 digital, green and other technologies.

Several adds will be brought to TWINRD's deliverable D2.2 at later stages of the project, either in the form of additional R&D datasets that will be published on the TWINRD's project data repository on Zenodo, or of additional technical description of the methodologies developed in the project to produce the R&D data.

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List of Acronyms and Abbreviations

EC	European Commission
EU	European Union
PA	Project Advisor
PC	Project Coordinator
SC	Steering Committee
TL	Task Leaders
WP	Work Packages
IAM	Integrated Assessment Model

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Introduction

This technical report describes the methodology that was developed to produce the TWINRD R&D datasets available on the TWINRD project community's repository on Zenodo, including:

1. R&D data for 45 countries (27 EU Member States and 18 non-EU countries), covering 25 sectors (NACE, rev. 2) within Manufacturing Industry (excluding C33) plus sector J62 (Computer Programming), for the period 1995-2022. The initial R&D data are the official figures from EUROSTAT, PREDICT, OECD, and OECD_STAN, merged and completed by SEURECO.

2. R&D data for 45 countries (27 EU Member States and 18 non-EU countries), covering 25 sectors (NACE, rev. 2) within manufacturing (excluding C33) plus sector J62 (computer programming), spread across 37 digital and green technologies, from patent data delivered by the University of Maastricht (see TWINRD Research Project's deliverable D2.1). Data are delivered as time series covering 2000–2021.

3. Decoding tables for the list of countries, NACE sectors and technologies covered by the data.

The report is organised as follows:

The section 1 presents the general scope of the data, in terms of countries and NACE sectors coverage, that were available in existing official data sources namely EUROSTAT, OECD and JRC's PREDICT, and the degree of completion of the data on the 1995-2022 time period.

The section 2 describes the methodologies that were developed for filling the missing data for ever countries and NACE sectors included in the project's R&D datasets. Then the section 3 presents the results of the data completion for the industrial and J62 sectors.

The section 4 explains how the R&D data, once completed, were broken down on an initial list of 37 (old – Jtag – and new – WIPO) digital and green (EPO's Y02-Y04S tagging scheme), with illustrative views of the data extracted from SEURECO's data viewer.

The section 5 finally indicates the data updates and adds that will be made in the course of the TWINRD project.

1. The general scope of the R&D data used to generate the TWINRD's R&D datasets

1.1. Merging initial official R&D figures from EUROSTAT, PREDICT, OECD and OECD_STAN

The common origin of R&D data are the national R&D surveys structured and organised following the official definitions defined by the OECD's 2015 Frascati Manual. The results of these surveys are processed and published on public repositories such as EUROSTAT for e.g.

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the EU-27 members states plus UK, Japan and United States and OECD for additional extra-EU countries.

In the TWINRD research project, that aims to enhance existing or new macroeconomic models for the evaluation the impacts of R&I and the modelling of green and digital technologies and of their impacts, the scope of NACE sectors and countries retained for the project's R&D datasets was constraint by the availability additional data sources necessary for the building of IAMs. It resulted with an initial list of 114 NACE sectors and sub-sectors (see Table 1 for the description of the sectors) for 45 countries (the individual EU-27 countries plus 18 extra-EU countries; see Table 2 for the list of countries).

The R&D data were collected from existing available public sources with the following priority order:

1. EUROSTAT
2. PREDICT
3. OECD
4. OECD-STAN

Note that the data collected at this stage are exclusively for Business Enterprise Expenditure on R&D (BERD) and exclude the R&D that is perform by public research organisations (Government, Higher eduction and Private-non-profit sectors).

2. Data completion methods

2.1. Initial rates of missing data

The Table 3 provides a synthetic view of the degree of initial data completion for the 114 NACE sectors and sub-sectors and the 45 countries for the period 1995-2022.

For the entire period 1995-2022 none of the series was fully complete, but the completion rate has importantly increased in time (we don't illustrate this here). 79% of the series were partially filled with completion rates generally over 90% and close 100% for most EU-27 countries. At the other extreme, the completion rates were very low for many emerging countries such as for Brazil (17%), China (22%) or India (29%), where the number of completely empty series (21 % in average), concentrates.

2.2. The general methodology used for filling missing data

The general methodology used for filling the missing data combines two approaches in three steps, illustrated by Figure 1, Figure 2 and Figure 3.

1. At the first step, a "Parent-Child" method is used for filling the missing data, for all the initially partially filled series, that consists in retro-, extra- and /or inter-polations.

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2. At the second step, a "Best-Correlation" method (is terms of countries' relative sectoral patent costs or R&D intensity) is used to infer R&D data for the NACE sectors and countries with fully missing series. The "Best-correlation" method was applied for selected years: 2000, 2005, 2010, 2015 and 2018.
3. At the third step, the "Parent-child" method was applied again, this time for the "temporal" filling of the series that were built only for five reference years at step 2.

This process results with a 100% completion rate of the data included in the project's R&D datasets.

2.3. An illustration of completing series with the "Parent-Child" method

The Figure 4 provides an example of filling missing data with the "Parent-Child" method, for the case of the NACE sector C19 in France.

The NACE sector C19 – "Manufacture of coke and refined petroleum products" – is the child of the NACE sector C – "Manufacturing industry" - that is itself the child of the aggregate BERD expenditure in France (variable BERD_FR_TOTAL in the table).

The first data available for the sector C19 is for 2010 and the data for 1995-2009 are rebuilt by applied the last known share (for 2010) of C19 in its parent (C) – Ratio "R" with a value of 0.78% in the middle of the table.

Next the data for C19 are available up to 2013 and for 2016 and 2017, but there are missing value for 2014 and 2015. The data for 2014 and 2015 are retrieved by interpolating the share of C19 in its parent from the values available for 2013 and 2016.

The same as above is used to retrieve the missing value for 2018 and 2019.

The R&D data for C19 is also missing for the last year, 2022, but this time the R&D data for its parent (C) is itself absent. In this case, we have first rebuilt the R&D for the parent C in 2022, by using the share of C in its own parent (BERD_FR_TOTAL) in 2021 (60.8% in the table), then we have rebuilt the missing data for C19, in 2022, by the same method.

The "Parent-Child" method allows therefore to fill all missing data if the data for the "ultimate" parent (BERD_TOTAL_FR) is available. If not, we use as "ultimate" parent the GDP value and apply the last known share of the R&D intensity of the country, as a percentage of GDP, to retrieve it from the same general methodology.

2.4. Inferring missing data by the "Best-Correlation" method

For the completely empty series, the "Parent-Child" method cannot be used immediately. An intermediary step is necessary to infer initial "Best-guest" R&D data for at least one reference year, and then apply again the "Parent-child" method to recover all the time series.

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To infer these "Best-guest" estimate reference data, the idea was using the empirical observation that most countries have similar sectoral R&D profiles.

For example, in every country for which we dispose of historical data, the more intensive NACE sectors in terms of R&D investments as a percentage of Turnover or Added Value are C21 – "Pharmaceutical products and preparation", C263 – "Communication equipment", C266 – "Irradiation, electromedical and electrotherapic equipment", etc. (see Table 4).

We find also similar profiles between countries in terms of relative sectoral "R&D costs" of patent. The highest costs are most on the time for the sectors C30 – "Other transports equipment", C24 – "Basic metals", J62 – "Computer programming, consultancy and related activities", etc. (see Table 5).

Note that as far as innovations by the agriculture, utilities and service sectors are not patentable, patent data can be used to infer missing R&D data only for countries that apply for patents, i.e. (essentially) the manufacturing industry (C sectors in the NACE), plus NACE sector J62.

For these latter sectors, that have patents, the R&D patent cost approach was preferred to infer best-guest R&D data for completely empty R&D series.

The first step was to match the NACE codes available for patent data, that originate from PATSTAT, with those available for R&D data. The Table 1 shows this mapping and ends with a correspondence between patent and R&D data including 25 unique NACE codes.

The Table 3 indicates that, for these sectors, the rate of initially completely missing series is less important than for the average of the sectors, with 9% against 21% for all sectors and 20% for the other NACE codes and aggregates.

In terms of geographical coverage, the 45 geocodes available for R&D data are also available in PATSTAT, as displayed in Table 2.

3. Data completion for industrial and J62 sectors

3.1. Focus on the methodology used

The Figure 2 describes the workflow for competing data for the industrial and J62 sectors.

The three steps were as follows:

1. Temporal completion: Partial time series were first completed by hierarchical filling (*Parent-Child Time Series Completion*) to fill missing years for each existing sector.
2. For sectors entirely missing, point estimates were generated for the target years (2000, 2005, 2010, 2015, 2018). The method is based on comparing countries' sectoral profiles of **patent costs** (R&D divided by the number of patents, normalized). A pool of candidate countries with the highest correlations to the target country profile is

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identified. Among these candidates, the reference profile selected is the one that produces **the lowest overall error**, when systematically reconstructing the total R&D of the target country (*Best-correlation*).

3. The values created for the five target years were then interpolated again, using the *Parent-Child Time Series Completion* method, to produce complete and consistent series covering 1995–2022.

3.2. Seeking for "Best candidates": Correlation analysis

For the analysis of correlations between countries' relative patent costs profiles, the technique employed has first consisted to centre and reduce the countries' relative patent costs profiles per NACE sector, in order to "normalize" them. Then we have calculated the table of linear correlation coefficients between the R&D patent cost profiles for every pair of 45 countries in our dataset. We could then select "Best candidates" for retrieving missing R&D data for a country, based on the R&D cost profile of another country, where the data are available and R&D patent costs can be calculated. Note also that the correlation coefficients were weighted by the number of available common tuples, in the correlation calculation, over the maximum e.g. 25.

The results of the correlation calculation, for the 45 countries, are summarized in the Table 6, where only the 5 first correlated countries, is decreasing order, were retained. The calculations in the table are for 2018. We find, for example, in this table, that for Austria, the "Best candidate" to infer (potentially) missing R&D data are by decreasing order Netherlands, Italy, Estonia, Germany and Czech Republic, with correlation coefficients of respectively 59%, 40%, 30%, 24% and 21%. For Netherlands, the "Best candidates" are respectively Austria, Finland, Israël, Luxembourg and Sweden, with correlation coefficients of respectively 59%, 46%, 37%, 27% and 24%.

3.3. The results of R&D data reconstruction process for 2018

The Table 7 illustrates the results of the R&D data "reconstruction" for 2018 and the ten first countries in terms of R&D investments, with respectively: USA, China, Japan, Germany, South Korea, France, United Kingdom, Taiwan, Italy and Israël.

To infer R&D for countries or sectors when missing, we have, in addition to the selection of the five "Best candidates" described above, systematically investigated the interest of using, in place of these five, the relative sectoral R&D patent costs of:

- the US.
- the World, e.g. the relative sectoral R&D patent costs calculated when aggregating the data over the countries covered by our data;
- the "Best candidates" aggregate, e.g. the relative sectoral R&D patent costs calculated when aggregating, this time, the data of the 5 best candidate countries;
- the "Best candidates" average, that retains, for each NACE sector, the relative sectoral R&D patent cost obtained by taking the direct average of the relative R&D patent costs calculated for each of the 5 best candidates.

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The candidate finally used for data reconstruction was, for a given country, the one providing the smallest "error", computed as the sum of the absolute values of the sector-specific errors, each weighted by the sector's share in the country's total known R&D value. This prevents "compensation" between overestimations and underestimations of R&D data across sectors.

In the Table 7, the candidates are "ranked" in order to select the "Best candidate" for data reconstruction i.e., from our methodological choice, the one that minimizes the sum of weighted absolute average sectoral errors (∑"Err(Sect.)", in the table.

The results indicate that, on the ten countries in Table 7, five, USA, Germany, South Korea, Taiwan and Italy have as best candidate, for data reconstruction, the "Best candidates" average, with sums of weighted absolute average sectoral errors of respectively 31.2%, 28.2%, 61.4%, 29.8% and 21.7%.

For four countries, China, Japan, France and United Kingdom, the first ranked candidates are respectively the first (with Poland), second (with Germany), second again (with Canada), and again first (with Czech Republic), best correlated countries. The sum of weighted absolute average sectoral errors are respectively of 51.4% (China), 38.9% (Japan), 36.1% (France) and 51.1% (United Kingdom).

For the remaining country, Israël, the first ranked candidate is the "Best candidates" average, with a sum of weighted absolute average sectoral errors equal to 80.8%.

Note that for every country in our dataset, the total error resulting from the R&D data reconstruction in three steps, described by Figure 2, is by construction null, any gap between the total R&D that is generated at step 2 for completely empty series, being adjusted, at the end of this step 2, such as the aggregation of the R&D data, for every country, at step 3 results with a completion rate of 100%, for all series, without affecting the Industry (plus J62) total, that is known at the end of the step 1.

3.4. Worldwide R&D data reconstruction accuracy: Patent cost versus R&D intensity.

The Table 8 provides a complementary view of the results of the R&D data reconstruction process we have just illustrated, with an aggregated view, over the 45 countries in our sample, for the other reference years used for data reconstruction: 2018, but also 2015, 2010, 2005 and 2000.

The immediate problem that emerges, when working with different reference years, is that the correlation analysis applied at step 3 can result with different "Best" candidates for rebuilding R&D data, for a given country. If the different candidates have different relative sectoral R&D patent costs, it results with breaks in the series that are completed at step 3.

For avoiding breaks in the R&D series that are completed, we have taken the decision to Frozen the selection of the "Best" candidate, i.e. to conserve the same, whatever the reference year

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considered. We have preferred to retain as "Best" candidate the one resulting from the correlation analysis for the most recent reference year, i.e. 2018.

As it is apparent on the left part of Table 8, freezing that way the choice of the "Best" candidate with the one for 2018, increases the sum of weighted (also over the 45 countries in our sample this time) absolute average sectoral errors, as we go in the past. It is calculated respectively at 50.2% for 2018, 53.5% for 2015, 63.5% for 2010, 70.3% for 2005 and 69.5% for 2000.

Freezing the "Best" candidate in 2018, also increases, as we go in the past, the maximum error (Max. Err.) that can be obtained for one given country. It is respectively 94% for 2018, 92% for 2015, 145% for 2010, 158% for 2005 and 157% for 2000.

The right part of the tableau also displays the results that we obtain if the correlation analysis is based on the similarities between the relative sectoral R&D intensity of the different countries (see Figure 2), in place of the correlations between their relative sectoral R&D patent costs. Comparing the results between the two alternative R&D reconstruction workflows, indicates that the R&D intensity correlation method performs slightly better for recent years, but that maximum errors obtained by this method, as we go in the past, increases very importantly, compared to our finally preferred method, based on the correlations between countries' relative sectoral R&D patent costs.

4. The breaking-down of patent and R&D data on digital, green and other technologies

This last section explains how the R&D that were completed for the 45 countries and 25 industrial plus J62 sectors, present in our datasets, were split up on digital, green and other technologies.

The list of 37 digital and green technologies (see TWINRD deliverable D1.1 for more information), used at this stage in the TWINRD project, is displayed in the Table 9, including 13 old digital (Jtag), 10 new digital (WIPO 4IR), and 14 green (EPO's Y02-T04s Scheme) technologies, plus a category "OTHERS", regrouping all the patent families that are not green, nor digital.

The braking-down of the patent families data on the three groups of technologies were realized by the University of Maastricht (see again TWINRD's deliverable D1.1 for more information). Then, from this split of patent families data on technologies, SEURECO has simply split the R&D data for the 45 countries and 25 industrial and J62 NACE sectors, included our TWINRD's R&D dataset, proportionally to the share of patent families, that every technology represents, in the total number of patent families included in the TWINRD's patent dataset.

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4.1. Composition of the patent and R&D portfolios of every NACE sector at the world level in 2021

To illustrate the results of this work, at the world level and for the year 2021, the Table 11 and Table 13 provide views of, respectively, the patent *versus R&D* contribution, in percentage, of each technology, in row, to the technologies portfolio, in column, of every NACE sector.

The table displays, also, the *R&D* contribution of the category "OTHERS", that regroups all patent families not identified as green or digital in table 9, to the technologies portfolio of the individual NACE sectors.

4.2. : Patent contribution of every NACE sector at world level in 2021, to the different digital, green and other technologies

The Table 10 and Table 12 provides, always at the world level and the year 2021, a complementary illustration of the resulting data with, respectively, the patent *versus* R&D contribution in percentage, of each technology, in row, to the technologies portfolio, in column, of every NACE sector.

The table displays, also, the patent contribution of the category "OTHERS", that regroups all patent families not identified as green or digital in table 9, to the technologies portfolio of the individual NACE sectors.

5. Conclusions/Next steps

This technical document has described the methodology that was employed in the TWINRD project to produce complete private R&D time series for a first list of 25 NACE sectors (the manufacturing industry plus the NACE sector J62 – "Computer programming"), 45 countries (the individual EU 27 Member States plus 18 extra-EU countries) for the period 1995-2022.

The document has also explained and illustrated how these private R&D have been broken-down over an initial list of 37 digital and green technologies, plus an additional for all the R&D invested to develop technologies that are not digital, nor green.

Several adds will brought to TWINRD's deliverable D2.2, either in the form of additional R&D datasets that will be published on the TWINRD's project data repository on Zenodo, or of additional technical description of the methodologies developed in the project to produce the R&D data.

A first add will be the provision of additional private R&D data for an additional list of 32 NACE sectors (Covering Agriculture, Utilities and Services) that the TWINRD project will consider. It will end with a project's R&D dataset that will include 57 individual NACE codes, 45 individual

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countries, for the period 1995-2022. The results of this work will be available on Zenodo before the end of July 2025.

A second add will be the extension of the list of green technologies that the TWINRD R&D project will detail, the initial list of green technologies for which we have produced R&D data remaining provisory. This will be available in the course of August 2025.

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6. Appendix – Tables and Figures

Table 1: List of the 114 NACE codes for which R&D data were initially collected, from and in this order: EUROSTAT, PREDICT, OCDE and OCDE-STAN

NACE	Description
TOTAL	Total R&D of the country
A	Agriculture, forestry, and fishing
B	Mining and quarrying
C	Manufacturing
C10_C12	Manufacture of food, beverages and tobacco products
C10_C11	Manufacture and processing of food products and beverages
C12	Manufacture of tobacco products
C13_C15	Manufacture of textiles, apparel and related products
C13	Manufacture of textiles
C14	Manufacture of wearing apparel
C15	Tanning and dressing of leather; manufacture of luggage, handbags and saddlery
C16_C18	Wood, paper, printing and related products manufacturing
C16	Wood and cork manufacturing (excl. furniture); straw and plaited products
C17	Manufacture of pulp, paper and paperboard
C18	Printing and reproduction of recorded media
C182	Reproduction of recorded media
C19	Coke and refined petroleum products
C20	Chemical industry
C21	Pharmaceutical industry
C22	Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24	Metallurgy
C24_FER	Manufacture of basic iron and steel products
C24_NFER	Production of precious and non-ferrous metals; metal casting
C25_C30	Manufacture of metal, machinery, electrical, electronic and transport products
C25	Manufacture of fabricated metal products, except machinery and equipment
C254	Manufacture of weapons and ammunition
C26	Manufacture of computer, electronic and optical products
C261_C264	Manufacture of electronic components, computers and communication equipment
C261	Manufacture of electronic components and boards
C262	Manufacture of computers and peripheral equipment
C263	Manufacture of communication equipment
C264	Manufacture of consumer electronics
C265	Manufacture of instruments for measuring, testing, navigation, and of watches and clocks
C266	Manufacture of irradiation, electromedical and electrotherapeutic equipment
C267	Manufacture of optical and photographic equipment
C268	Manufacture of magnetic and optical media
C27_C28	Manufacture of electrical equipment and industrial machinery
C27	Manufacture of electrical equipment
C28	Manufacture of machinery and equipment n.e.c.
C29	Motor vehicle industry
C30	Manufacture of other transport equipment
C301	Building of ships and boats
C302	Manufacture of locomotives and rolling stock
C303	Manufacture of air and spacecraft and related machinery
C304	Manufacture of military fighting vehicles
C309	Manufacture of transport equipment n.e.c.
C31	Manufacture of furniture
C32	Other manufacturing
C325	Manufacture of medical and dental instruments and supplies
C33	Repair and installation of machinery and equipment
D_E	Electricity, gas, steam, water, waste management and construction
D35_E36	Production and distribution of electricity, gas, steam and water
D35	Electricity, gas, steam and air conditioning supply
E	Water supply; sewerage, waste management, and remediation activities
E37_E39	Sewerage, waste management, materials recovery and remediation
F	Construction
G_U	Wholesale and retail trade, services, public administration and households
G_N	Trade, transport, accommodation and professional services
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
G465	Wholesale of information and communication equipment
G4651_G4652	Wholesale of computers, software, electronic and telecom equipment
G4791	Mail order and online retail sale
H_U	Transport, accommodation, services, public administration and households
H	Transportation and storage
H49	Land transport and transport via pipelines
H50	Water transport
H51	Air transport
H52	Warehousing and support activities for transportation
H53	Postal and courier activities
I	Accommodation and food service activities
J	Information and communication
J58_J60	Publishing of print and software, audiovisual production and broadcasting
J58	Publishing activities
J581	Publishing of books, periodicals and other publishing activities
J582	Software publishing
J59_J60	Film, video, TV production and distribution; broadcasting and music publishing
J59	Motion picture, video and TV production, sound recording and music publishing
J60	Programming and broadcasting activities
J61	Telecommunications
J62	Computer programming, consultancy and related activities
J63	Information service activities
J631	Data processing, hosting and related activities; web portals
J639	Other information service activities
K	Financial and insurance activities
L	Real estate activities
M_N	Legal, accounting, consulting, technical services, R&D, rental and business support
M	Professional, scientific, and technical activities
M69_M71	Legal, accounting, management consulting, architectural and engineering services
M71	Architectural and engineering activities; technical testing and analysis
M72	Scientific research and development
M721	Research and experimental development on natural sciences and engineering
M722	Research and experimental development on social sciences and humanities
M73_M75	Advertising, market research, design, translation, veterinary and other services
N	Administrative and support service activities
N77	Rental and leasing activities
N78	Employment activities
N79	Travel agency, tour operator and other reservation service and related activities
N80	Investigation and security activities
N81	Services to buildings and landscape activities
N82	Office administrative, office support and other business support activities
O_U	Public administration, education, health, arts, households and other services
O_P	Public administration, defence, social security, education and health
O	Public administration
P	Education
Q	Human health and social work activities
Q86	Hospital activities
Q87_Q88	Residential care and non-residential social work activities
R	Arts, entertainment, and recreation
S_U	Membership organisations, repair of goods, personal services and extraterritorial
S	Other service activities
S951	Repair of computers and communication equipment
T	Household activities as employers and own-use production
U	Extra-territorial organizations and bodies

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Table 2: List of countries covered by the R&D data and correspondence with the countries covered by PATSTAT

PATENTS country code	corresponding country_label_en		TWINRD country code	corresponding country_label_en
AT	Austria	=>	AT	Austria
AU	Australia	=>	AU	Australia
BE	Belgium	=>	BE	Belgium
BG	Bulgaria	=>	BG	Bulgaria
BR	Brazil	=>	BR	Brazil
CA	Canada	=>	CA	Canada
CH	Switzerland	=>	CH	Switzerland
CL	Chile	=>	CL	Chile
CN	China	=>	CN	China
CY	Cyprus	=>	CY	Cyprus
CZ	Czechia	=>	CZ	Czechia
DE	Germany	=>	DE	Germany
DK	Denmark	=>	DK	Denmark
EE	Estonia	=>	EE	Estonia
ES	Spain	=>	ES	Spain
FI	Finland	=>	FI	Finland
FR	France	=>	FR	France
GB	Great Britain and North. Ireland	renamed to	UK	United Kingdom
GR	Greece	=>	GR	Greece
HK	Hong Kong (S.A.R.)	merged with	CN	China
HR	Croatia	=>	HR	Croatia
HU	Hungary	=>	HU	Hungary

PATENTS country code	corresponding country_label_en		TWINRD country code	corresponding country_label_en
IE	Ireland	=>	IE	Ireland
IL	Israel	=>	IL	Israel
IN	India	=>	IN	India
IS	Iceland	=>	IS	Iceland
IT	Italy	=>	IT	Italy
JP	Japan	=>	JP	Japan
KR	South Korea	=>	KR	South Korea
LT	Lithuania	=>	LT	Lithuania
LU	Luxembourg	=>	LU	Luxembourg
LV	Latvia	=>	LV	Latvia
MT	Malta	=>	MT	Malta
MX	Mexico	=>	MX	Mexico
NL	Netherlands	=>	NL	Netherlands
NO	Norway	=>	NO	Norway
PL	Poland	=>	PL	Poland
PT	Portugal	=>	PT	Portugal
RO	Romania	=>	RO	Romania
RU	Russia	=>	RU	Russia
SE	Sweden	=>	SE	Sweden
SG	Singapore	=>	SG	Singapore
SI	Slovenia	=>	SI	Slovenia
SK	Slovakia	=>	SK	Slovakia

PATENTS country code	corresponding country_label_en		TWINRD country code	corresponding country_label_en
TW	Taiwan	=>	TW	Taiwan
US	U.S.A.	=>	US	U.S.A.
AR	Argentina		not_used	
CO	Colombia		not_used	
CR	Costa Rica		not_used	
EC	Ecuador		not_used	
EG	Egypt		not_used	
ID	Indonesia		not_used	
LI	Liechtenstein		not_used	
MA	Morocco		not_used	
MC	Monaco		not_used	
MY	Malaysia		not_used	
NZ	New Zealand		not_used	
PA	Panama		not_used	
PE	Peru		not_used	
PH	Philippines		not_used	
RS	Serbia		not_used	
TR	Turkey		not_used	
UA	Ukraine		not_used	
UY	Uruguay		not_used	
VN	Viet Nam		not_used	
ZA	South Africa		not_used	

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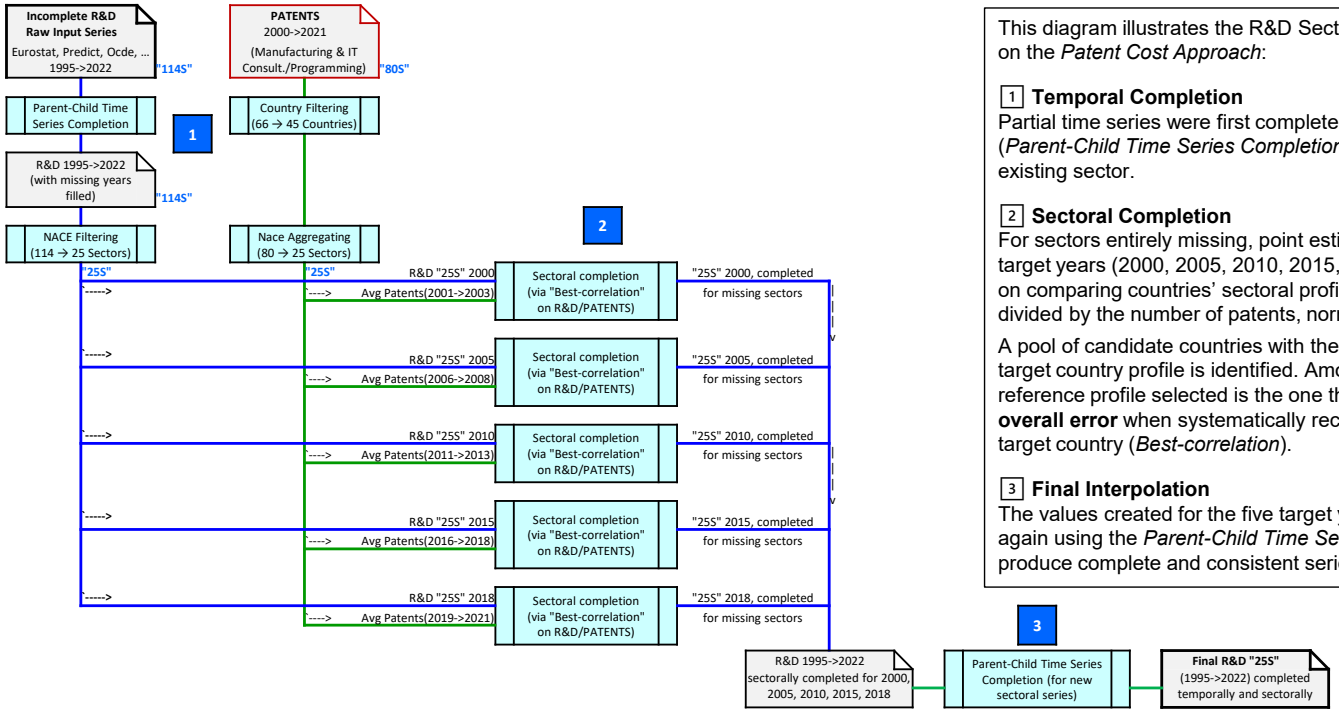
Table 3: Degree of initial data completion for the 114 NACE sectors and sub-sectors and the 45 countries initially selected and the period 1995-2022

PERIOD 1995–2022 / 45 COUNTRIES	45C	AT	AU	BE	BG	BR	CA	CH	CL	CN	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HR	HU	IE	IL
114 NACE codes and aggregates																							
Number of completely empty series	21%	4%	25%	5%	6%	83%	25%	78%	44%	41%	2%	2%	2%	10%	2%	3%	14%	3%	5%	4%	4%	8%	63%
Number of partially filled series	79%	96%	75%	95%	94%	17%	75%	22%	56%	59%	98%	98%	98%	90%	98%	97%	86%	97%	95%	96%	96%	92%	37%
25 NACE codes and aggregates																							
Number of completely empty series	9%	4%	16%	0%	4%	60%	8%	48%	32%	16%	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%	0%	28%
Number of partially filled series	91%	96%	84%	100%	96%	40%	92%	52%	68%	84%	100%	100%	100%	100%	100%	100%	96%	100%	100%	100%	100%	100%	72%
57 NACE codes and aggregates																							
Number of completely empty series	20%	2%	26%	8%	8%	81%	23%	77%	37%	37%	0%	3%	3%	11%	3%	0%	10%	5%	3%	3%	3%	6%	52%
Number of partially filled series	80%	98%	74%	92%	92%	19%	77%	23%	63%	63%	100%	97%	97%	89%	97%	100%	90%	95%	97%	97%	97%	94%	48%

PERIOD 1995–2022 / 45 COUNTRIES	IN	IS	IT	JP	KR	LT	LU	LV	MT	MX	NL	NO	PL	PT	RO	RU	SE	SG	SI	SK	TW	UK	US
114 NACE codes and aggregates																							
Number of completely empty series	71%	4%	1%	32%	18%	16%	26%	11%	2%	53%	31%	18%	8%	2%	6%	75%	46%	22%	6%	2%	22%	7%	44%
Number of partially filled series	29%	96%	99%	68%	82%	84%	74%	89%	98%	47%	69%	82%	92%	98%	94%	25%	54%	78%	94%	98%	78%	93%	56%
25 NACE codes and aggregates																							
Number of completely empty series	60%	0%	0%	0%	0%	0%	28%	4%	0%	16%	0%	0%	0%	0%	0%	64%	16%	0%	0%	0%	0%	0%	4%
Number of partially filled series	40%	100%	100%	100%	100%	100%	72%	96%	100%	84%	100%	100%	100%	100%	100%	36%	84%	100%	100%	100%	100%	100%	96%
57 NACE codes and aggregates																							
Number of completely empty series	69%	2%	0%	31%	18%	11%	21%	11%	0%	53%	26%	15%	6%	3%	5%	74%	42%	21%	10%	2%	23%	10%	34%
Number of partially filled series	31%	98%	100%	69%	82%	89%	79%	89%	100%	47%	74%	85%	94%	97%	95%	26%	58%	79%	90%	98%	77%	90%	66%

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Figure 1: R&D completion workflow - Patent cost approach



This diagram illustrates the R&D Sectoral Completion process based on the *Patent Cost Approach*:

1 **Temporal Completion**
Partial time series were first completed by hierarchical interpolation (*Parent-Child Time Series Completion*) to fill missing years for each existing sector.

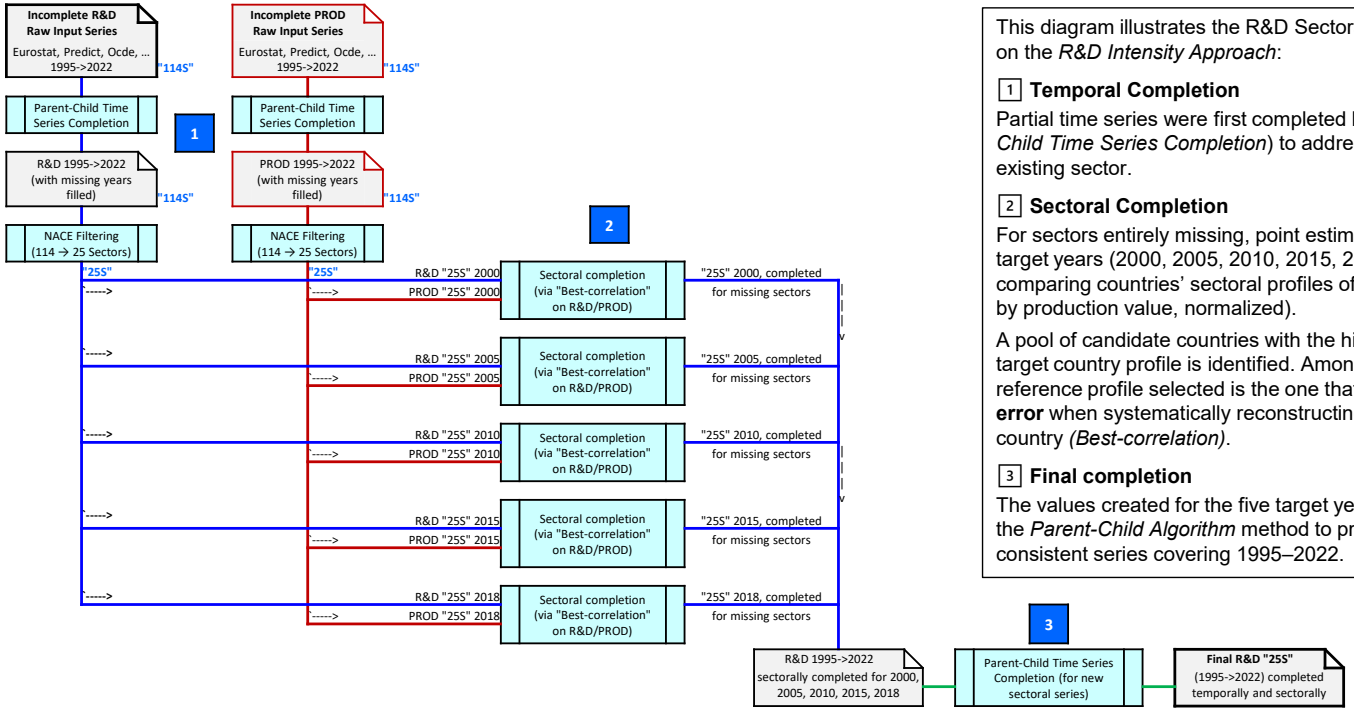
2 **Sectoral Completion**
For sectors entirely missing, point estimates were generated for the target years (2000, 2005, 2010, 2015, 2018). The method is based on comparing countries' sectoral profiles of **patent costs** (R&D divided by the number of patents, normalized).

A pool of candidate countries with the highest correlations to the target country profile is identified. Among these candidates, the reference profile selected is the one that produces **the lowest overall error** when systematically reconstructing the total R&D of the target country (*Best-correlation*).

3 **Final Interpolation**
The values created for the five target years were then interpolated again using the *Parent-Child Time Series Completion* method to produce complete and consistent series covering 1995–2022.

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Figure 2: R&D completion workflow – R&D intensity approach



This diagram illustrates the R&D Sectoral Completion process based on the *R&D Intensity Approach*:

1 Temporal Completion

Partial time series were first completed by hierarchical filling (*Parent-Child Time Series Completion*) to address missing years for each existing sector.

2 Sectoral Completion

For sectors entirely missing, point estimates were generated for the target years (2000, 2005, 2010, 2015, 2018). The method is based on comparing countries' sectoral profiles of **R&D intensity** (R&D divided by production value, normalized).

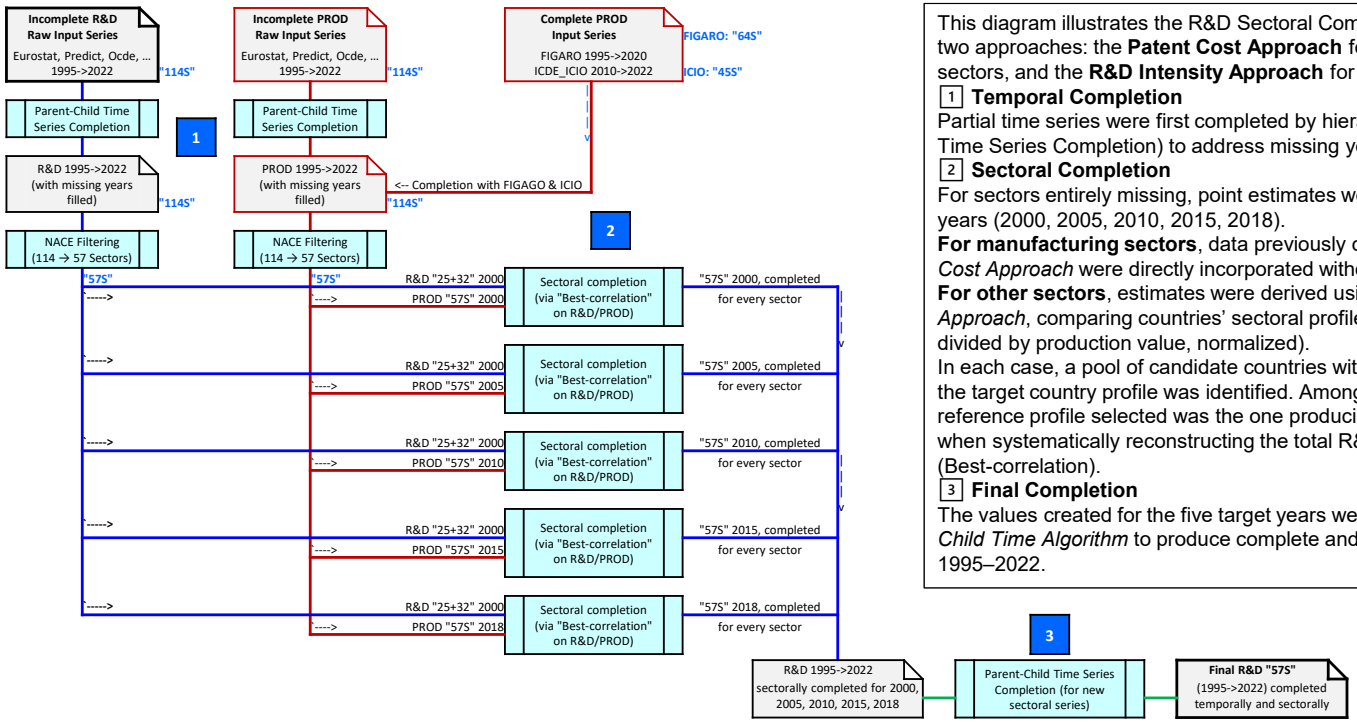
A pool of candidate countries with the highest correlations to the target country profile is identified. Among these candidates, the reference profile selected is the one that produces **the lowest overall error** when systematically reconstructing the total R&D of the target country *(Best-correlation)*.

3 Final completion

The values created for the five target years were then again using the *Parent-Child Algorithm* method to produce complete and consistent series covering 1995–2022.

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Figure 3: R&D completion workflow – Combined approach – Patent/intensity



This diagram illustrates the R&D Sectoral Completion process, combining two approaches: the **Patent Cost Approach** for the 25 manufacturing sectors, and the **R&D Intensity Approach** for the other activities.

1 **Temporal Completion**

Partial time series were first completed by hierarchical filling (Parent-Child Time Series Completion) to address missing years for each existing sector.

2 **Sectoral Completion**

For sectors entirely missing, point estimates were generated for the target years (2000, 2005, 2010, 2015, 2018).

For manufacturing sectors, data previously completed using the *Patent Cost Approach* were directly incorporated without additional estimation.

For other sectors, estimates were derived using the *R&D Intensity Approach*, comparing countries' sectoral profiles of R&D intensity (R&D divided by production value, normalized).

In each case, a pool of candidate countries with the highest correlations to the target country profile was identified. Among these candidates, the reference profile selected was the one producing the lowest overall error when systematically reconstructing the total R&D of the target country (Best-correlation).

3 **Final Completion**

The values created for the five target years were then infilled in the *Parent-Child Time Algorithm* to produce complete and consistent series covering 1995–2022.

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Figure 4: Completing series with a "Parent-Child" method

RAW INPUT DATA (From EUROSTAT, completed with PREDICT, completed with OCDE, completed with OCDE_STAN, in this order)

Level	Variable	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	BERD_FR_TOTAL	16738	17306	17217	17520	18655	19348	20782	21839	21646	22523	22503	23911	24753	25761	26426	27455	28851	30041	30590	31133	31665	32326	33019	34023	35220	34625	36478	37782
2	BERD_FR_C	8007	8343	8411	*Missing*	9192	9449	10332	11100	*Missing*	11719	11664	14202	14518	14896	14084	13825	14352	*Missing*		15982	16435	16209	16071	*Missing*	17266	15654	22182	*Missing*
3	BERD_FR_C19	(Data missing... to be estimated...)															108,3	107,5	77,5	100,6	*Missing*		54,9	46,2	*Missing*		6,4	151,8	*Missing*

(INTERNAL) : Ratio "R" **These ratios (intermediate calculations) correspond to the share of the series to be completed (child) in relation to the series of its encompassing activity (parent)**

1	BERD_FR_TOTAL	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*
2	"C / TOTAL" Share	47,8%	48,2%	48,9%	49,1%	49,3%	48,8%	49,7%	50,8%	51,4%	52,0%	51,8%	59,4%	58,7%	57,8%	53,3%	50,4%	49,7%	50,3%	50,8%	51,3%	51,9%	50,1%	48,7%	48,8%	49,0%	45,2%	60,8%	60,8%
3	"C19 / C" Share	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%	0,75%	0,51%	0,65%	0,54%	0,44%	0,34%	0,29%	0,21%	0,12%	0,04%	0,68%	0,68%
		left extrapolated ratio															raw input ratio		based on parent calcu-lated ratio		interpol. ratio		raw input ratio		interpol. ratio		raw input ratio		right interpolated

OUTPUT DATA :

1	BERD_FR_TOTAL	16738	17306	17217	17520	18655	19348	20782	21839	21646	22523	22503	23911	24753	25761	26426	27455	28851	30041	30590	31133	31665	32326	33019	34023	35220	34625	36478	37782
2	BERD_FR_C	8007	8343	8411	8595	9192	9449	10332	11100	11132	11719	11664	14202	14518	14896	14084	13825	14352	15103	15541	15982	16435	16209	16071	16619	17266	15654	22182	22975
3	BERD_FR_C19	62,7	65,4	65,9	67,3	72,0	74,0	80,9	86,9	87,2	91,8	91,4	111,2	113,7	116,7	110,3	108,3	107,5	77,5	100,6	87,0	72,6	54,9	46,2	34,1	21,2	6,4	151,8	157,3
		calculated data															input data				calculated data		input data		calculated data		input data		calculat.

For each C (child) series, an auxiliary series R (Ratio) is calculated such that R(t) = C(t) / P(t), where P is the closest "parent" series with at least one value, if this "parent" is eligible; otherwise, the calculation is performed relative to its "grandparent."
R(t) is completed, if necessary, by linear interpolation between two known values, and by left propagation of the first known value or, to the right, with the last available value.
Indeed, if the "parent" series is empty, it cannot be used; in this case, the algorithm moves up the "parent-child" hierarchy until it finds an ancestor with data; otherwise, it uses TOTAL COUNTRY, the "ultimate" parent.
Each value missing from the "child" series is calculated by: C(t) = P(t) × R(t).

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Table 4: "R&D intensity" profile across countries

	Food products, beverages, tobacco C10_C12	Textiles, apparel, leather C13_C15	Wood, paper, printing C16_C18	Coke & refined petroleum C19	Chemicals & chemical products C20	Basic pharmaceutical products C21	Rubber & plastic products C22	Other non-metallic minerals C23	Basic metals C24	Fabricated metal products (excl. machinery) C25	Electronic components & boards C261	Computers & peripherals C262	Communication equipment C263	Consumer electronics C264	Measuring & testing instruments; watches & clocks C265	Irradiation & electrotherapeutic equipment C266	Optical instruments & photographic equipment C267	Electrical equipment C27	Machinery & equipment n.e.c. C28	Motor vehicles & trailers C29	Other transport equipment C30	Furniture C31	Other manufacturing C32	Computer programming & consultancy J62			
AT	12%	39%	15%		54%	211%	82%	49%	45%	42%	343%	285%	379%	285%		296%		214%	159%	122%	218%			146%	AT	Austria	900%
AU		39%	15%	23%	69%	186%	31%	29%	26%	35%	343%	219%	386%					134%	172%	177%	56%			194%	AU	Australia	880%
BE	20%	56%	15%	7%	40%	517%	55%	59%	35%	38%	343%	444%	427%	71%		420%		213%	137%	51%	192%			180%	BE	Belgium	860%
BG	12%	83%	31%		68%	211%	54%	29%	30%	53%	343%	267%	427%	285%				80%	150%	57%	56%			194%	BG	Bulgaria	840%
BR					57%	189%					86%	111%	107%	110%						80%	225%			62%	BR	Brazil	820%
CA	12%	39%	35%	6%	60%	327%	49%	29%	26%	61%	343%	444%	427%	285%				226%	166%	48%	225%	37%	427%	194%	CA	Canada	800%
CH	12%				65%	179%			105%		343%								195%						CH	Switzerland	780%
CL																									CL	Chile	760%
CN					30%	135%					86%	111%	107%	71%						48%	56%				CN	China	740%
CY	12%				22%	539%	112%	29%	26%	19%								80%	189%		225%			76%	CY	Cyprus	720%
CZ	12%	44%	15%	6%	48%	301%	33%	45%	26%	40%	157%	111%	188%	71%		420%		144%	131%	99%	225%			194%	CZ	Czechia	700%
DE	12%	39%	15%	8%	89%	312%	43%	29%	26%	20%	240%	369%	376%	185%		376%		80%	78%	192%	114%			75%	DE	Germany	680%
DK	13%	39%	15%	6%	90%	238%	28%	29%	26%	17%	86%	111%	331%	201%		420%		105%	84%	48%	56%			112%	DK	Denmark	660%
EE	13%	39%	15%	23%	60%	204%	28%	29%		17%	127%	444%	218%	170%				199%	67%	61%	56%			194%	EE	Estonia	640%
ES	25%	49%	21%	23%	82%	539%	60%	32%	30%	44%	295%	444%	427%	285%		420%		124%	148%	90%	225%			194%	ES	Spain	620%
FI	20%	39%	20%		58%	271%	62%	39%	26%	29%	178%	277%	427%	254%		401%		174%	125%	102%	75%			189%	FI	Finland	600%
FR	12%	42%	15%	6%	69%	139%	86%	30%	26%	61%	343%	444%	355%	219%		293%		169%	126%	161%	177%			101%	FR	France	580%
GR	34%	39%	52%	23%	90%	443%	37%	75%	55%	68%	343%	444%	427%	285%				127%	153%	52%	56%			194%	GR	Greece	560%
HR	20%	39%	15%	6%	27%	539%	28%	29%	26%	17%	86%	249%	427%	285%				90%	74%	192%	56%			148%	HR	Croatia	540%
HU	24%	39%	53%	22%	23%	539%	28%	31%	26%	39%	86%	111%	107%	71%		420%		104%	138%	96%	89%			194%	HU	Hungary	520%
IE	36%	39%	23%		58%	135%	60%	29%	38%	68%								126%	173%	121%	56%			92%	IE	Ireland	500%
IL																									IL	Israel	480%
IN					58%	355%					86%	111%	111%	71%						144%	56%			49%	IN	India	460%
IS	12%	39%	15%	23%	90%	161%	87%	29%	26%	57%								80%	268%	192%	56%			194%	IS	Iceland	440%
IT	17%	74%	24%	6%	80%	188%	73%	42%	26%	43%	343%	393%	265%	181%		339%		138%	127%	192%	225%			181%	IT	Italy	420%
JP	20%	84%	15%	7%	90%	432%	66%	64%	26%	17%	151%	443%	331%	285%		272%		80%	97%	180%	56%			53%	JP	Japan	400%
KR	19%	39%	15%	14%	63%	204%	35%	29%	26%	20%	107%	267%	427%	285%		105%		80%	72%	123%	56%			49%	KR	South Korea	380%
LT	19%	39%	15%	6%	90%	135%	28%	29%	26%	40%	343%	185%	427%	71%				318%	111%	148%	56%			194%	LT	Lithuania	360%
LU					90%	539%			91%	68%		444%	427%					318%	268%	79%	225%			49%	LU	Luxembourg	340%
LV	25%	110%	20%		90%	539%	96%	116%		26%	343%	111%	214%	76%				209%	207%	192%	225%	63%	427%	103%	LV	Latvia	320%
MT	21%	39%			22%	153%	58%	29%		17%	86%							80%	194%	176%	56%			169%	MT	Malta	300%
MX																									MX	Mexico	280%
NL	35%	39%	15%	23%	57%	208%	62%	29%	57%	22%	343%	111%	295%	285%		420%		318%	248%	64%	59%			130%	NL	Netherlands	260%
NO	27%	76%	36%		87%	135%	81%	29%	46%	68%	343%	234%	427%	285%				120%	143%	148%	56%			194%	NO	Norway	240%
PL	18%	73%	23%	13%	90%	484%	38%	29%	60%	68%	86%	410%	427%	71%		420%		123%	133%	150%	201%			194%	PL	Poland	220%
PT	46%	39%	59%	11%	86%	539%	111%	103%	49%	56%	343%	444%	193%	100%				158%	135%	48%	114%			194%	PT	Portugal	200%
RO	12%	39%	15%	6%	31%	539%	28%	29%	105%	30%	86%	111%	107%					80%	67%	192%	114%	37%	427%	49%	RO	Romania	180%
RU					90%	135%					343%	444%		285%						123%	225%			49%	RU	Russia	160%
SE	12%	39%	15%		61%	220%	28%	29%	34%	30%	86%	111%	427%	71%				135%	103%	132%	225%			189%	SE	Sweden	140%
SG																									SG	Singapore	120%
SI	20%	46%	19%		58%	477%	34%	29%	26%	21%	86%	111%	427%	71%		295%		177%	81%	54%	225%			136%	SI	Slovenia	100%
SK	13%	39%	42%	23%	45%	344%	112%	29%	26%	45%	86%	212%	216%	71%				298%	176%	95%	225%	37%	427%	194%	SK	Slovakia	80%
TW					22%	155%					117%	112%	164%	170%						48%	56%			76%	TW	Taiwan	60%
UK	14%	39%	15%	14%	52%	135%	28%	29%	29%	68%	146%	182%	203%	190%		176%		80%	132%	192%	225%			130%	UK	United Kingdom	40%
US	12%	39%	42%	6%	37%	539%	28%	29%	26%	17%	343%	444%	427%	285%		158%		80%	80%	75%	165%	37%	427%	70%	US	U.S.A.	20%
45C	23%	78%	30%	11%	45%	269%	56%	58%	52%	34%	171%	222%	214%	143%		210%		159%	134%	96%	113%	74%	855%	97%	45C	WORLD	0%

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Table 5: "R&D patent costs" profiles across countries

	Food products, beverages, tobacco	Textiles, apparel, leather	Wood, paper, printing	Coke & refined petroleum	Chemicals & chemical products	Basic pharmaceutical products	Rubber & plastic products	Other non-metallic minerals	Basic metals	Fabricated metal products (excl. machinery)	Electronic components & boards	Computers & peripherals	Communication equipment	Consumer electronics	Measuring & testing instruments; watches & clocks	Irradiation & electrotherapeutic equipment	Optical instruments & photographic equipment	Electrical equipment	Machinery & equipment n.e.c.	Motor vehicles & trailers	Other transport equipment	Furniture	Other manufacturing	Computer programming & consultancy			
	C10_C12	C13_C15	C16_C18	C19	C20	C21	C22	C23	C24	C25	C261	C262	C263	C264	C265	C266	C267	C27	C28	C29	C30	C31	C32	J62			
AT	92%	132%	189%		72%	141%	103%	129%	281%	73%	222%	19%	24%	174%	28%	331%	40%	94%	92%	185%	223%	33%	30%	673%	AT	Austria	900%
AU	344%	132%	382%	932%	81%	101%	148%	168%	416%	149%	228%	19%	39%				26%	34%	36%	331%	223%	33%	30%	673%	AU	Australia	880%
BE	135%	208%	189%	322%	45%	379%	100%	73%	315%	71%	57%	29%	50%	174%	24%	103%	15%	54%	30%	170%	223%	61%	30%	673%	BE	Belgium	860%
BG	92%	253%	189%		53%	101%	118%	51%	751%	86%	228%	19%	69%	208%	24%	147%	58%	27%	35%	170%	223%		30%	673%	BG	Bulgaria	840%
BR					131%	230%					73%	33%	96%	698%						452%	894%			416%	BR	Brazil	820%
CA	96%	132%	756%	233%	62%	101%	197%	55%	399%	180%	89%	19%	29%	174%	62%			61%	46%	170%	608%	44%	30%	673%	CA	Canada	800%
CH	92%				74%	404%			890%		228%				77%						99%				CH	Switzerland	780%
CL	367%	132%	756%		120%	187%	154%	81%	223%	189%								30%	25%	170%	223%	83%	30%	673%	CL	Chile	760%
CN	358%	528%	756%	932%	164%	101%	296%	205%	890%	240%	73%	19%	42%	367%				93%	66%	268%	340%	134%	119%	168%	CN	China	740%
CY					45%	228%			223%			75%			24%			23%	25%		223%		30%	632%	CY	Cyprus	720%
CZ	92%	132%	189%	233%	45%	101%	168%	59%	223%	88%	57%	19%	24%	174%	53%	83%	36%	92%	46%	447%	233%	33%	30%	673%	CZ	Czechia	700%
DE	92%	132%	189%	237%	103%	251%	91%	51%	223%	60%	74%	23%	24%	174%	59%	331%	58%	34%	47%	451%	223%	33%	30%	554%	DE	Germany	680%
DK	92%	132%	189%	233%	175%	343%	74%	51%	223%	60%	57%	19%	24%	469%	97%	331%	58%	44%	57%	170%	223%	66%	33%	673%	DK	Denmark	660%
EE	218%	163%		274%	45%	101%	74%	140%		60%	228%	28%	96%		24%			94%	25%	170%	223%	33%	30%	673%	EE	Estonia	640%
ES	299%	139%	242%	932%	92%	166%	79%	88%	276%	116%	63%	19%	24%	195%	24%	83%	17%	40%	27%	339%	506%	33%	30%	673%	ES	Spain	620%
FI	187%	132%	189%		66%	186%	173%	82%	223%	126%	57%	19%	96%	174%	84%	331%	15%	94%	78%	170%	223%	82%	30%	673%	FI	Finland	600%
FR	198%	197%	189%	233%	62%	101%	134%	51%	223%	179%	184%	19%	45%	174%	97%	198%	18%	46%	34%	192%	478%	33%	30%	673%	FR	France	580%
GR	367%	337%	344%		109%	129%	146%	97%	890%	240%	104%	19%	24%		33%			75%	25%	170%	223%	39%	30%	673%	GR	Greece	560%
HR	367%	132%	189%		45%	101%			223%	113%	57%	28%	96%	353%	24%	83%		40%	25%	206%	223%	33%	30%	673%	HR	Croatia	540%
HU	325%	132%	706%	932%	45%	309%	194%	156%	317%	78%	70%	19%	24%	174%	24%	93%	58%	50%	52%	217%	223%	106%	30%	673%	HU	Hungary	520%
IE	271%	132%	189%		134%	238%	74%	53%	501%	198%	186%	56%	24%	174%	24%	313%	58%	23%	25%	170%	223%	58%	53%	673%	IE	Ireland	500%
IL	92%	132%	189%		45%	101%	74%		434%		101%	19%	75%	174%	87%	312%	41%	94%		170%			30%	673%	IL	Israel	480%
IN					176%	316%					57%	19%	25%	174%						680%	223%			168%	IN	India	460%
IS	112%				45%	101%						19%			28%			23%	98%	170%	223%	33%	56%	673%	IS	Iceland	440%
IT	154%	350%	277%	233%	78%	101%	98%	79%	223%	127%	205%	26%	33%	174%	25%	322%	15%	55%	59%	278%	519%	86%	30%	673%	IT	Italy	420%
JP	189%	313%	213%	848%	86%	342%	187%	75%	223%	60%	76%	39%	32%	698%	30%	209%	58%	28%	60%	534%	223%	69%	30%	168%	JP	Japan	400%
KR	104%	206%	244%	932%	84%	101%	227%	51%	223%	135%	112%	19%	96%	698%	29%	83%	15%	32%	46%	324%	236%	54%	30%	168%	KR	South Korea	380%
LT	121%	132%			176%	101%	106%	51%		61%	105%	19%	24%		97%	83%	58%	94%	25%	170%	223%		30%	673%	LT	Lithuania	360%
LU					135%	101%			506%	240%		19%	54%					94%	100%	170%	429%		30%	215%	LU	Luxembourg	340%
LV	367%	526%			45%	111%	77%	205%		125%	228%	19%	96%		97%			94%	25%	284%	223%		30%	653%	LV	Latvia	320%
MT					45%	184%		51%		60%	228%		24%					23%	25%	339%	223%		30%	673%	MT	Malta	300%
MX	214%	176%	282%	233%	45%	101%	140%	205%	223%	206%	57%	75%	39%		24%			94%	25%	473%	236%	33%	30%	463%	MX	Mexico	280%
NL	206%	132%	252%	777%	96%	101%	100%	51%	496%	109%	121%	19%	24%	174%	55%	221%	15%	94%	100%	170%	223%	49%	30%	673%	NL	Netherlands	260%
NO	367%	293%	756%		148%	101%	202%	153%	322%	240%	221%	19%	50%	174%	76%	209%	15%	41%	25%	170%	223%	134%	30%	673%	NO	Norway	240%
PL	233%	528%	368%	718%	88%	101%	205%	85%	371%	216%	57%	19%	51%	174%	31%	83%	21%	86%	25%	313%	223%	134%	30%	673%	PL	Poland	220%
PT	367%	453%	756%	449%	52%	119%	258%	205%	283%	240%	64%	19%	24%	668%	24%		15%	62%	26%	170%	223%	134%	30%	673%	PT	Portugal	200%
RO	92%	132%	189%		45%	266%	74%	51%	890%	88%	57%	19%	24%		24%	83%	15%	64%	25%	680%	223%	33%	30%	168%	RO	Romania	180%
RU					142%	101%					228%	75%	96%	477%						321%	765%			168%	RU	Russia	160%
SE	92%	132%	189%		83%	205%	101%	51%	308%	82%	57%	19%	24%	174%				69%	66%	300%	894%	33%	30%	673%	SE	Sweden	140%
SG	92%	132%	189%	233%	180%	101%	74%	51%	223%	214%	228%	52%	24%	252%	35%	331%	58%	23%	75%	170%	845%	46%	46%	168%	SG	Singapore	120%
SI	153%	212%	404%		45%	315%	290%	77%	354%	60%	57%	19%	82%	174%	37%	106%	58%	76%	29%	297%	223%	33%	30%	673%	SI	Slovenia	100%
SK	92%	132%		294%	45%	101%	296%	51%	223%	127%	57%	19%	24%		24%			94%	46%	493%	223%	33%	30%	673%	SK	Slovakia	80%
TW	234%	305%	202%	932%	113%	101%	170%	51%	464%	60%	211%	75%	47%	174%	26%	83%	39%	25%	26%	170%	223%	33%	30%	282%	TW	Taiwan	60%
UK	92%	132%	211%	366%	56%	101%	95%	103%	267%	223%	57%	19%	24%	174%	95%	83%	20%	24%	53%	680%	515%	134%	30%	673%	UK	United Kingdom	40%
US	181%	132%	277%	233%	61%	186%	89%	51%	223%	68%	228%	73%	33%	174%	80%	132%		29%	37%	267%	761%	41%	49%	252%	US	U.S.A.	20%
45C	184%	264%	378%	466%	90%	202%	148%	103%	445%	120%	114%	38%	48%	349%	48%	165%	29%	47%	50%	340%	447%	67%	60%	337%	45C	WORLD	0%

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Table 6: For each of the 45 countries in the dataset, list of the 5 best correlated countries in terms of relative sectoral R&D patent costs for the year 2018

	Austria	Australia	Belgium	Bulgaria	Brazil	Canada	Switzerland	Chile	China	Cyprus	Czechia	Germany	Denmark	Estonia	Spain	Finland	France	Greece	Croatia	Hungary	Ireland	Israel
	AT	AU	BE	BG	BR	CA	CH	CL	CN	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HR	HU	IE	IL	.../...
1°)	59%NL	41%NO	44%SI	36%EE	24%KR	34%FR	15%BE	54%NO	27%PL	26%TW	69%SK	72%DK	72%DE	36%BG	40%AU	46%NL	34%IL	32%PL	35%EE	42%SI	44%SG	37%NL	
2°)	40%IT	40%ES	31%HU	30%TW	15%JP	21%CZ	10%CZ	35%HU	20%NO	26%IE	37%SI	36%JP	44%LT	35%HR	37%SE	27%FR	34%CA	24%IE	27%SI	35%CL	34%TW	34%FR	
3°)	30%EE	23%HR	22%DK	08%AU	09%SG	18%NO	09%JP	26%IE	06%KR	20%BE	31%UK	30%SE	27%JP	30%AT	27%HU	20%DK	31%US	23%NO	26%ES	33%PT	29%DE	29%EE	
4°)	24%DE	20%HU	20%CY	07%IT	06%ES	14%UK	09%DE	17%ES	06%HU	15%JP	28%SE	30%IN	26%IE	29%IL	26%HR	19%CZ	30%IT	19%ES	24%KR	31%BE	26%DK	20%CZ	
5°)	21%CZ	16%FR	19%FI	00%SG	05%UK	13%IL	05%UK	08%FR	03%SG	11%HU	27%LT	29%IE	24%SG	17%FI	19%GR	19%BE	27%UK	17%BG	23%LV	27%ES	22%US	17%DK	

	India	Iceland	Italy	Japan	South Korea	Lithuania	Luxembourg	Latvia	Malta	Mexico	Netherlands	Norway	Poland	Portugal	Romania	Russia	Sweden	Singapore	Slovenia	Slovakia	Taiwan	United Kingdom	U.S.A.
	IN	IS	IT	JP	KR	LT	LU	LV	MT	MX	NL	NO	PL	PT	RO	RU	SE	SG	SI	SK	TW	UK	US
1°)	30%DE	27%BG	40%AT	47%KR	47%JP	44%DK	27%NL	24%PL	32%BG	24%CZ	59%AT	52%PT	57%PT	57%PL	32%JP	27%SG	37%ES	52%US	44%BE	69%CZ	38%US	31%CZ	52%SG
2°)	22%JP	27%AT	32%SG	36%DE	24%HR	27%CZ	23%SG	19%FR	28%CY	07%UK	46%FI	43%PL	43%NO	52%NO	26%IN	26%TW	30%DE	44%IE	42%HU	41%SI	34%IE	27%FR	38%TW
3°)	13%DK	24%NL	30%FR	32%RO	24%BR	20%IL	16%KR	10%IT	22%IT	05%PL	37%IL	41%AU	32%GR	33%HU	19%CZ	18%KR	28%CZ	32%IT	41%SK	18%PL	30%BG	19%SE	31%FR
4°)	12%UK	15%IT	25%SE	27%DK	23%TW	19%NL	06%PL		18%US	03%TW	27%LU	26%FR	27%CN	13%KR	18%UK	02%JP	27%SG	27%SE	37%CZ	14%FI	26%RU	19%PL	22%IE
5°)	08%ES	11%FI	22%MT	22%TW	18%RU	19%DE	04%PT		17%TW		24%SE	20%CN	24%LV	13%IT	18%BE	01%IT	25%IT	27%RU	27%HR	12%RO	26%CY	18%RO	13%DE

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Table 7: Illustration of the results for R&D data "reconstruction" for ten countries and the year 2018

U.S.A.

Model Aggr.	Σ "Err(Sect.)"	RANK	BEST
US	0,0%		
World (45C)	35,5%	2	
52%SG	42,7%	5	
38%TW	41,9%	4	
31%FR	45,5%	6	
22%IE	47,4%	7	
13%DE	53,4%	8	
AVRG.5C	**31,2%**	**1**	**X**
AGGR.5C	39,7%	3	
AVG :	37%		

China

Model Aggr.	Σ "Err(Sect.)"	RANK	BEST
US	79,1%	8	
World (45C)	56,3%	3	
27%PL	**51,4%**	**1**	**X**
20%NO	64,7%	6	
06%KR	62,1%	4	
06%HU	64,3%	5	
03%SG	70,1%	7	
AVRG.5C	54,9%	2	
AGGR.5C	87,9%	9	
AVG :	66%		

Japan

Model Aggr.	Σ "Err(Sect.)"	RANK	BEST
US	67,7%	8	
World (45C)	47,5%	5	
47%KR	44,5%	4	
36%DE	**38,9%**	**1**	**X**
32%RO	48,5%	6	
27%DK	62,4%	7	
22%TW	68,8%	9	
AVRG.5C	43,5%	3	
AGGR.5C	40,8%	2	
AVG :	51%		

Germany

Model Aggr.	Σ "Err(Sect.)"	RANK	BEST
US	57,1%	8	
World (45C)	43,2%	4	
72%DK	49,8%	6	
36%JP	36,5%	3	
30%SE	50,3%	7	
30%IN	48,9%	5	
29%IE	59,6%	9	
AVRG.5C	**28,2%**	**1**	**X**
AGGR.5C	30,6%	2	
AVG :	45%		

South Korea

Model Aggr.	Σ "Err(Sect.)"	RANK	BEST
US	88,8%	9	
World (45C)	67,3%	2	
47%JP	80,4%	6	
24%HR	72,7%	3	
24%BR	80,6%	7	
23%TW	81,9%	8	
18%RU	77,0%	5	
AVRG.5C	**61,4%**	**1**	**X**
AGGR.5C	73,6%	4	
AVG :	76%		

France

Model Aggr.	Σ "Err(Sect.)"	RANK	BEST
US	52,2%	6	
World (45C)	55,4%	8	
34%IL	42,2%	4	
34%CA	**36,1%**	**1**	**X**
31%US	52,2%	6	
30%IT	38,5%	2	
27%UK	67,2%	9	
AVRG.5C	39,7%	3	
AGGR.5C	46,2%	5	
AVG :	48%		

United Kingdom

Model Aggr.	Σ "Err(Sect.)"	RANK	BEST
US	83,4%	9	
World (45C)	76,7%	8	
31%CZ	**51,1%**	**1**	**X**
27%FR	57,9%	4	
19%SE	69,9%	5	
19%PL	72,0%	7	
18%RO	71,2%	6	
AVRG.5C	57,7%	3	
AGGR.5C	57,2%	2	
AVG :	66%		

Taiwan

Model Aggr.	Σ "Err(Sect.)"	RANK	BEST
US	36,2%	3	
World (45C)	63,4%	9	
38%US	36,2%	3	
34%IE	37,5%	5	
30%BG	34,7%	2	
26%RU	37,6%	6	
26%CY	52,0%	8	
AVRG.5C	**29,8%**	**1**	**X**
AGGR.5C	38,3%	7	
AVG :	41%		

Italy

Model Aggr.	Σ "Err(Sect.)"	RANK	BEST
US	47,0%	7	
World (45C)	40,0%	5	
40%AT	44,2%	6	
32%SG	52,7%	9	
30%FR	32,5%	3	
25%SE	39,6%	4	
22%MT	47,0%	8	
AVRG.5C	**21,7%**	**1**	**X**
AGGR.5C	24,8%	2	
AVG :	39%		

Israel

Model Aggr.	Σ "Err(Sect.)"	RANK	BEST
US	133,0%	8	
World (45C)	132,1%	7	
37%NL	98,7%	3	
34%FR	97,5%	2	
29%EE	102,7%	5	
20%CZ	101,5%	4	
17%DK	141,1%	9	
AVRG.5C	105,1%	6	
AGGR.5C	**80,8%**	**1**	**X**
AVG :	110%		

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Table 8: Worldwide R&D data reconstruction accuracy: Patent cost versus R&D intensity

"Patent Cost" Method	2018-Based Model Selection Frozen	
YEAR	AVG	MAX
2000	69,5%	157%
2005	70,3%	158%
2010	63,5%	145%
2015	53,5%	92%
2018	50,2%	94%
ERR Avg / Max :	61,4%	129%

"R&D Intensity" Method	2018-Based Model Selection Frozen	
YEAR	AVG	MAX
2000	107,6%	1320%
2005	72,5%	386%
2010	59,4%	140%
2015	49,8%	125%
2018	43,7%	107%
ERR Avg / Max :	66,6%	416%

"Patent Cost" Method: R&D reconstruction scenario based on correlation analysis of 'Patent Cost Profiles' across different sectors observed in the 45 countries.

"R&D Intensity" Method: R&D reconstruction scenario based on correlation analysis of observed 'R&D Intensity Profiles' across different countries.

2018-Based Model Selection Frozen: Simulation framework where the selection of reference countries (best-correlated patent cost profiles) is established on 2018 data and kept unchanged for reconstructing R&D levels in all target years (2000, 2005, 2010, 2015, and 2018). This approach reduces reconstruction accuracy for earlier years but improves cross-year consistency.

AVG: Average relative error in total R&D reconstruction across the 45 target countries ("World" aggregate), computed for each simulation year.

MAX: Maximum relative error observed among the 45 target countries in each simulation year (worst case scenario).

ERR avg: Mean relative error across all simulation years, aggregated at the "World" level.

ERR Max: Maximum relative error observed across all simulation years and all countries (global worst case).

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Table 9: Patent and R&D data breakdown around 37 digital and green technologies

Old Digital (Jtag, ICT…)	New Digital (WIPO, 4IR)	Green (EPO's Y02-Y04S Scheme)
JTag_1: High speed network	AI_ML: Artificial intelligence and/or Machine Learning	Y02A: Technologies For Adaptation To Climate Change
JTag_2: Mobile communication	AutonmSys: Autonomous Systems	Y02B: Climate Change Mitigation Technologies Related To Buildings
JTag_3: Security	BigData: Big Data	Y02C: Capture, Storage, Sequestration Or Disposal Of Greenhouse Gases
JTag_4: Sensor and device network	CloudComp: Cloud Computing	Y02D: Climate Change Mitigation In I.C.T.
JTag_5: High speed computing	IoT: Internet of Things	Y02E: Climate Change Mitigation Technologies Related To Energy
JTag_6: Large-capacity and high-speed storage	Quantum: Quantum (computing, sensors, clocks)	Y02P: Climate Change Mitigation Technologies In The Production Of Goods
JTag_7: Large-capacity information analysis	Robots: Robotics	Y02T: Climate Change Mitigation Technologies Related To Transportation
JTag_8: Cognition and meaning understanding	SmartCities: Smart City Technologies	Y02W: Climate Change Mitigation in Waste Management and Wastewater Treatment
JTag_9: Human-interface	Blockchain: Blockchain Technologies	Y04S: Power network operation, smart grid integration, and energy efficiency
JTag_10: Imaging and sound technology	Virt_Aug_Reality: Virtual/Augmented Reality	EvT_1_1: Environmental Management - Air Pollution Abatement
JTag_11: Information communication device		EvT_1_2: Environmental Management - Water Pollution Abatement
JTag_12: Electronic measurement		EvT_1_3: Environmental Management - Waste Management
JTag_13: Others (Computer input-output and others)		EvT_1_4: Environmental Management - Soil Remediation
		EvT_1_5: Environmental Management - Environmental Monitoring

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Table 10: Patent contribution of every NACE sector at world level in 2021 to the different digital and in green technologies

PATENT by TECHNO -->	C10_C12	C13_C15	C16_C18	C19	C20	C21	C22	C23	C24	C25	C261	C262	C263	C264	C265	C266	C267	C268	C27	C28	C29	C30	C31	C32	J62	TOTAL
AGR_Green	0,8%	0,2%	0,2%	0,7%	13,9%	3,9%	1,5%	1,9%	1,7%	1,5%	2,7%	1,8%	3,5%	0,1%	3,4%	0,1%	0,1%	0,0%	29,2%	20,2%	8,6%	1,6%	0,0%	1,9%	0,5%	100%
AGR_JTag	0,0%	0,0%	0,0%	0,0%	0,9%	0,2%	0,1%	0,3%	0,0%	0,2%	15,3%	21,4%	33,2%	1,2%	5,3%	0,1%	2,6%	0,0%	3,1%	7,3%	1,4%	0,2%	0,0%	2,7%	4,3%	100%
AGR_WIPO_Digtl	0,1%	0,0%	0,0%	0,0%	0,4%	0,7%	0,3%	0,1%	0,0%	0,2%	1,3%	34,1%	7,9%	0,1%	7,4%	0,4%	0,4%	0,0%	3,2%	17,5%	8,5%	1,2%	0,0%	12,6%	3,6%	100%
Digtl_AI_ML	0,1%	0,0%	0,0%	0,0%	0,2%	1,0%	0,2%	0,0%	0,1%	0,2%	0,9%	50,1%	7,3%	0,1%	9,1%	0,5%	0,3%	0,0%	1,9%	10,7%	2,8%	0,3%	0,0%	10,6%	3,6%	100%
Digtl_AugReality	0,0%	0,1%	0,0%	0,0%	0,1%	0,1%	0,0%	0,0%	0,0%	0,4%	0,1%	51,1%	7,3%	0,0%	2,4%	0,1%	6,1%	0,0%	0,9%	3,2%	0,9%	0,3%	0,0%	24,3%	2,7%	100%
Digtl_AutSys	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,8%	0,2%	3,0%	2,5%	0,0%	7,6%	0,0%	0,1%	0,0%	6,0%	19,8%	48,8%	7,6%	0,0%	2,2%	1,2%	100%
Digtl_BigData	0,0%	0,0%	0,0%	0,1%	0,3%	12,0%	0,0%	0,0%	0,0%	0,0%	1,3%	58,0%	4,0%	0,1%	7,8%	0,1%	0,1%	0,0%	1,0%	4,0%	3,2%	0,0%	0,0%	1,9%	6,2%	100%
Digtl_BlockCh	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,3%	0,0%	0,0%	0,0%	0,1%	28,3%	35,9%	0,0%	0,4%	0,0%	0,0%	0,0%	0,2%	1,4%	0,1%	0,0%	0,0%	0,9%	32,3%	100%
Digtl_CloudComp	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,5%	70,6%	14,0%	0,0%	1,6%	0,0%	0,1%	0,0%	0,8%	3,4%	0,6%	0,1%	0,0%	1,4%	6,7%	100%
Digtl_IoT	0,4%	0,0%	0,0%	0,0%	0,4%	0,1%	0,0%	0,1%	0,0%	0,1%	0,2%	10,9%	41,2%	0,0%	9,1%	0,2%	0,0%	0,0%	10,1%	6,8%	6,2%	0,7%	0,2%	4,0%	9,1%	100%
Digtl_Quantum	0,0%	0,0%	0,1%	0,0%	9,3%	0,6%	0,1%	0,3%	0,0%	0,0%	19,2%	39,2%	17,1%	1,1%	7,3%	0,8%	1,6%	0,0%	1,4%	0,6%	0,0%	0,0%	0,0%	0,6%	0,5%	100%
Digtl_Robots	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%	0,9%	0,1%	0,0%	0,2%	1,1%	2,2%	0,4%	0,0%	5,7%	0,6%	0,2%	0,0%	4,9%	47,3%	2,3%	0,4%	0,0%	32,9%	0,4%	100%
Digtl_SmartCities	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,5%	7,9%	66,8%	0,2%	9,1%	0,0%	0,0%	0,0%	10,5%	2,0%	0,5%	0,0%	0,0%	0,6%	1,9%	100%
Green_EvT1	0,1%	0,3%	0,0%	1,0%	11,5%	0,4%	0,2%	0,9%	0,5%	0,5%	0,7%	0,2%	0,1%	0,0%	2,3%	0,1%	0,0%	0,0%	3,0%	47,1%	27,9%	0,9%	0,0%	2,3%	0,0%	100%
Green_EvT2	0,6%	0,1%	0,2%	0,6%	59,9%	1,7%	0,6%	1,0%	0,5%	0,3%	0,4%	0,1%	0,1%	0,0%	2,3%	0,1%	0,1%	0,0%	2,6%	24,0%	0,3%	0,9%	0,0%	3,5%	0,1%	100%
Green_EvT3	3,9%	0,6%	2,0%	4,5%	33,4%	2,4%	5,6%	7,3%	6,7%	0,7%	0,2%	0,1%	0,0%	0,0%	0,7%	0,0%	0,0%	0,0%	4,8%	21,0%	0,7%	1,8%	0,1%	3,3%	0,2%	100%
Green_EvT4	0,1%	0,0%	0,1%	0,4%	79,2%	6,9%	0,0%	0,8%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	1,5%	0,0%	0,0%	0,0%	0,0%	10,3%	0,0%	0,1%	0,0%	0,6%	0,0%	100%
Green_EvT5	0,0%	0,0%	0,0%	0,0%	0,6%	0,2%	0,0%	0,1%	0,0%	0,9%	0,3%	1,0%	13,5%	0,1%	12,7%	0,0%	0,0%	0,0%	1,9%	53,4%	12,7%	0,9%	0,0%	0,4%	1,3%	100%
Green_Y02A	3,5%	0,2%	0,1%	0,0%	10,8%	36,6%	0,3%	1,0%	0,1%	0,6%	0,5%	1,6%	0,6%	0,0%	8,2%	0,3%	0,2%	0,0%	2,9%	24,7%	1,1%	1,1%	0,1%	4,5%	0,9%	100%
Green_Y02B	0,3%	0,0%	0,0%	0,0%	1,2%	0,0%	0,1%	0,6%	0,1%	0,7%	2,8%	0,5%	0,7%	0,8%	1,9%	0,2%	0,3%	0,0%	49,5%	37,3%	1,2%	0,2%	0,1%	1,4%	0,2%	100%
Green_Y02C	0,0%	0,5%	0,0%	1,7%	33,7%	0,4%	0,2%	1,6%	1,3%	0,0%	0,4%	0,2%	0,0%	0,0%	1,0%	0,2%	0,0%	0,0%	0,5%	56,7%	0,2%	0,1%	0,0%	1,1%	0,0%	100%
Green_Y02D	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	6,7%	21,4%	62,7%	1,4%	1,9%	0,0%	0,2%	0,0%	1,3%	3,1%	0,1%	0,0%	0,0%	0,6%	0,3%	100%
Green_Y02E	0,4%	0,1%	0,1%	0,3%	10,7%	1,7%	0,7%	0,8%	0,4%	1,9%	4,0%	0,5%	0,2%	0,0%	3,6%	0,1%	0,1%	0,0%	57,9%	12,8%	1,6%	0,9%	0,0%	1,2%	0,1%	100%
Green_Y02P	1,7%	0,3%	0,1%	1,6%	15,2%	5,8%	2,8%	3,1%	9,0%	5,0%	4,8%	2,0%	0,6%	0,0%	5,2%	0,0%	0,1%	0,0%	17,8%	21,4%	0,3%	0,1%	0,0%	0,9%	2,2%	100%
Green_Y02T	0,0%	0,0%	0,0%	0,0%	2,9%	0,0%	3,0%	0,4%	0,4%	0,5%	1,3%	0,9%	0,3%	0,0%	2,4%	0,0%	0,0%	0,0%	22,7%	16,4%	40,6%	7,2%	0,0%	0,4%	0,5%	100%
Green_Y02W	0,6%	0,7%	2,0%	0,8%	37,4%	1,4%	5,1%	17,7%	2,4%	0,2%	0,2%	0,2%	0,0%	0,0%	1,3%	0,0%	0,0%	0,0%	4,9%	14,2%	0,3%	0,1%	0,1%	9,7%	0,7%	100%
Green_Y04S	0,0%	0,0%	0,0%	0,0%	0,2%	0,0%	0,0%	0,0%	0,0%	0,1%	0,4%	9,6%	5,9%	0,1%	15,6%	0,1%	0,0%	0,0%	42,4%	3,7%	9,0%	0,5%	0,0%	0,2%	12,1%	100%
JTag_1	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	1,5%	5,7%	75,9%	6,4%	3,2%	0,1%	0,5%	0,0%	3,1%	1,2%	0,8%	0,1%	0,0%	0,6%	0,8%	100%
JTag_2	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	1,0%	94,8%	0,0%	1,3%	0,0%	0,0%	0,0%	0,7%	0,6%	0,6%	0,1%	0,0%	0,3%	0,4%	100%
JTag_3	0,1%	0,0%	0,2%	0,0%	0,1%	0,1%	0,1%	0,1%	0,0%	0,3%	0,9%	36,1%	38,8%	0,1%	1,2%	0,0%	0,1%	0,0%	0,6%	6,8%	0,8%	0,1%	0,0%	1,2%	12,3%	100%
JTag_4	0,5%	0,1%	0,0%	0,0%	0,3%	0,1%	0,1%	0,1%	0,0%	0,8%	1,1%	3,3%	36,5%	0,4%	14,7%	0,1%	0,5%	0,0%	22,4%	7,1%	5,8%	0,9%	0,3%	3,2%	1,9%	100%
JTag_5	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,8%	80,9%	7,4%	0,4%	2,5%	0,1%	0,1%	0,0%	0,9%	1,5%	1,1%	0,0%	0,0%	0,7%	1,5%	100%
JTag_6	0,0%	0,0%	0,1%	0,0%	0,3%	0,1%	0,1%	0,1%	0,0%	0,0%	41,7%	36,6%	3,0%	0,8%	1,5%	0,0%	0,3%	0,0%	0,7%	13,2%	0,1%	0,0%	0,0%	0,7%	0,6%	100%
JTag_7	0,1%	0,0%	0,0%	0,0%	0,2%	0,1%	0,1%	0,0%	0,0%	0,2%	0,2%	15,3%	4,0%	0,0%	5,6%	0,0%	0,1%	0,0%	10,0%	6,9%	6,7%	1,1%	0,1%	2,2%	47,0%	100%
JTag_8	0,0%	0,0%	0,0%	0,0%	0,1%	0,2%	0,1%	0,1%	0,0%	0,2%	0,8%	50,7%	5,4%	0,0%	7,4%	0,2%	1,0%	0,0%	1,2%	20,8%	2,1%	0,2%	0,0%	7,9%	1,5%	100%
JTag_9	0,1%	0,1%	0,0%	0,0%	0,4%	0,0%	0,1%	0,5%	0,0%	0,2%	2,6%	53,3%	14,8%	0,2%	2,9%	0,1%	2,0%	0,0%	4,0%	5,6%	3,1%	0,3%	0,1%	8,1%	1,5%	100%
JTag_10	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,1%	0,1%	0,0%	0,1%	2,4%	19,4%	44,9%	0,1%	2,3%	0,1%	5,5%	0,0%	2,0%	17,3%	1,2%	0,1%	0,0%	3,7%	0,5%	100%
JTag_11	0,0%	0,0%	0,0%	0,0%	3,4%	0,5%	0,3%	0,8%	0,1%	0,3%	52,4%	6,1%	11,5%	1,9%	2,8%	0,2%	6,4%	0,0%	3,9%	5,8%	0,3%	0,1%	0,0%	3,1%	0,0%	100%
JTag_12	0,0%	0,0%	0,0%	0,0%	0,2%	0,0%	0,2%	0,1%	0,0%	0,5%	1,0%	2,5%	8,7%	0,2%	69,5%	0,1%	2,1%	0,0%	2,4%	5,3%	3,8%	0,9%	0,0%	2,1%	0,3%	100%
JTag_13	0,1%	0,0%	0,0%	0,0%	0,2%	0,2%	0,1%	0,2%	0,0%	0,2%	5,4%	61,1%	6,9%	0,6%	4,0%	0,1%	0,6%	0,0%	2,8%	9,0%	1,2%	0,1%	0,1%	4,3%	2,5%	100%
OTHERS	2,7%	0,8%	0,4%	0,1%	8,8%	13,2%	1,9%	1,8%	0,8%	2,2%	3,3%	1,0%	0,2%	0,0%	7,0%	0,8%	1,7%	0,0%	11,4%	20,7%	5,4%	1,9%	0,7%	13,1%	0,0%	100%
TECH_ALL	1%	0%	0%	0%	6%	7%	1%	1%	1%	1%	7%	10%	13%	0%	6%	0%	2%	0%	10%	16%	4%	1%	0%	8%	2%	100%

Reading:

This table illustrates, at the world level for the year 2021, the *patent* contribution in percentage, of every NACE sector, in column, to every technology, in row.

The table displays also, the *patent* contribution of each NACE sector to the category "OTHERS", that regroups all patent families not identified as green or digital in table 9.

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Table 11: Composition of the patent portfolio of every NACE sector at the world level in 2021

PATENT by TECHNO --v	C10_C12	C13_C15	C16_C18	C19	C20	C21	C22	C23	C24	C25	C261	C262	C263	C264	C265	C266	C267	C268	C27	C28	C29	C30	C31	C32	J62	TOTAL
AGR_Green	6,0%	3,8%	10,3%	48,9%	23,4%	5,7%	13,4%	16,5%	29,1%	11,6%	3,8%	1,9%	2,8%	2,7%	5,8%	2,3%	0,6%	7,1%	30,3%	13,1%	19,6%	13,1%	1,0%	2,3%	3,0%	**10,25%**
AGR_JTag	1,0%	1,5%	4,7%	0,4%	5,3%	0,9%	4,1%	8,0%	1,3%	4,8%	73,3%	75,6%	93,2%	96,5%	31,1%	8,6%	51,6%	4,6%	11,1%	16,5%	11,4%	6,2%	2,5%	11,8%	86,5%	**35,46%**
AGR_WIPO_Digtl	0,2%	0,1%	0,3%	0,4%	0,3%	0,5%	1,2%	0,3%	0,3%	1,0%	0,9%	17,6%	3,2%	0,7%	6,3%	4,3%	1,1%	0,0%	1,7%	5,7%	9,8%	5,2%	0,4%	7,8%	10,5%	**5,16%**
Digtl_AI_ML	0,1%	0,1%	0,1%	0,4%	0,1%	0,4%	0,3%	0,1%	0,2%	0,4%	0,3%	13,0%	1,5%	0,3%	3,9%	2,7%	0,5%	0,0%	0,5%	1,8%	1,6%	0,6%	0,3%	3,3%	5,2%	**2,59%**
Digtl_AugReality	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,5%	0,1%	0,0%	0,0%	0,0%	0,3%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,3%	0,1%	**0,09%**
Digtl_AutSys	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,4%	0,0%	0,2%	0,1%	0,0%	0,8%	0,1%	0,0%	0,0%	0,4%	0,8%	7,3%	4,1%	0,0%	0,2%	0,5%	**0,67%**
Digtl_BigData	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,5%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,3%	**0,09%**
Digtl_BlockCh	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,3%	0,3%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,0%	**0,11%**
Digtl_CloudComp	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,2%	0,3%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,1%	1,1%	**0,31%**
Digtl_IoT	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,2%	0,6%	0,0%	0,3%	0,1%	0,0%	0,0%	0,2%	0,1%	0,2%	0,1%	0,1%	0,1%	0,9%	**0,18%**
Digtl_Quantum	0,0%	0,0%	0,1%	0,0%	0,2%	0,0%	0,0%	0,0%	0,0%	0,0%	0,3%	0,5%	0,2%	0,3%	0,2%	0,2%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	**0,13%**
Digtl_Robots	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,8%	0,1%	0,0%	0,1%	0,2%	0,2%	0,0%	0,0%	0,9%	1,1%	0,1%	0,0%	0,5%	2,9%	0,5%	0,3%	0,0%	3,9%	0,2%	**0,98%**
Digtl_SmartCities	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	**0,01%**
Green_EvT1	0,1%	0,6%	0,0%	6,2%	1,6%	0,1%	0,1%	0,7%	0,7%	0,3%	0,1%	0,0%	0,0%	0,0%	0,3%	0,1%	0,0%	0,0%	0,3%	2,6%	5,4%	0,7%	0,1%	0,2%	0,0%	**0,87%**
Green_EvT2	0,2%	0,1%	0,5%	2,1%	5,1%	0,1%	0,3%	0,4%	0,5%	0,1%	0,0%	0,0%	0,0%	0,0%	0,2%	0,2%	0,0%	7,1%	0,1%	0,8%	0,0%	0,4%	0,0%	0,2%	0,0%	**0,52%**
Green_EvT3	1,4%	0,8%	4,5%	16,5%	2,8%	0,2%	2,5%	3,2%	5,7%	0,3%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,2%	0,7%	0,1%	0,7%	0,2%	0,2%	0,1%	**0,51%**
Green_EvT4	0,0%	0,0%	0,0%	0,1%	0,3%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	**0,02%**
Green_EvT5	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%	0,0%	0,0%	0,0%	0,0%	**0,03%**
Green_Y02A	1,6%	0,3%	0,3%	0,1%	1,2%	3,4%	0,2%	0,6%	0,1%	0,3%	0,0%	0,1%	0,0%	0,0%	0,9%	0,5%	0,1%	0,0%	0,2%	1,0%	0,2%	0,6%	0,2%	0,4%	0,3%	**0,66%**
Green_Y02B	0,1%	0,0%	0,1%	0,0%	0,1%	0,0%	0,1%	0,3%	0,1%	0,3%	0,2%	0,0%	0,0%	1,0%	0,2%	0,3%	0,1%	0,0%	2,9%	1,4%	0,2%	0,1%	0,1%	0,1%	0,1%	**0,58%**
Green_Y02C	0,0%	0,1%	0,0%	0,8%	0,4%	0,0%	0,0%	0,1%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,2%	0,0%	0,0%	0,0%	0,0%	0,0%	**0,07%**
Green_Y02D	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,5%	1,1%	2,6%	1,6%	0,2%	0,0%	0,1%	0,0%	0,1%	0,1%	0,0%	0,0%	0,0%	0,0%	0,1%	**0,52%**
Green_Y02E	1,0%	0,6%	1,4%	7,4%	6,3%	0,9%	2,1%	2,4%	2,4%	5,3%	1,9%	0,2%	0,1%	0,1%	2,2%	1,1%	0,2%	0,0%	21,0%	2,9%	1,3%	2,6%	0,2%	0,5%	0,2%	**3,58%**
Green_Y02P	1,3%	0,7%	0,3%	13,5%	2,8%	0,9%	2,8%	3,0%	17,3%	4,4%	0,7%	0,2%	0,1%	0,0%	1,0%	0,1%	0,1%	0,0%	2,1%	1,6%	0,1%	0,1%	0,0%	0,1%	1,4%	**1,14%**
Green_Y02T	0,0%	0,0%	0,0%	0,2%	0,6%	0,0%	3,6%	0,4%	0,9%	0,5%	0,2%	0,1%	0,0%	0,1%	0,5%	0,0%	0,0%	0,0%	3,1%	1,4%	12,2%	7,9%	0,1%	0,1%	0,4%	**1,35%**
Green_Y02W	0,2%	0,6%	3,2%	2,1%	2,2%	0,1%	1,6%	5,4%	1,4%	0,1%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,2%	0,3%	0,0%	0,0%	0,1%	0,4%	0,1%	**0,36%**
Green_Y04S	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,2%	0,0%	0,1%	0,0%	0,0%	0,0%	0,3%	**0,04%**
JTag_1	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%	0,0%	0,3%	0,7%	2,1%	22,2%	51,7%	2,0%	0,6%	1,0%	0,0%	1,1%	0,3%	0,7%	0,3%	0,1%	0,3%	1,6%	**3,69%**
JTag_2	0,1%	0,1%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,1%	0,0%	0,4%	33,2%	0,4%	1,0%	0,2%	0,1%	0,0%	0,3%	0,2%	0,6%	0,4%	0,0%	0,1%	1,0%	**4,43%**
JTag_3	0,1%	0,1%	1,3%	0,0%	0,0%	0,0%	0,2%	0,1%	0,0%	0,3%	0,2%	6,2%	5,3%	0,2%	0,3%	0,2%	0,1%	0,0%	0,1%	0,7%	0,3%	0,1%	0,2%	0,2%	12,0%	**1,73%**
JTag_4	0,1%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,2%	0,1%	0,1%	1,0%	0,3%	0,8%	0,1%	0,1%	0,0%	0,8%	0,2%	0,4%	0,2%	0,3%	0,1%	0,4%	**0,35%**
JTag_5	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,6%	12,6%	0,9%	1,4%	0,7%	0,2%	0,1%	0,0%	0,1%	0,1%	0,4%	0,1%	0,1%	0,1%	1,3%	**1,55%**
JTag_6	0,0%	0,1%	0,5%	0,0%	0,1%	0,0%	0,1%	0,1%	0,1%	0,0%	7,2%	4,6%	0,3%	2,2%	0,3%	0,0%	0,2%	0,0%	0,1%	1,1%	0,0%	0,0%	0,1%	0,1%	0,4%	**1,27%**
JTag_7	0,2%	0,1%	0,2%	0,1%	0,1%	0,0%	0,3%	0,0%	0,1%	0,3%	0,1%	3,6%	0,7%	0,1%	2,2%	0,1%	0,2%	0,0%	2,4%	1,0%	3,5%	2,1%	0,5%	0,6%	62,2%	**2,35%**
JTag_8	0,0%	0,0%	0,3%	0,0%	0,0%	0,1%	0,2%	0,1%	0,1%	0,2%	0,2%	8,5%	0,7%	0,1%	2,1%	0,7%	0,9%	0,3%	0,2%	2,2%	0,8%	0,3%	0,1%	1,6%	1,4%	**1,69%**
JTag_9	0,2%	0,2%	0,3%	0,0%	0,1%	0,0%	0,1%	0,8%	0,1%	0,3%	0,6%	9,8%	2,2%	0,7%	0,9%	0,2%	2,1%	0,0%	0,7%	0,7%	1,2%	0,5%	0,4%	1,8%	1,6%	**1,83%**
JTag_10	0,1%	0,3%	0,7%	0,0%	0,1%	0,0%	0,4%	0,3%	0,0%	0,3%	1,5%	9,2%	16,9%	1,3%	1,8%	1,2%	14,6%	3,1%	0,9%	5,2%	1,3%	0,5%	0,3%	2,1%	1,4%	**4,75%**
JTag_11	0,0%	0,3%	1,0%	0,1%	4,7%	0,6%	2,3%	5,9%	0,7%	1,8%	60,4%	5,2%	7,8%	34,6%	4,0%	4,3%	30,2%	1,2%	3,4%	3,1%	0,6%	0,5%	0,0%	3,2%	0,1%	**8,50%**
JTag_12	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,2%	0,1%	0,0%	0,5%	0,2%	0,3%	0,8%	0,6%	13,7%	0,1%	1,4%	0,0%	0,3%	0,4%	1,0%	0,9%	0,0%	0,3%	0,2%	**1,19%**
JTag_13	0,1%	0,1%	0,5%	0,2%	0,1%	0,1%	0,2%	0,4%	0,1%	0,4%	1,6%	13,0%	1,2%	3,0%	1,4%	0,6%	0,7%	0,0%	0,6%	1,2%	0,6%	0,2%	0,4%	1,1%	3,1%	**2,13%**
OTHERS	92,8%	94,6%	84,6%	50,2%	71,0%	92,9%	81,3%	75,2%	69,3%	82,6%	22,0%	4,9%	0,7%	0,0%	56,8%	84,8%	46,8%	88,3%	56,9%	64,5%	59,2%	75,6%	96,0%	78,0%	0,0%	**49,11%**
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Reading:

This table illustrates, at the world level for the year 2021, the *patent* contribution in percentage, of each technology, in row, to the technologies portfolio, in column, of every NACE sector.

The table displays also, the *patent* contribution of the category "OTHERS", that regroups all patent families not identified as green or digital in table 9, to the technologies portfolio of the individual NACE sectors.

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Table 12: R&D contribution of every NACE sector at world level in 2021 to the different digital and in green technologies

R&D by TECHNO -->	C10_C12	C13_C15	C16_C18	C19	C20	C21	C22	C23	C24	C25	C261	C262	C263	C264	C265	C266	C267	C268	C27	C28	C29	C30	C31	C32	J62	TOTAL
AGR_Green	1,5%	0,5%	1,1%	2,9%	11,0%	5,9%	2,2%	2,3%	8,2%	2,8%	2,9%	0,5%	1,7%	0,3%	1,4%	0,2%	0,0%	0,0%	13,9%	10,7%	22,6%	5,6%	0,0%	0,5%	1,3%	100%
AGR_JTag	0,1%	0,0%	0,1%	0,0%	0,7%	0,3%	0,3%	0,3%	0,1%	0,3%	26,3%	8,9%	18,5%	2,7%	3,3%	0,2%	1,0%	0,1%	1,6%	4,7%	4,9%	1,2%	0,0%	1,0%	23,3%	100%
AGR_WIPO_Digtl	0,1%	0,0%	0,1%	0,1%	0,3%	1,8%	0,4%	0,1%	0,1%	0,6%	2,5%	13,8%	4,3%	0,1%	4,5%	0,7%	0,2%	0,0%	1,7%	10,6%	25,8%	6,8%	0,0%	5,9%	19,4%	100%
Digtl_AI_ML	0,1%	0,0%	0,1%	0,1%	0,2%	3,0%	0,3%	0,1%	0,2%	0,5%	2,8%	25,3%	4,7%	0,1%	7,1%	1,0%	0,2%	0,0%	1,3%	8,5%	10,9%	2,3%	0,0%	5,7%	25,6%	100%
Digtl_AugReality	0,1%	0,1%	0,1%	0,0%	0,1%	0,1%	0,0%	0,0%	0,1%	1,3%	0,5%	40,5%	5,9%	0,0%	2,1%	0,2%	4,2%	0,1%	0,8%	2,9%	3,6%	1,4%	0,0%	14,9%	21,0%	100%
Digtl_AutSys	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,1%	1,1%	0,2%	0,6%	0,6%	0,0%	2,2%	0,0%	0,0%	0,0%	1,3%	5,9%	66,5%	18,5%	0,0%	0,5%	2,4%	100%
Digtl_BigData	0,0%	0,0%	0,1%	1,7%	0,3%	30,4%	0,0%	0,0%	0,1%	0,0%	1,3%	19,1%	2,5%	0,2%	5,5%	0,1%	0,1%	0,1%	0,7%	3,0%	11,1%	0,1%	0,0%	0,6%	23,1%	100%
Digtl_BlockCh	0,0%	0,0%	0,1%	0,0%	0,0%	0,1%	0,2%	0,0%	0,0%	0,0%	0,1%	4,0%	7,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,4%	0,1%	0,0%	0,0%	0,3%	87,3%	100%
Digtl_CloudComp	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%	0,0%	0,0%	1,1%	37,1%	10,2%	0,0%	1,4%	0,1%	0,0%	0,0%	0,7%	3,2%	2,7%	0,6%	0,0%	0,7%	41,8%	100%
Digtl_IoT	0,6%	0,1%	0,0%	0,0%	0,3%	0,2%	0,1%	0,0%	0,0%	0,3%	0,6%	3,1%	33,3%	0,1%	4,0%	0,8%	0,0%	0,1%	3,8%	4,6%	20,9%	2,8%	0,2%	1,2%	22,8%	100%
Digtl_Quantum	0,1%	0,0%	1,2%	0,0%	10,1%	1,0%	0,3%	0,8%	0,0%	0,1%	38,3%	21,8%	9,1%	1,7%	5,3%	3,3%	0,6%	0,1%	0,8%	0,5%	0,2%	0,1%	0,0%	0,2%	4,2%	100%
Digtl_Robots	0,2%	0,0%	0,2%	0,0%	0,2%	0,3%	2,3%	0,1%	0,1%	0,4%	3,3%	1,6%	0,4%	0,0%	4,4%	1,5%	0,2%	0,0%	4,7%	39,6%	9,6%	3,2%	0,0%	25,0%	2,6%	100%
Digtl_SmartCities	0,2%	0,0%	1,2%	0,6%	0,0%	0,0%	0,1%	0,0%	0,8%	0,0%	0,4%	7,8%	57,4%	0,4%	7,0%	0,3%	0,0%	1,6%	10,9%	1,7%	1,8%	0,0%	0,2%	0,6%	6,8%	100%
Green_EvT1	0,1%	0,6%	0,1%	3,5%	6,4%	0,6%	0,1%	0,7%	1,5%	0,6%	0,6%	0,0%	0,0%	0,0%	1,0%	0,1%	0,0%	0,0%	0,9%	18,0%	61,7%	2,3%	0,0%	0,7%	0,1%	100%
Green_EvT2	1,4%	0,1%	1,1%	2,7%	59,7%	3,9%	1,0%	1,4%	2,1%	0,7%	0,6%	0,0%	0,1%	0,0%	1,7%	0,2%	0,0%	0,1%	1,7%	15,8%	0,9%	2,9%	0,0%	1,5%	0,5%	100%
Green_EvT3	6,2%	0,8%	5,8%	12,0%	17,9%	3,3%	5,1%	5,4%	21,4%	0,5%	0,2%	0,0%	0,0%	0,0%	0,3%	0,0%	0,0%	0,0%	1,6%	7,7%	1,6%	8,3%	0,0%	1,0%	0,7%	100%
Green_EvT4	0,2%	0,0%	1,2%	1,6%	81,4%	6,8%	0,0%	1,0%	0,2%	0,0%	0,0%	0,0%	0,0%	0,0%	0,7%	0,1%	0,0%	0,4%	0,0%	5,9%	0,0%	0,2%	0,0%	0,2%	0,0%	100%
Green_EvT5	0,0%	0,0%	0,2%	0,1%	0,4%	0,6%	0,0%	0,0%	0,1%	1,7%	0,5%	0,1%	6,6%	0,2%	6,9%	0,0%	0,0%	0,3%	1,1%	27,3%	39,0%	5,9%	0,0%	0,1%	8,5%	100%
Green_Y02A	6,0%	0,5%	0,7%	0,2%	8,5%	53,7%	0,7%	1,6%	0,6%	1,1%	0,7%	0,3%	0,3%	0,0%	3,1%	0,5%	0,1%	0,0%	1,3%	12,1%	2,4%	2,6%	0,1%	1,0%	2,1%	100%
Green_Y02B	0,7%	0,0%	0,8%	0,0%	1,4%	0,0%	0,3%	1,3%	0,5%	2,1%	4,8%	0,3%	0,4%	2,0%	1,3%	0,8%	0,1%	0,0%	42,5%	33,2%	4,8%	0,8%	0,1%	0,5%	1,2%	100%
Green_Y02C	0,0%	0,7%	0,1%	10,0%	33,8%	1,2%	0,5%	1,5%	2,7%	0,1%	0,6%	0,0%	0,0%	0,0%	0,7%	0,3%	0,0%	0,2%	0,4%	43,5%	0,9%	1,4%	0,0%	1,2%	0,3%	100%
Green_Y02D	0,1%	0,0%	0,0%	0,0%	0,1%	0,0%	0,5%	0,1%	0,0%	0,0%	15,5%	12,5%	55,8%	6,7%	1,3%	0,0%	0,1%	0,0%	1,4%	3,1%	0,7%	0,1%	0,0%	0,3%	1,6%	100%
Green_Y02E	0,9%	0,4%	0,5%	2,1%	12,2%	3,5%	1,5%	1,5%	2,3%	5,9%	6,1%	0,1%	0,2%	0,1%	2,0%	0,3%	0,0%	0,0%	39,6%	10,0%	6,0%	4,1%	0,0%	0,4%	0,3%	100%
Green_Y02P	2,2%	1,1%	0,3%	5,9%	10,1%	5,3%	3,3%	3,6%	36,6%	6,3%	3,4%	0,3%	0,2%	0,0%	1,4%	0,0%	0,0%	0,0%	6,4%	8,9%	0,4%	0,3%	0,0%	0,2%	3,5%	100%
Green_Y02T	0,0%	0,0%	0,1%	0,1%	1,1%	0,0%	2,9%	0,2%	0,8%	0,8%	0,9%	0,1%	0,1%	0,0%	0,7%	0,0%	0,0%	0,0%	6,8%	5,4%	63,5%	15,8%	0,0%	0,1%	0,8%	100%
Green_Y02W	0,8%	1,5%	9,8%	3,2%	28,2%	1,9%	8,0%	20,1%	9,5%	0,6%	0,2%	0,0%	0,0%	0,0%	0,5%	0,0%	0,0%	0,0%	2,4%	7,2%	0,7%	0,4%	0,0%	2,2%	2,7%	100%
Green_Y04S	0,0%	0,0%	0,2%	0,1%	0,1%	0,0%	0,1%	0,0%	0,1%	0,0%	0,4%	2,5%	2,8%	0,2%	7,2%	0,2%	0,0%	0,2%	26,4%	2,4%	19,2%	2,1%	0,0%	0,0%	35,7%	100%
JTag_1	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,2%	4,0%	4,0%	55,1%	18,7%	2,9%	0,2%	0,3%	0,0%	2,3%	1,1%	3,8%	0,9%	0,0%	0,3%	5,8%	100%
JTag_2	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,1%	0,1%	0,8%	86,2%	0,2%	1,7%	0,1%	0,0%	0,0%	0,6%	0,7%	3,5%	1,2%	0,0%	0,2%	4,2%	100%
JTag_3	0,1%	0,0%	0,4%	0,0%	0,1%	0,1%	0,1%	0,1%	0,0%	0,3%	1,4%	12,1%	14,7%	0,1%	0,7%	0,1%	0,0%	0,0%	0,3%	3,1%	1,9%	0,3%	0,0%	0,5%	63,6%	100%
JTag_4	0,5%	0,1%	0,1%	0,0%	0,3%	0,3%	0,2%	0,4%	0,0%	1,6%	2,6%	1,5%	19,6%	0,7%	9,8%	0,2%	0,2%	0,0%	14,4%	5,2%	22,5%	4,7%	0,1%	1,6%	13,5%	100%
JTag_5	0,1%	0,0%	0,0%	0,0%	0,0%	0,2%	0,0%	0,0%	0,0%	0,2%	9,3%	55,3%	6,4%	1,5%	2,5%	0,2%	0,1%	0,0%	0,9%	1,5%	5,4%	0,6%	0,0%	0,5%	15,4%	100%
JTag_6	0,0%	0,1%	0,3%	0,0%	0,2%	0,4%	0,1%	0,1%	0,2%	0,1%	68,3%	15,5%	1,5%	1,9%	0,7%	0,0%	0,1%	0,0%	0,3%	6,6%	0,4%	0,0%	0,0%	0,3%	3,0%	100%
JTag_7	0,1%	0,0%	0,0%	0,0%	0,1%	0,1%	0,1%	0,0%	0,0%	0,1%	0,2%	2,2%	0,9%	0,0%	1,1%	0,0%	0,0%	0,0%	1,5%	1,5%	8,0%	1,8%	0,0%	0,3%	81,9%	100%
JTag_8	0,0%	0,0%	0,2%	0,0%	0,1%	0,8%	0,4%	0,1%	0,1%	0,5%	2,0%	28,0%	4,9%	0,1%	6,6%	0,5%	0,6%	0,3%	1,0%	22,8%	10,4%	2,2%	0,0%	4,4%	14,0%	100%
JTag_9	0,2%	0,2%	0,4%	0,0%	0,5%	0,0%	0,2%	1,0%	0,8%	0,6%	4,7%	27,6%	16,0%	0,8%	2,4%	0,2%	1,4%	0,0%	3,1%	5,4%	15,1%	3,0%	0,1%	4,3%	11,9%	100%
JTag_10	0,0%	0,1%	0,2%	0,0%	0,2%	0,1%	0,3%	0,2%	0,0%	0,4%	4,7%	12,1%	41,8%	0,5%	2,2%	0,5%	2,5%	0,8%	1,6%	18,0%	6,5%	1,2%	0,0%	2,1%	4,2%	100%
JTag_11	0,0%	0,0%	0,1%	0,0%	2,3%	0,7%	0,5%	0,7%	0,1%	0,4%	73,8%	1,6%	5,5%	3,4%	1,4%	0,3%	2,3%	0,2%	1,7%	2,9%	0,9%	0,4%	0,0%	0,8%	0,0%	100%
JTag_12	0,1%	0,0%	0,0%	0,0%	0,2%	0,1%	0,6%	0,1%	0,1%	1,2%	2,3%	1,5%	5,8%	0,4%	54,7%	0,2%	1,2%	0,0%	1,6%	4,4%	15,7%	5,7%	0,0%	1,1%	3,1%	100%
JTag_13	0,1%	0,0%	0,3%	0,1%	0,2%	0,6%	0,3%	0,3%	0,1%	0,6%	16,0%	33,6%	5,6%	1,7%	3,2%	0,4%	0,3%	0,0%	1,8%	7,2%	5,2%	1,0%	0,1%	1,8%	19,4%	100%
OTHERS	4,0%	1,8%	1,4%	0,6%	6,0%	25,6%	2,8%	1,7%	3,0%	3,1%	3,8%	0,3%	0,1%	0,0%	3,3%	1,2%	0,5%	0,4%	5,0%	10,0%	14,1%	6,5%	0,4%	4,5%	0,0%	100%
TECH_ALL	2%	1%	1%	1%	5%	15%	2%	1%	3%	2%	10%	4%	6%	1%	3%	1%	1%	0%	5%	9%	13%	5%	0%	3%	8%	100%

Reading:

This table illustrates, at the world level for the year 2021, the *R&D* contribution in percentage, of every NACE sector, in column, to every technology, in row.

The table displays also, the *R&D* contribution of each NACE sector to the category “OTHERS”, that regroups all patent families not identified as green or digital in table 9.

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Table 13: Composition of the R&D portfolio of every NACE sector at the world level in 2021

R&D by TECHNO --v	C10_C12	C13_C15	C16_C18	C19	C20	C21	C22	C23	C24	C25	C261	C262	C263	C264	C265	C266	C267	C268	C27	C28	C29	C30	C31	C32	J62	TOTAL
AGR_Green	6,9%	4,9%	12,4%	48,8%	25,1%	4,3%	12,9%	19,6%	34,9%	14,3%	3,0%	1,4%	3,0%	3,5%	4,7%	2,2%	0,5%	0,5%	31,3%	13,5%	18,9%	12,4%	1,4%	1,8%	1,7%	**10,72%**
AGR_JTag	0,8%	1,1%	4,4%	0,8%	4,7%	0,7%	4,1%	6,9%	1,1%	4,8%	75,9%	75,5%	92,8%	96,0%	31,8%	8,2%	52,4%	15,0%	10,0%	16,7%	11,5%	7,2%	2,1%	9,3%	86,7%	**30,09%**
AGR_WIPO_DigtI	0,2%	0,1%	0,5%	0,9%	0,3%	0,6%	1,1%	0,3%	0,2%	1,4%	1,2%	18,9%	3,5%	0,5%	6,9%	4,7%	1,5%	0,3%	1,7%	6,0%	9,8%	6,9%	0,6%	9,3%	11,6%	**4,85%**
DigtI_AI_ML	0,1%	0,1%	0,2%	0,4%	0,1%	0,4%	0,3%	0,1%	0,2%	0,5%	0,5%	14,1%	1,5%	0,2%	4,4%	2,7%	0,7%	0,0%	0,5%	2,0%	1,7%	0,9%	0,4%	3,6%	6,2%	**1,97%**
DigtI_AugReality	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,7%	0,1%	0,0%	0,0%	0,0%	0,5%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,3%	0,2%	**0,06%**
DigtI_AutSys	0,0%	0,0%	0,0%	0,2%	0,0%	0,0%	0,0%	0,0%	0,0%	0,7%	0,0%	0,2%	0,1%	0,0%	1,0%	0,1%	0,0%	0,0%	0,4%	1,0%	7,3%	5,4%	0,0%	0,2%	0,4%	**1,40%**
DigtI_BigData	0,0%	0,0%	0,0%	0,2%	0,0%	0,2%	0,0%	0,0%	0,0%	0,0%	0,0%	0,4%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,2%	**0,08%**
DigtI_BlockCh	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,3%	0,3%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,9%	**0,27%**
DigtI_CloudComp	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	2,1%	0,3%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	1,0%	**0,20%**
DigtI_IoT	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,8%	0,0%	0,2%	0,2%	0,0%	0,0%	0,1%	0,1%	0,2%	0,1%	0,1%	0,1%	0,4%	**0,15%**
DigtI_Quantum	0,0%	0,0%	0,1%	0,0%	0,2%	0,0%	0,0%	0,1%	0,0%	0,0%	0,3%	0,6%	0,1%	0,2%	0,2%	0,4%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	**0,09%**
DigtI_Robots	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,8%	0,1%	0,0%	0,1%	0,2%	0,3%	0,0%	0,0%	0,9%	1,2%	0,2%	0,0%	0,6%	2,9%	0,5%	0,4%	0,0%	5,0%	0,2%	**0,62%**
DigtI_SmartCities	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	**0,00%**
Green_EvT1	0,1%	0,7%	0,2%	6,6%	1,6%	0,1%	0,1%	0,7%	0,7%	0,3%	0,1%	0,0%	0,0%	0,0%	0,4%	0,1%	0,0%	0,0%	0,2%	2,6%	5,8%	0,6%	0,2%	0,3%	0,0%	**1,20%**
Green_EvT2	0,3%	0,0%	0,5%	1,9%	5,6%	0,1%	0,2%	0,5%	0,4%	0,2%	0,0%	0,0%	0,0%	0,0%	0,2%	0,1%	0,0%	0,1%	0,2%	0,8%	0,0%	0,3%	0,0%	0,2%	0,0%	**0,44%**
Green_EvT3	1,9%	0,6%	4,6%	14,1%	2,8%	0,2%	2,0%	3,2%	6,3%	0,2%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,3%	0,7%	0,1%	1,3%	0,1%	0,2%	0,1%	**0,74%**
Green_EvT4	0,0%	0,0%	0,0%	0,1%	0,4%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	**0,02%**
Green_EvT5	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%	0,0%	0,0%	0,0%	0,0%	**0,03%**
Green_Y02A	1,9%	0,4%	0,5%	0,2%	1,3%	2,7%	0,3%	0,9%	0,2%	0,4%	0,1%	0,1%	0,0%	0,0%	0,7%	0,4%	0,1%	0,0%	0,2%	1,1%	0,1%	0,4%	0,2%	0,2%	0,2%	**0,74%**
Green_Y02B	0,1%	0,0%	0,4%	0,0%	0,1%	0,0%	0,1%	0,4%	0,1%	0,4%	0,2%	0,0%	0,0%	0,9%	0,2%	0,4%	0,1%	0,0%	3,6%	1,6%	0,2%	0,1%	0,2%	0,1%	0,1%	**0,40%**
Green_Y02C	0,0%	0,0%	0,0%	0,8%	0,4%	0,0%	0,0%	0,1%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,3%	0,0%	0,0%	0,0%	0,0%	0,0%	**0,05%**
Green_Y02D	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,4%	1,0%	2,7%	2,3%	0,1%	0,0%	0,1%	0,0%	0,1%	0,1%	0,0%	0,0%	0,0%	0,0%	0,1%	**0,29%**
Green_Y02E	0,9%	0,9%	1,5%	8,3%	6,6%	0,6%	2,1%	2,9%	2,4%	7,1%	1,5%	0,1%	0,1%	0,2%	1,6%	1,0%	0,2%	0,0%	21,0%	3,0%	1,2%	2,2%	0,2%	0,3%	0,1%	**2,53%**
Green_Y02P	1,5%	1,6%	0,5%	14,7%	3,4%	0,6%	2,8%	4,5%	22,7%	4,8%	0,5%	0,1%	0,0%	0,0%	0,7%	0,1%	0,1%	0,0%	2,1%	1,6%	0,1%	0,1%	0,1%	0,1%	0,7%	**1,57%**
Green_Y02T	0,0%	0,0%	0,1%	0,3%	0,5%	0,0%	3,5%	0,4%	0,7%	0,8%	0,2%	0,0%	0,0%	0,1%	0,5%	0,0%	0,0%	0,0%	3,2%	1,5%	11,3%	7,5%	0,2%	0,0%	0,2%	**2,28%**
Green_Y02W	0,1%	0,5%	4,0%	1,9%	2,3%	0,0%	1,6%	6,0%	1,4%	0,1%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,2%	0,3%	0,0%	0,0%	0,0%	0,3%	0,1%	**0,38%**
Green_Y04S	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,0%	0,2%	0,0%	0,1%	0,0%	0,0%	0,0%	0,2%	**0,04%**
JTag_1	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%	0,0%	0,2%	0,9%	2,6%	21,4%	50,8%	2,2%	0,6%	1,3%	0,0%	1,1%	0,3%	0,7%	0,4%	0,0%	0,3%	1,7%	**2,32%**
JTag_2	0,0%	0,1%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,0%	0,1%	0,0%	0,5%	32,3%	0,4%	1,2%	0,3%	0,1%	0,0%	0,3%	0,2%	0,6%	0,5%	0,1%	0,2%	1,2%	**2,25%**
JTag_3	0,1%	0,0%	1,0%	0,0%	0,0%	0,0%	0,1%	0,1%	0,0%	0,3%	0,3%	6,9%	4,9%	0,2%	0,4%	0,2%	0,1%	0,0%	0,1%	0,7%	0,3%	0,1%	0,2%	0,3%	15,8%	**2,01%**
JTag_4	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,2%	0,1%	0,1%	0,9%	0,2%	0,8%	0,1%	0,1%	0,0%	0,8%	0,2%	0,5%	0,3%	0,2%	0,1%	0,4%	**0,27%**
JTag_5	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,1%	0,8%	13,3%	0,9%	1,5%	0,7%	0,2%	0,1%	0,0%	0,2%	0,2%	0,4%	0,1%	0,0%	0,1%	1,6%	**0,85%**
JTag_6	0,0%	0,1%	0,5%	0,0%	0,1%	0,0%	0,0%	0,1%	0,1%	0,0%	8,7%	5,9%	0,3%	2,9%	0,3%	0,0%	0,3%	0,0%	0,1%	1,0%	0,0%	0,0%	0,1%	0,1%	0,5%	**1,34%**
JTag_7	0,2%	0,1%	0,2%	0,3%	0,1%	0,0%	0,2%	0,1%	0,0%	0,3%	0,1%	3,6%	0,8%	0,0%	2,0%	0,1%	0,2%	0,0%	1,8%	1,0%	3,5%	2,1%	0,4%	0,5%	57,1%	**5,65%**
JTag_8	0,0%	0,0%	0,3%	0,0%	0,0%	0,1%	0,2%	0,1%	0,0%	0,2%	0,2%	7,5%	0,8%	0,1%	2,0%	0,6%	1,0%	1,2%	0,2%	2,6%	0,8%	0,4%	0,1%	1,3%	1,6%	**0,95%**
JTag_9	0,1%	0,2%	0,4%	0,0%	0,1%	0,0%	0,1%	0,8%	0,3%	0,3%	0,5%	8,1%	2,8%	0,9%	0,8%	0,2%	2,5%	0,0%	0,7%	0,7%	1,2%	0,7%	0,3%	1,4%	1,5%	**1,03%**
JTag_10	0,0%	0,2%	0,5%	0,0%	0,1%	0,0%	0,4%	0,3%	0,0%	0,4%	1,1%	8,6%	17,6%	1,4%	1,8%	1,5%	10,7%	8,2%	0,8%	5,3%	1,3%	0,6%	0,2%	1,7%	1,3%	**2,52%**
JTag_11	0,0%	0,2%	1,2%	0,1%	4,2%	0,4%	2,2%	4,7%	0,5%	1,8%	60,8%	3,9%	7,8%	34,2%	3,9%	3,3%	33,5%	5,2%	3,1%	2,9%	0,6%	0,7%	0,1%	2,1%	0,0%	**8,59%**
JTag_12	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,3%	0,1%	0,0%	0,5%	0,2%	0,3%	0,8%	0,3%	14,3%	0,2%	1,7%	0,0%	0,3%	0,4%	1,0%	1,0%	0,0%	0,3%	0,3%	**0,83%**
JTag_13	0,1%	0,1%	0,5%	0,3%	0,1%	0,1%	0,2%	0,4%	0,0%	0,4%	2,3%	14,1%	1,4%	2,9%	1,5%	0,8%	0,8%	0,0%	0,6%	1,3%	0,6%	0,3%	0,4%	0,9%	3,6%	**1,48%**
OTHERS	92,1%	93,9%	82,7%	49,5%	69,8%	94,5%	81,8%	73,2%	63,8%	79,5%	19,9%	4,1%	0,7%	0,0%	56,6%	84,9%	45,6%	84,2%	56,9%	63,6%	59,8%	73,5%	96,0%	79,6%	0,0%	**54,33%**
TECH_ALL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Reading:

This table illustrates, at the world level for the year 2021, the *R&D* contribution in percentage, of each technology, in row, to the technologies portfolio, in column, of every NACE sector.

The table displays also, the *R&D* contribution of the category "OTHERS", that regroups all patent families not identified as green or digital in table 9, to the technologies portfolio of the individual NACE sectors.

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