



JRC TECHNICAL REPORT

Data and methods for building a disaggregated EU investment matrix

With an application to the 23 non-power generation and 8 power generation sectors of the JRC-GEM-E3 model

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Contents

Abstract	1
Acknowledgements	2
1 Introduction	3
2 Gross Fixed Capital Formation data processing	5
3 Power generation sectors data source	10
4 Results – EU average investment matrix	13
5 Conclusions	16
References	18
List of abbreviations and definitions	20
List of figures	21
List of tables	22
Annexes	24
Annex 1. EU Member States GFCF Eurostat data availability in year	24
Annex 2. Comparison of EU-wide results pre- and post-data processing	27
Annex 3. Breakdown of power generation capital costs	28
Annex 4. Investment matrix for JRC-GEM-E3 non-power sectors by Member States with filled in values when data is unavailable	36

Abstract

The transition to a net-zero economy will imply significant investments into low carbon technologies. However, macroeconomic models using capital stock investment treatment from GTAP Input-Output data only assumes a generic representation of investment, where all sectors use the same proportion of inputs to build capital stock (plant, equipment and other assets that help in production). This means that general equilibrium effects on upstream sectors producing investments for low carbon technologies may not be fully captured. In this study, we extend the methodology of Tamba et al (2022) to all EU Member States using Eurostat gross fixed capital formation (GFCF) data to build investment matrices with flexible aggregations for non-power generation sectors. In this report, we present investment matrices for all 23 non-power generation sectors of the JRC-GEM-E3 model. In addition, we build investment matrices for 8 power generation sectors using available cost data in the literature. A comparison of the original generic investment vector in the EU and a disaggregated investment matrix for all individual JRC-GEM-E3 sectors confirms that “one size does not fit all”. While a generic investment matrix puts more emphasis on construction (43%) and market services (25%), most sectors in our disaggregated investment matrix put more emphasis on “other equipment goods”.

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1 Introduction

The significant investment required to build the physical infrastructure (aka capital stock) (e.g., buildings, equipment, software) to transition to a climate-neutral economy as set by the European Green Deal will lead to a structural change in EU investments. For example, households and industrial processes will increasingly demand more energy from green power generation sectors, such as solar and wind, rather than coal, gas and oil. Also improving the energy performance of buildings will increase demand for sectors producing the capital good (e.g., construction, equipment). And the public and private transport system will source alternative technologies to replace fuel combustion engines in order to decarbonise the sector. Furthermore, to scale up manufacturing of clean technologies (wind, solar, batteries, heat pumps, electrolyzers), the European Commission has proposed the Net Zero Industry Act (NZIA) ⁽¹⁾. This will increase the need for investment in capital stock, as well as additional skilled workers (European Commission_b, 2023).

Analyses are needed to understand how green investments will affect the manufacturing industries (e.g., construction, transport equipment, electrical equipment, market services) supplying the long lasting capital stock of low carbon production technologies. Unfortunately, investment data identifying the links between sectors that invests and sectors supplying capital goods is not readily available. As a result, macro-economic models generally assume capital investment is the same for all sectors of activity due to the level of aggregation of investments in commonly used GTAP Input-Output data (Aguilar *et al.*, 2023). Here, capital stock (known as capital goods or CGDS) represents purchases of goods and equipment destined for investment (as opposed to purchases as intermediate inputs, household consumption or exports). This data does not indicate in which industries the investment goods are installed.

The JRC-GEM-E3 model is a global multi-sectoral general equilibrium model that covers the interactions between the economy, the energy system and the environment. The model is used to calculate macro-economic impacts such as GDP, welfare, consumption, trade, employment, sectoral output, and carbon price. This model has recently been used for the EU Impact Assessments of the 2030 Framework of Energy and Climate Policies, its implementation in the context of the Energy Union, the Paris Agreement, and the Clean Air Package ⁽²⁾.

In the JRC-GEM-E3 model, firms in each of the 31 sectors ⁽³⁾ of activity are constrained by the physical capital stock (fixed within the current period, but capital is assumed to be mobile across sectors) and the available technology. Investment decisions of sectors are driven by the cost of the investment good with the aim to (a) maintain their capital stock (i.e. replace capital that is depreciated), (b) increase their capital stock due to an expansion of the sector in order to produce more output, and (c) to deepen the capital stock when production becomes more capital intensive, in order to substitute out of other inputs, such as energy. This investment by sectors of activity is translated into deliveries by industries producing the capital stock through an investment matrix. The column totals of the investment matrix represent the total investment by each sector of activity, while the row totals represent the total deliveries by industries.

The original model code (see Capros *et al.*, 2013) is set up to use an investment matrix. However, in recent applications (Weitzel *et al.*, 2023), the use of GTAP data implied that each country has one investment vector for all sectors of activity, based on consumption of gross fixed capital formation available from GTAP Input-Output tables ⁽⁴⁾. This implied that sectors supplying the investment good were benefiting from additional investments regardless of which sector was increasing investments. In other words, independently if the policy analysis considered an additional investment to build solar PV, coal power plants or even additional investment in the land transport sector, the same sectors were assumed to build the new physical infrastructure or capital good (i.e., investment good). Instead, a more refined investment matrix is required to better identify the sectors delivering the physical infrastructure to build clean technologies, and that in turn can benefit from the green transition, such as with new renewable jobs.

¹ Legislation - European Commission_a (2023)

² For more information, see https://joint-research-centre.ec.europa.eu/gem-e3/gem-e3-model_en.

³ The 31 sectors result from an aggregation of the sectors available in the GTAP-Power database and are mainly sectors that would be affected by the energy transition, representing energy sectors and sector in energy intensive manufacturing in greater detail. As other aggregations of the model have been used, the method for deriving an investment matrix is kept flexible to adjust to other choices of aggregation.

⁴ Technically, the model code operated with an investment matrix, but all columns of the matrix were characterized by the same shares, i.e. all sectors' investment was made of the same composition.

In a recent application of JRC-GEM-E3 to transport, Tamba et al. (2022) successfully refined the assumptions for three transport sectors using Eurostat gross fixed capital formation (GFCF) data to capture the fact that sectors providing transport services mainly purchase transport equipment as capital goods (and in turn, transport equipment contributing to capital formation mainly ends up in the transport sectors). As this study split the production of transport equipment into conventional and electric vehicle production, changes in the investment matrix could then be used to model the progressive shift of investments from conventional vehicles to electric vehicles.

In this study, we build, for all power and non-power sectors, a transition matrix linking investment by origin (i.e., industries providing physical inputs) to investment by destination (i.e., sectors demanding the capital) disaggregated by sector and by Member State. The method is applicable to any other model, although the sectors discussed in this report are specific to the aggregation of the standard JRC-GEM-E3 model. Our contribution to the literature is twofold. First, we extend the methodology in Tamba et al (2022) to all sectors in all EU Member States using Eurostat gross fixed capital formation (GFCF) Data. Second, we use the latest bottom-up cost data available for building the investment matrix for 8 different power generation sectors, with detailed representation of the wind power sector by Member State.

To use the GFCF data at its highest level of disaggregation, this study develops a method to fill in the missing data while ensuring total investments by asset type in each Member State are respected. No (readily available) equivalent dataset exists for other world region at right level of disaggregation. Hence, this work focuses on the EU. One challenge is that the NACE classifies all economic activities in the European Community but does not disaggregate power generation by technology. As investments in low carbon power technologies are an important element of the transition to a net zero carbon economy, we have used bottom-up cost data available for building the investment matrix for the 8 power generation sectors represented in JRC-GEM-E3.

The report is structured as follows, in section 2, we refine the investment matrices of the 23 non-power generation sectors in JRC-GEM-E3 for individual EU countries based on Eurostat GFCF data. Then, in section 3 we use complementary and most recent cost data in the literature to build investment matrices for 8 power generation sectors of JRC-GEM-E3. In section 4, the investment matrix results for all JRC-GEM-E3 sectors are presented and discussed for the EU as a whole together with a disaggregation of the wind power generation sector by Member States. The conclusion is available in section 5. Finally this report provides four annexes. Annex 1 provides a full discussion of the GFCF 2018 data availability. Annex 2 includes a further comparison of EU-wide results pre- and post-data processing. Annex 3 details a breakdown of derived capital costs from the literature for each power generation sector considered (coal, gas, nuclear, biomass, hydro, PV, and wind (offshore and onshore)). Annex 4 summarises the estimated investment matrix of non-power generation sectors for each of the 27 Member States using GFCF data.

2 Gross Fixed Capital Formation data processing

From Eurostat, we use the latest, most complete dataset for investment by sector of activity, i.e. gross fixed capital formation ⁽⁵⁾ for 2018 ⁽⁶⁾ for EU 27 Member States. This represents “resident producers’ acquisitions, less disposals, of fixed tangible or intangible assets”. This GFCF data is disaggregated on the industry side at NACE Rev.2 2-digit level, which are then matched to the JRC-GEM-E3 31 sectors based on Rueda-Cantuche et al. (2020) ⁽⁷⁾. The GFCF data classifies investment by asset type, which we match to JRC-GEM-E3 industries as shown in **Table 1** below.

Table 1 GFCF asset type matching

		JRC-GEM-E3 Code	Sector Name
N11G	Total fixed assets (gross)		
N11KG	Total Construction (gross)	16	Construction
N115G	Cultivated biological resources (gross)	1	Crops
N1131G	Transport equipment (gross)	13	Transport equipment
N1132G	ICT equipment (gross)	12	Electric Goods
N110G	Other machinery and equipment and weapons systems (gross)	14	Other Equipment Goods
N117G	Intellectual property products (gross)	20	Market Services

Source: JRC 2023 compilation using Eurostat GFCF data at NACE Rev.2-2 and JRC-GEM-E3 sectors based on Rueda-Cantuche et al. (2020).

Data completeness varies from Member State to Member State, with some records reported missing or negative in value. A summary count of the EU Member States reporting zero or positive GFCF data by NACE Rev.2.2 industry and by asset flow and its matching to the JRC-GEM-E3 sectors is reported in Table 2. Higher count values ⁽⁸⁾ and green colouring indicate high levels of reporting and vice versa indicates low levels of reporting when counts are low and the colour is dark orange or red. A comparison by NACE categories (i.e., looking down the rows) shows most Member States report GFCF data at higher levels of NACE aggregation (TOTAL and aggregated NACE categories (A, B-E, etc.)) and vice versa when the NACE categories are disaggregated.

When comparing the level of reporting by GFCF asset types (i.e., across the columns) in Table 2, the lowest level of reporting occurs in two categories, namely, “N1132G – ICT equipment” and “N110G – Other machinery and equipment and weapons systems” which are matched respectively in JRC-GEM-E3 industries to “12 – Electric goods” and “14 – Other equipment goods”.

Since GFCF data for “mining & quarrying” (B) and “manufacturing of basic metals” (C24) are aggregated, the same share values are assigned to JRC-GEM-E3 sectors respectively for mining (2-Coal, 3-Crude oil and 5-Gas), and basic metals (7-ferrous metals and 8 non-ferrous metals).

⁵ Cross-classification of gross fixed capital formation by industry and by asset (flows) [nama_10_nfa_fl]

⁶ While 2019 was also available, a cross examination identified more missing values across Member States than in 2018.

⁷ The 31 JRC-GEM-E3 sectors are the following: 1 Crops, 2 Coal, 3 Crude oil, 4 Oil, 5 Gas, 6 Electricity supply, 7 Ferrous metals, 8 Non-ferrous metals, 9 Chemical products, 10 Paper products, 11 Non-metallic minerals, 12 Electric goods, 13 Transport equipment, 14 Other equipment goods, 15 Consumer goods industries, 16 Construction, 17 Transport (Air), 18 Transport (Land), 19 Transport (Water), 20 Market services, 21 Non market services, 22 Coal fired, 23 Oil fired, 24 Gas fired, 25 Nuclear, 26 Biomass, 27 Hydro electric, 28 Wind, 29 PV, 30 Livestock, 31 Forestry

⁸ All Member States reporting will be a total count of 27

Table 2 Total count and summary colour scale of EU Member States reporting zero and positive (i.e., no negative or missing) GFCF data by industry and by asset type and their matching to JRC-GEM-E3 sectors

Industry NACE R2 (Code and Label)		Asset Code	N11G	N11KG	N115G	N1131G	N1132G	N110G	N117G
		JRC-GEM-E3 Code	TOTAL	16	1	13	12	14	20
TOTAL	Total - all NACE activities		27	26	24	27	27	27	27
A	Agri., forestry and fishing		25	26	24	27	18	18	25
A01	Crop and animal production	1	14	14	11	14	10	10	13
A02	Forestry and logging	31	13	13	14	14	10	10	13
A03	Fishing and aquaculture	30	13	14	14	14	9	10	13
B-E	Industry (except const.)		25	26	27	27	18	18	25
B	Mining and quarrying	2,3,5	23	25	26	26	17	17	23
C	Manufacturing		25	26	27	27	18	18	25
C10-C12	Manuf. food products	15	16	17	17	17	13	13	16
C13-C15	Manuf. of textiles	15	17	18	18	17	14	14	17
C16-C18	Manuf. of wood, paper		16	17	17	17	13	13	16
C16	Manuf. of wood products	15	13	13	13	12	9	9	12
C17	Manuf. of paper	10	13	13	14	13	9	9	12
C18	Printing and recorded media	10	13	12	14	12	9	9	12
C19	Manuf. ref petroleum prod.	4	16	18	18	18	14	14	17
C20	Manuf. of chemicals	9	16	17	17	17	13	13	16
C21	Manuf. of basic pharma.	9	15	16	16	14	12	12	15
C22_C23	Manuf. of rubber and plastic		16	17	17	17	13	13	16
C22	Manuf. of rubber and plastic	9	13	13	14	13	9	9	12
C23	Manuf. non-metallic mineral	11	13	13	14	13	9	9	12
C24_C25	Manuf. of basic metals		16	17	17	17	13	13	16
C24	Manuf. of basic metals	7,8	13	13	14	13	9	9	12
C25	Manuf. metal products	14	13	13	14	13	9	9	12
C26	Manuf. of electronic	12	16	16	17	17	13	13	16
C27	Manuf. of electrical equip.	14	16	17	17	17	13	13	16
C28	Manuf. machn and equip.nec	14	16	17	17	17	13	13	16
C29_C30	Manuf. of motor vehicles	13	16	17	17	14	13	13	16
C31-C33	Manuf. of furniture; jewellery	14	16	17	16	17	13	13	16
D	Electricity, gas, steam supply	6	23	25	26	24	17	17	23
E	Water supply		24	26	27	27	18	18	24
E36	Water collection, treatment	20	14	14	15	13	10	10	13
E37-E39	Sewerage, waste manag.	21	14	14	15	14	10	10	13
F	Construction	16	25	26	27	27	18	18	25
G-I	Wholesale and retail trade		24	25	26	26	18	18	24
G	Wholesale and retail trade	20	24	26	27	27	18	18	24
H	Transportation and storage		24	26	27	27	18	18	23
H49	Land transport	18	14	14	15	14	10	10	13
H50	Water transport	19	12	12	14	12	8	8	12
H51	Air transport	17	12	13	14	11	9	9	12
H52	Warehousing and support	18	12	12	13	11	8	8	11
H53	Postal and courier activities	20	12	12	13	12	8	8	11
I	Accommodation & food serv	20	24	26	27	27	18	18	24
J	Information & comms.		25	26	27	27	18	18	25
J58-J60	Publishing, motion picture,		17	18	18	17	14	14	17
J58	Publishing activities	10	14	14	15	14	10	9	13
J59_J60	Motion picture, video, tv	20	13	12	14	13	9	9	12
J61	Telecommunications	20	17	18	17	18	14	14	17
J62_J63	Computer programming	20	16	17	17	17	13	13	16
K	Financial & insurance act	20	25	22	27	26	18	18	25
L	Real estate activities	20	25	26	27	26	18	18	25
M_N	Prof., scientific & tech	20	25	26	27	27	18	18	25
O-Q	Public administration	21	25	26	27	27	18	18	25
R-U	Arts, entertainment		25	26	27	27	18	18	25
R	Arts, entertainment	21	24	26	27	27	18	18	24
S	Other service activities		24	26	27	27	18	18	24
S94	Membership organisations	21	14	14	15	14	10	10	13
S95	Repair of computers	20	14	13	15	14	10	10	13
S96	Other personal service	21	14	14	15	14	10	10	13
T	Act. HH as employers	20	0	19	21	20	13	13	17
U	Act. Extraterritorial org.	20	0	16	18	17	11	11	14

Source: JRC 2023 compilation using GFCF data available at NACE Rev.2 and JRC-GEM-E3 sectors equivalent.

Table 3 counts EU Member States reporting zero or positive for the six GFCF assets by NACE Rev.2.2 industry matched to JRC-GEM-E3 sectors, so that full reporting by a Member State means a total count of 6 assets and green colour, and lower reporting will imply low counts and dark orange/red colour. Data completeness varies from Member State to Member State, with only eight countries consistently reporting investment for all six assets type at NACE 2-digit level (Austria, Belgium, Czech Republic, Finland, Latvia, Portugal, Romania, Slovakia). While Bulgaria seems to provide a consistent reporting (in Table 3), many zeros should be considered missing values instead, if the sum of the 6 assets to total gross investment values is to hold true.

For other Member States, the level of detail will become more disperse at higher levels of disaggregation in NACE categories (A1, C10-C12, etc.). But even at aggregated NACE categories (A, B-E, etc.) the quality of reporting varies. In particular, nine Member States (Estonia, France, Italy, Lithuania, Luxembourg, Malta ⁽⁹⁾, Netherlands, Slovenia, Sweden) report data for all six assets type at aggregated NACE categories (A, B-E, etc.). Eight Member States (Bulgaria ⁽¹⁰⁾, Cyprus ⁽¹¹⁾, Denmark, Germany, Greece, Hungary, Poland, Spain) only report data in four assets type plus total gross investment at aggregated NACE categories (A, B-E, etc.) (i.e., the two missing asset type investment categories are “N1132G-ICT equipment” and “N110G-Other machinery equipment”). Finally, two Member States (Croatia, Ireland ⁽¹²⁾) only report data on “N1131G-Transport equipment” and “N115G- Cultivated biological resources” at aggregated NACE categories (A, B-E, etc.) with no information on total gross investment either. For a more detailed explanation of the GFCF data available by Member State in 2018 see **Annex 1**.

In order to derive Member State specific matrices for all EU27 countries, we process the Eurostat data based on two general principles: (i) for each country, we use all the available data, (ii) where data is missing (or confidential), we use a top-down disaggregation method based on EU27 shares, while ensuring total investments by asset type in each country are respected. The method is described in more detail in **Figure 1**.

The bottom table of **Figure 1** represents an example of an investment matrix with several investment assets in columns and fictitious production sectors in rows. The colours represent differences in the quality of the data, with green highlighting most or all Member States supply data at high levels of aggregation, moving onto amber and then red in categories with least information available (i.e., generally the ones more disaggregated).

In addition, the description in **Figure 1** summarises the procedure to fill in missing values and uses the bottom table as an example. In this case, the green cells represents data available and the amber and red cells represent missing values by a fictitious Member State.

For a comparison of EU-wide results pre and post data processing see **Annex 2**.

⁹ Malta does not report any data (including total investment) in aggregated NACE sectors B and D

¹⁰ Bulgaria reports as zero 3 assets type (ICT, Other machinery and Intellectual property products) in aggregated NACE categories (A, B-E, etc.), but based on the total gross investment values the zeroes should be interpreted as missing values

¹¹ Cyprus additionally misses data in Intellectual property asset type in higher NACE categories B, D, E, G, H, I

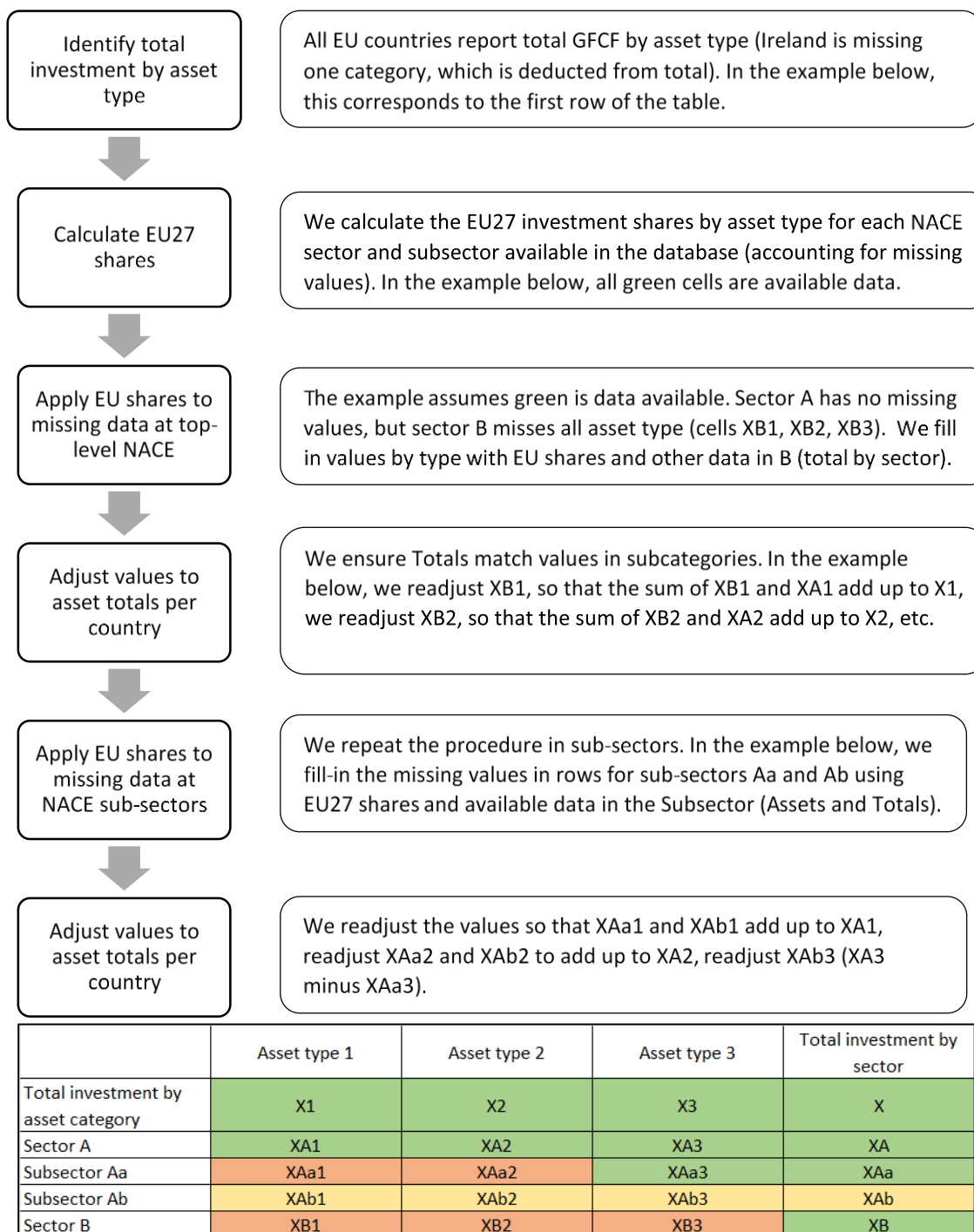
¹² Ireland similar to Malta does not report data (including total investment) in aggregated NACE sectors B and C

Table 3 Total count and summary colour scale of individual EU Member States reporting zero and positive GFCF data (i.e., no negative or missing) by industry and their matching to JRC-GEM-E3 sectors

NACE R2	JRC- GEM- E3	AUT	BEL	BGR	CYP	CRO	CZE	DEU	DNK	ESP	EST	FIN	FRA	GRC	HUN	IRL	ITA	LTU	LUX	LVA	MLT	NLD	POL	PRT	SVK	SVN	SWE	ROU
TOTAL		6	6	6	6	6	6	6	5	6	6	6	6	6	6	4	6	6	5	6	6	6	6	6	6	6	6	6
A		6	6	6	4	3	6	4	3	4	6	6	6	4	4	1	6	6	5	6	6	6	4	6	6	6	6	6
A01	1	6	0	6	3	0	6	0	3	0	0	6	0	4	4	0	0	0	5	6	0	0	0	6	6	0	5	6
A02	31	6	0	6	3	0	6	0	3	0	0	6	0	4	4	0	0	0	6	6	0	0	0	6	6	0	6	6
A03	30	6	0	6	3	0	6	0	4	0	0	5	0	4	4	0	0	0	6	6	0	0	0	6	6	0	6	6
B-E		6	6	6	4	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
B	2,3,5	6	6	6	3	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	0	6	4	6	6	6	6
C		6	6	6	4	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
C10-C12	15	6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	0	6	0	6	0	6	6	0	6	6
C13-C15	15	6	6	6	3	0	6	0	4	0	0	6	6	3	4	0	6	0	6	6	0	6	0	6	6	0	6	6
C16-C18		6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	0	6	0	6	0	6	6	0	6	6
C16	15	6	0	6	3	0	6	0	4	0	0	6	1	3	4	0	0	0	0	6	0	0	0	6	5	0	6	6
C17	10	6	0	6	3	0	6	0	4	0	0	6	1	4	4	0	0	0	0	6	0	0	0	6	6	0	6	6
C18	10	6	0	6	3	0	5	0	4	0	0	6	1	4	4	0	0	0	0	6	0	0	0	6	5	0	6	6
C19	4	6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	6	6	0	6	0	6	6	0	6	6
C20	9	6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	6	6	0	6	0	6	6	0	6	6
C21	9	6	6	5	3	0	6	0	4	0	0	6	6	3	4	0	6	0	0	6	0	6	0	6	6	0	6	6
C22_C23		6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	0	6	0	6	0	6	6	0	6	6
C22	9	6	0	6	3	0	6	0	4	0	0	6	1	4	4	0	0	0	0	6	0	0	0	6	6	0	6	6
C23	11	6	0	6	3	0	6	0	4	0	0	6	1	4	4	0	0	0	0	6	0	0	0	6	6	0	6	6
C24_C25		6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	0	6	0	6	0	6	6	0	6	6
C24	7,8	6	0	6	3	0	6	0	4	0	0	6	1	4	4	0	0	0	0	6	0	0	0	6	6	0	6	6
C25	14	6	0	6	3	0	6	0	4	0	0	6	1	4	4	0	0	0	0	6	0	0	0	6	6	0	6	6
C26	12	6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	0	6	0	6	0	6	5	0	6	6
C27	14	6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	0	6	0	6	0	6	6	0	6	6
C28	14	6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	0	6	0	6	0	6	6	0	6	6
C29_C30	13	6	6	6	2	0	6	0	4	0	0	6	6	3	4	0	5	0	0	6	0	6	0	6	6	0	6	6
C31-C33	14	6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	5	0	6	0	6	6	0	6	6	
D	6	6	6	6	3	3	5	4	4	4	5	6	6	4	4	2	6	6	6	6	0	6	4	6	6	6	6	6
E		6	6	6	3	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
E36	20	6	0	6	2	0	6	0	4	0	0	6	1	4	4	0	0	0	6	6	0	0	0	6	6	0	6	6
E37-E39	21	6	0	6	3	0	6	0	4	0	0	6	1	4	4	0	0	0	6	6	0	0	0	6	6	0	6	6
F	16	6	6	6	4	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
G-I		6	6	6	4	3	6	4	0	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
G	20	6	6	6	3	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
H		6	6	6	3	3	6	4	4	3	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
H49	18	6	0	6	3	0	6	0	4	0	0	6	1	4	4	0	0	0	6	6	0	0	0	6	6	0	6	6
H50	19	6	0	6	3	0	6	0	4	0	0	6	1	3	4	0	0	0	0	3	0	0	0	6	6	0	6	6
H51	17	6	0	6	2	0	6	0	4	0	0	6	1	4	4	0	0	0	0	6	0	0	0	6	5	0	6	6
H52	18	6	0	6	2	0	6	0	4	0	0	6	1	4	4	0	0	0	0	6	0	0	0	6	6	0	6	6
H53	20	6	0	6	3	0	6	0	4	0	0	6	1	4	4	0	0	0	0	6	0	0	0	6	6	0	6	6
I	20	6	6	6	3	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
J		6	6	6	4	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
J58-J60		6	5	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	6	6	0	6	0	6	6	0	6	6
J58	10	6	0	6	3	0	6	0	4	0	0	6	1	4	4	0	0	0	6	6	0	0	0	6	5	0	6	6
J59_J60	20	6	0	6	3	0	6	0	3	0	0	6	1	4	4	0	0	0	0	6	0	0	0	6	6	0	6	6
J61	20	6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	6	6	0	6	0	6	5	0	6	6
J62_J63	20	6	6	6	3	0	6	0	4	0	0	6	6	4	4	0	6	0	0	6	0	6	0	6	6	0	6	6
K	20	6	6	6	4	3	6	4	3	3	6	4	6	4	4	2	6	6	6	6	6	6	4	5	6	6	6	6
L	20	6	6	6	4	3	6	4	4	4	6	6	6	3	4	2	6	6	6	6	6	6	4	6	6	6	6	6
M_N	20	6	6	6	4	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
O-Q	21	6	6	6	4	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
R-U		6	6	6	4	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
R	21	6	6	6	3	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
S		6	6	6	3	3	6	4	4	4	6	6	6	4	4	2	6	6	6	6	6	6	4	6	6	6	6	6
S94	21	6	0	6	3	0	6	0	4	0	0	6	1	4	4	0	0	0	6	6	0	0	0	6	6	0	6	6
S95	20	6	0	6	3	0	6	0	3	0	0	6	1	4	4	0	0	0	6	6	0	0	0	6	6	0	6	6
S96	21	6	0	6	3	0	6	0	4	0	0	6	1	4	4	0	0	0	6	6	0	0	0	6	6	0	6	6
T	20	6	6	6	3	3	0	4	4	4	0	1	6	4	0	2	6	0	6	6	6	0	0	6	6	6	6	6
U	20	0	6	6	3	3	0	0	4	4	0	1	6	4	0	2	6	0	6	0	6	0	0	6	6	6	6	6

Source: JRC 2023 compilation using GFCF data available at NACE Rev.2 and JRC-GEM-E3 sectors equivalent.

Figure 1 Data processing method



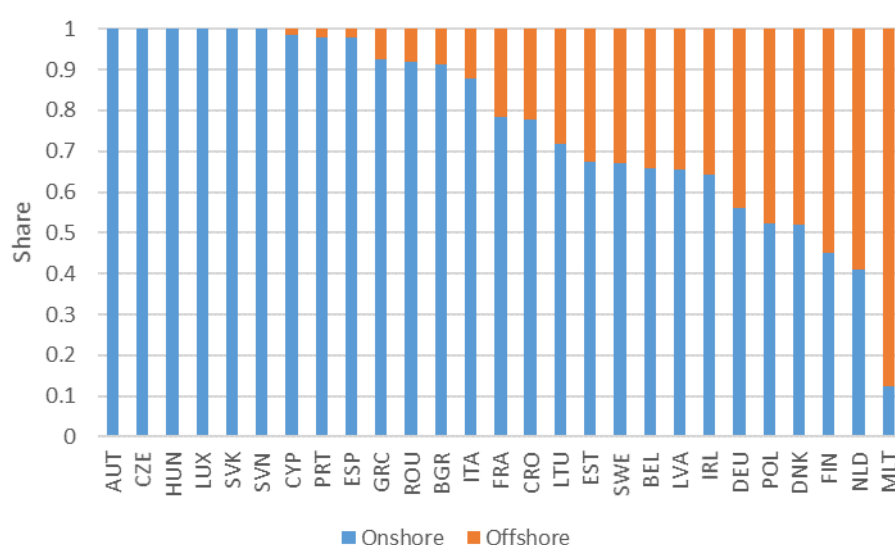
Source: JRC, 2023

3 Power generation sectors data source

GFCF data in Eurostat for the electricity sector is reported at aggregated level, namely NACE 35 (Electricity, gas, steam and air-conditioning supply). However, in the JRC-GEM-E3, the electricity sector is split into transmission and distribution activities (sector 6) and power generation activities across eight technology types (coal fired, gas-fired, oil-fired, nuclear, biomass-fired, hydro, wind and solar generation). These power generation technologies have very different physical characteristics and therefore distinct capital intensities and investment needs. A more precise representation of investment by asset type for each of these sectors is particularly important in the context of decarbonisation of the power sector, where we project large shifts from fossil fuels to renewables-based electricity generation.

In the absence of Eurostat data, we use a bottom-up approach by collecting and using complementary data on the composition of capital expenditures by power plant type from the engineering literature. **Table 4** summarises the list of studies considered for computing and validating all power generation investment matrices. It should be noted that the final estimates selected from the literature are from U.S. sources, as they were more readily available and complete in terms of data requirements for our purposes. Unfortunately, for oil-fired power generation, no representative technology was identified which meant we assume the same cost shares as those derived for the coal fired sector. For all other power generation sectors, a representative technology is selected based on data availability, and likelihood of future investment (e.g., ultra super-critical for coal, CCGT for gas, utility-scale PV for solar). For wind, we identified the investment costs to build both a representative onshore wind farm and an offshore wind farm. Then, a weighted average is computed for each EU country to account for the share of onshore vs. offshore wind in the total capacity in 2050 according to the PRIMES's model reference scenario projections (European Commission, 2021). **Figure 2** highlights differences in onshore and offshore wind capacity in EU Member States according to PRIMES. From Figure 2, land-locked Member States (Austria, Czech Republic, Hungary, Luxembourg, Slovakia and Slovenia) will have the same cost shares for wind since they only use onshore wind farms. But other Member States wind power weighted cost shares differ with an increasing share of offshore wind.

Figure 2 Share of onshore and offshore wind total capacity by EU27 Member States in 2050



Source: JRC 2023 compilation using PRIMES reference scenario (European Commission, 2021).

Based on the above mentioned studies, we create a customised mapping for capital cost to the JRC-GEM-E3 sectors for each of the technologies, based on the NACE Rev.2 two-digit level, mapped to GTAP and JRC-GEM-E3 in a similar way as the Eurostat asset types above. See in **Annex 3** the estimated capital cost breakdown for different components associated to the relevant NACE Rev.2 sector and mapped to GTAP and JRC-GEM-E3 sectors for all available power generation sectors (Table A1 coal fired, Table A2 gas-fired, Table A3 nuclear, Table A4 biomass without retrofit, Table A5 hydro, Table A6 utility-scale PV, Table A7 wind offshore and Table A8 wind onshore).

Table 4 Summary of sources for power generation sectors' capital costs and composition of investment purchases

Source and Content	Used for:
Reports including capital costs data used to build the investment matrix	
<p>EIA (2020) Capital Cost and Performance Characteristic Estimates for Utility Scale Electric Power Generating Technologies</p> <p>Overnight capital cost and performance characteristics for 25 electric generator types (fossil and renewables)</p>	<p>Data extracted for coal (ultra supercritical), gas (CCGT), biomass, nuclear (both advanced and SMR technologies) and hydroelectric plants. The specific cost data used to build the investment matrix is obtained from an ultra-super critical coal-fired power plant without CO₂ capture, 650 MW (Case 1, pp. 45-46). Although the majority of EU coal plants are subcritical, we use ultra-supercritical data as comparable source to the other technologies. In any case, little coal investment should be expected in the trajectory to net zero. For gas, a Combined Cycle power plant is used with Gas firing in a 2x2x1 configuration (CCGT), 1100 MW (Case 7, pp. 82-84). For nuclear, since most power reactors in Europe are pressurised water reactors (PWR), we rely on the example of an Advanced PWR nuclear power plant, 2156 MW (Case 11, pp. 106-107). For biomass no retrofit is assumed and we use cost data from a greenfield biomass-fired power generation facility, 50 MW (Case 13, pp. 116-118). For hydroelectric, the cost used is that for a 100MW hydroelectric power plant that includes a dam to store water in a reservoir where water is released through tunnels to a powerhouse to spin a turbine (Case 17, pp. 137-138).</p>
<p>Tyler et al. (2020) NREL 2019 Cost of Wind Energy Review</p> <p>Uses representative utility-scale and distributed wind energy projects to estimate the levelized cost of energy (LCOE) for land-based and offshore wind power plants in the United States.</p>	<p>Data extracted for onshore wind, offshore wind fixed bottom, and offshore wind floating. The cost data used in the investment matrix is a weighted mix of the total capital cost structure of an onshore wind turbine, 2.6 MW (Figure 1, pp. 7) and a fixed bottom offshore wind turbine, 6.1 MW (Figure 8, pp. 22).</p>
<p>Vignesh et al (2021) NREL U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks: Q1 2021</p> <p>Installed costs for U.S. solar photovoltaic (PV) systems using a bottom-up method, accounting for all system and project development costs incurred during installation to model the costs for residential, commercial, and utility-scale PV systems, with and without energy storage.</p>	<p>Data extracted for residential, commercial rooftop, commercial ground-mounted and utility scale solar PV. The specific cost data used to build the investment matrix is that for a utility-scale PV with 100 MW one axis-tracker system without storage (Figure 11, pp. 19).</p>

Reports including capital costs data used to validate the investment matrix

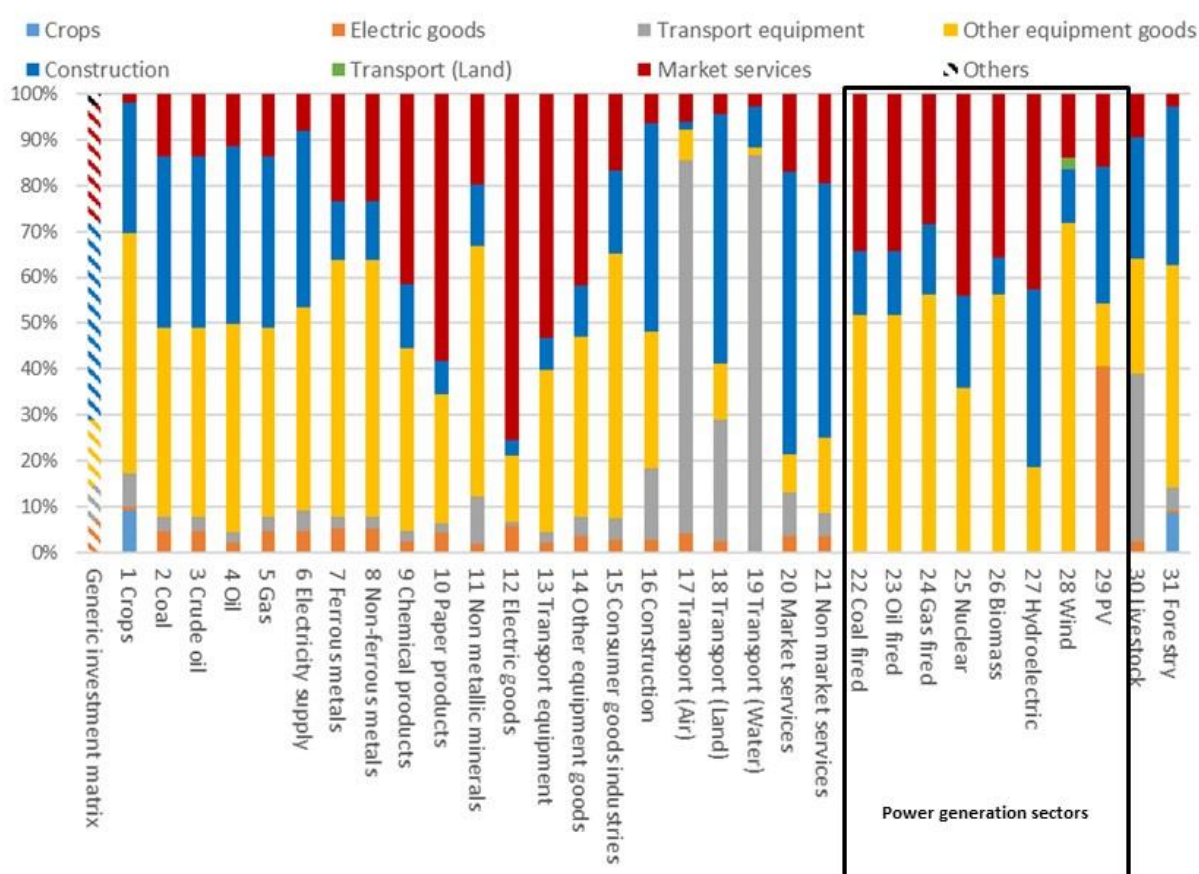
<p>Černý et al (2021) Employment effects of the renewable energy transition in the electricity sector – an input-output approach</p> <p>The report builds a concordance matrix using NACE rev.1 industry description for 13 power generation sectors (EXIOBASE 3.6) matched to the 2013 bottom-up cost data available in the JRC ETRI 2014 report (Carlsson, 2014).</p>	<p>Since the cost data is 10 years old (from 2013), we use the derived concordance matrix to validate all power generation sectors, including offshore and onshore wind farms.</p>
<p>IRENA (2021) Renewable power generation costs in 2020</p> <p>LCOE and capital cost breakdown for renewable energy technologies (solar, wind, hydropower, bioenergy and renewable heat).</p>	<p>Due to the lack of readily extractable data (figures but no tables), this report is used for quality checks of results for renewables.</p>
<p>BVG Associates (2019) Offshore Renewable Energy Catapult Wind farm costs</p> <p>Detailed breakdown of costs for the development of UK offshore wind farms (capital, financing, operational and decommissioning costs).</p>	<p>Data extracted for CAPEX and financing costs, and used to validate investment matrix for wind sector.</p>
<p>Pöyry (2018) Cost of new entrant peaking plant and combined cycle plant in I-SEM</p> <p>Sets out the capital and annual fixed cost estimates associated with OCGT and CCGT for Northern Ireland and Ireland.</p>	<p>Data extracted for CCGT, but not used for gas investment matrix due to the lack of disaggregated information on construction costs (all civil works and components aggregated into an Engineering, Procurement and Construction (EPC) cost, making up almost 80% of capital costs).</p>

Source: JRC 2023 compilation.

4 Results – EU average investment matrix

In this section, we compare a generic investment matrix using GTAP 10 data (Aguiar *et al.*, 2019) and our sector specific investment matrix for the EU27, based on the data extracted and processed as described in sections 2 and 3. The results in **Figure 3** confirm that “one size does not fit all”. While a generic investment matrix puts more emphasis on construction (43%) and market services (25%), most sectors in our disaggregated investment matrix put more emphasis on “other equipment goods”. This asset type encompasses a wide range of manufacturing of machinery and equipment; including furniture as well as, steam generators, turbines and electrical equipment for power generation sectors, also agricultural machinery (e.g., tractors, hand tools and power tools), and industrial mining equipment (e.g., excavators, drills).

Figure 3 Generic (dashed) versus sector specific investment matrix for EU27 by asset type across 31 sectors using JRC-GEM-E3 classification



Source: JRC, 2023

For power generation sectors (JRC-GEM-E3 sectors 22-29 which are also highlighted in the box), oil-fired assumes the same cost shares as those derived for the coal fired sector due to lack of data. Conventional fossil-fuel combustion technologies and biomass fired generation, all exhibit similar investment vectors. With 50 to 60% of investment in steam generators, turbines and electrical equipment, all provided by the “other equipment goods” sector. Then, 30% to 35% of costs allocated to the “market services” sector due to engineering and project services, including for planning and permitting. And the rest of costs accounted by construction with 8% to 15% of costs.

Nuclear, through its higher safety requirements and financing costs, sources a larger share of investments on “market services”, 44%. This is followed by “other equipment goods” which account for 36% related to the manufacture of the steam generator and coolant pump as well as the electrical equipment in the island as well as the nuclear power plant. Finally, only 20% of costs relate to the construction of the concrete building in the nuclear island and the construction of utility projects for electric components.

On the other hand, construction works represent a significant capital costs in hydropower and solar PV, with respectively 39% and 30% of costs. In particular for solar PV, the construction sector accounts for electrical installation and other specialised construction activities. However, the actual manufacture of the PV module is classified under “electric goods” and accounts for 41% of the capital costs. Engineering activities and related technical consultancy belong to “market services” and they account for 43% of the costs in hydropower but only 16% of costs in solar PV.

Moving onto the wind power sector, we identify different cost structures for onshore and offshore wind power plants. For details see Annex 3 Table A7 and Table A8. The weighted EU27 average investment matrix for wind power (JRC-GEM-E3 sector 28) is represented in Figure 3. The weighted cost shares highlight “other equipment goods” sector accounts for the majority of the capital cost, 72%, as it accounts for the manufacture of the rotor, nacelle, tower and electrical infrastructure. The rest of the costs are accounted by engineering installation (“market services”, 16%), construction (14%) and logistics and transportation (“Transport (Land)”, 3%).

The disaggregated representation of the wind power cost shares by Member State, taking into account their onshore and offshore wind power capacity (as in Figure 2) is available in Figure 4. In onshore and offshore wind power plants, the manufacture of the turbine and other electrical infrastructure (“other equipment goods”) represent the majority of costs (51% offshore vs 79% onshore). However, offshore power plants require higher safety requirements, additional planning and permitting steps and financing costs making “market services” cost represent 23% of costs versus 11% in onshore power plants. Also the expense of constructing (25% offshore versus 7% onshore) and transporting infrastructure (3% offshore versus 1% onshore) is more costly in offshore wind power plants. Wind power cost shares will vary between Member States depending on their individual wind capacities.

With the exception of the PV power generation sector, the asset “Electric goods” (ICT assets) represents less of 5% of investment across all sectors in Figure 3. This specific classification has been derived from the estimated capital cost breakdown for different components associated to the relevant NACE Rev.2 sector and mapped to GTAP and JRC-GEM-E3 sectors for all available power generation sectors.

For energy extraction and supply sectors (JRC-GEM-E3 sectors 2-6), investments by source are all relatively similar (see Figure 3), with roughly 40% of investment sourced from construction and 40% sourced from other equipment goods. All three mining and extraction sectors (2, 3, 5) have the same cost shares due to the data aggregation in GFCF dataset.

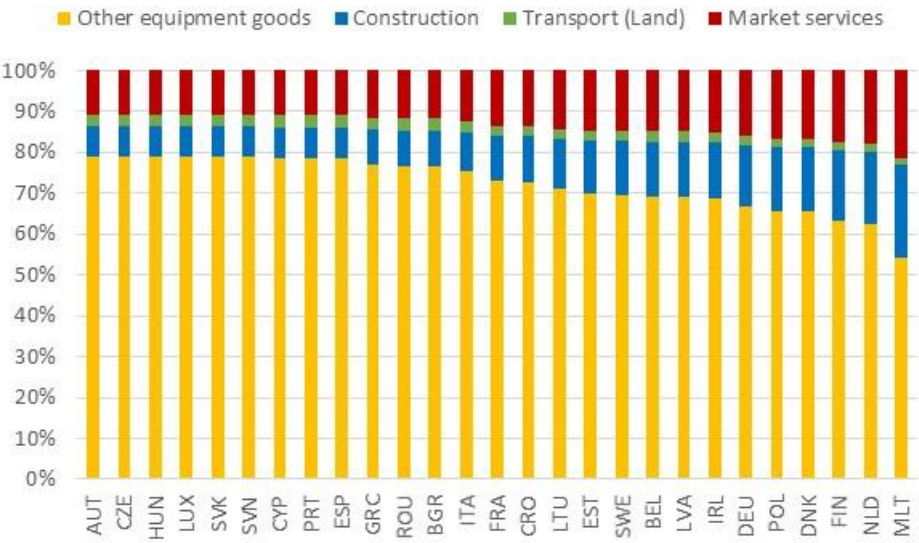
Amongst energy intensive manufacturing sectors (JRC-GEM-E3 sectors 7-16), ferrous and non-ferrous metals have the same cost shares due to the data aggregation in GFCF dataset (see Figure 3). These sectors and non-metallic minerals present similarities, with over half of assets provided by “other equipment goods”, while chemicals and paper products rely more heavily on “market services” with over 41% and 58% of investments in intellectual property assets respectively. Other manufacturing sectors producing equipment goods are also reliant on intellectual property assets for over 40% of their investments (“electric goods” (75%), “transport equipment” (53%), “other equipment goods” (42%)), while “consumer goods industries” sector rely more on “other equipment goods” (58%). The construction sector mainly relies on its own investment (45%), followed by “other equipment goods” (30%) and “transport equipment” (16%).

Logically, transport sectors (JRC-GEM-E3 sectors 17-19) are the most reliant on transport equipment (see Figure 3), which represent 81% and 86% of air and water transport investments respectively. The land transport sector, which also includes activities of warehousing and storage relies less heavily on transport equipment (27%), but has over half (54%) of its investments in buildings (construction). Similarly, the services sectors (market and non-market) invests primarily in buildings (61% and 55% respectively).

With respect to Crops and Forestry (JRC-GEM-E3 sectors 1 and 31) these are the only two sectors investing in biological resources (crops) (around 9%) (see Figure 3). They also have similar investment patterns, with around 50% of inputs sources from “other equipment goods” and around 30% from “construction”, and very limited contributions of “market services” (<5%), “transport equipment” (<10%) and “electric goods” (1%). For Livestock on the other hand, transport equipment makes up 36% of new assets, followed by “construction” (26%) and “other equipment goods” (25%).

For interested readers, **Annex 4** provides our derived investment matrix for non-power sectors by Member State. Power sectors are not included since they are fully discussed in the results section. Mining sectors 3 and 5 have the same cost shares as sector 2. Also, non-ferrous metallic sector 8 has the same cost share as ferrous metallic sector 7.

Figure 4 Individual EU Member States wind power generation investment by asset type using JRC-GEM-E3 classification



Source: JRC, 2023

5 Conclusions

Our study builds, for the first time, a transition matrix linking investment by origin (i.e., industries/sectors providing physical inputs) to investment by destination (i.e., sectors demanding the capital) disaggregated by sector and by Member State. Our contribution to the literature is twofold. First, we refine the disaggregation of investments for 23 non-power sectors by Member State using Eurostat gross fixed capital formation (GFCF) data by asset type and by NACE sector. Second, we build an investment matrix for 8 different power generation sectors using available cost data, with detailed representation of the wind power sector by Member State. In contrast, the original investment data, used in the recent applications of the macro-economic model JRC-GEM-E3, assumes each country has one investment vector for all sectors of activity, based on consumption of gross fixed capital formation available from GTAP Input-Output tables. Hence, the original investment matrix assumes all the different power and non-power industries (sectors) produce goods and services using the same proportion of physical inputs (capital) (e.g., “electric goods”, “market services”, “construction”). Our results provide an important improvement over this generic investment matrix, since for example, transport sectors can be expected to rely more on “transport equipment”, while service sectors will invest more on “construction” of office buildings and “equipment goods”.

A comparison of the generic investment matrix and our latest development of a disaggregated investment matrix by sector and by Member State highlights that “one size does not fit all”. Overall, the disaggregated investment matrix indicates substantial investment differences between sectors, with none of them matching closely the generic investment matrix. While the generic investment matrix puts more emphasis on construction (43%) and market services (25%), most sectors in our disaggregated investment matrix put more emphasis on “other equipment goods”.

With respect to power sectors, while conventional fossil-fuel combustion technologies and biomass fired generation exhibit similar investment vectors, greener power sectors exhibit different levels of investment between them. In particular, in fossil-fuel combustion and biomass fired power sectors, more than half of investment costs are represented by steam generators, turbines and electrical equipment within “other equipment goods”. But in greener technologies, PV requires most inputs from “electric goods” (41%) due to the manufacture of the PV module. In contrast, hydro and nuclear require most inputs from “market services” (43% and 44%, respectively) due to engineering and technical costs for the former and higher safety requirements and financing costs for the latter. Finally, for wind power plants; offshore wind farms have higher safety costs and construction costs than onshore wind farms, making manufacturing costs of the turbine and other electrical infrastructure (“other equipment goods”) relatively smaller in (51%) offshore versus (79%) onshore wind power plants. Our detailed representation of onshore and offshore wind capacity by Member State using PRIMES projections to 2050 allow us to differentiate the wind power generation costs by Member State.

With respect to non-power sectors, “other equipment goods” represent over 40% of assets in energy extraction and supply sectors as well as in energy intensive metallic and non-metallic mineral manufacturing. On the other hand, “market services” represent over 40% of inputs in the manufacturing of chemicals and paper products as well as the manufacturing of equipment goods (“electric goods”, “transport equipment” and “other equipment goods”). However, manufacturing of “consumer goods industries” rely more on “other equipment goods” (58%). In addition, the construction sector mainly relies on its own investment (45%) and transport sectors invests heavily on “transport equipment”. Finally, cultivated biological resources provide investment to food production sectors although “other equipment goods” supply over 40% of inputs to sectors “crops” and “forestry”, while the “livestock” sector relies heavily on “transport equipment” due to the transport of live animals.

The disaggregated investment matrix by sector and by Member State can be used as a standalone dataset to inform economic analysis as well as an input to calibrate the JRC-GEM-E3 model for the assessment of e.g. mitigation policies. In conjunction with labour intensities from the macroeconomic baseline tables from JRC-GEM-E3, the investment matrix has already served as an input to calculate employment implications of the European Commission proposal for the Net Zero Industry Act (European Commission^d, 2023) and a related assessment in the latest [Employment and Social Developments in Europe \(ESDE\)](#) report (European Commission^b, 2023, see box 2.4). Within the JRC-GEM-E3 model, the use of the investment matrix will provide an improved analysis on the impacts of climate policies on upstream sectors delivering investment goods. As the transition will lead to increased investments in clean technologies, sectors delivering such goods may

benefit from the transition. With the refined investment matrix, these sectors will be better identified. Analyses can therefore be expected to generate differences ⁽¹³⁾ in domestic production, domestic demand and investment by sector and terms of trade. In particular, the “generic investment matrix” significantly favours the “construction sector” independently of which sector invests in new physical infrastructure. On the other hand, in our “sector specific investment” matrix investments in key abatement technologies, like solar will need more “electric good” inputs, which in turn will have an effect on the employment and production in these sectors.

Our sector specific investment matrix has two major weaknesses due to lack of data availability. We could not identify similar GFCF data for non-EU countries. In addition, the cost power generation data was retrieved from US power technologies. Therefore, improvements in power generation cost estimates could come from using EU cost data from power generation industries. Note that while we trade investments e.g. in clean technologies to the corresponding upstream sector, the JRC-GEM-E3 model does not explicitly represent the production of clean technologies as individual sectors. For example, the share of imported and domestic production of PV modules may be different than for the aggregate “electric goods” sector, or the cost structure, including labour intensities, may differ from the specific technology relative to the more aggregate sector. Additional work is required to explicitly represent clean technologies (e.g. as done in Tamba et al., 2022, for electric vehicles); however, this comes with additional needs for data and modelling.

¹³ In-house tests to understand the behaviour of JRC-GEM-E3 model indicate negligible differences in macroeconomic indicators (GDP, as well as aggregate investment, public and private consumption, exports, imports, real interest rate, and consumer price index), when comparing policy analysis using a generic and a sector specific investment matrix.

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List of abbreviations and definitions

Assets	The GFCF data classifies investment by asset type
CCGT	Combined-cycle gas turbine
GFCF	Gross Fixed Capital Formation
JRC-GEM-E3	Joint Research Centre's General Equilibrium Model for the Economy Energy and Environment
PV	Photo-voltaic

List of figures

Figure 1 Data processing method.....	9
Figure 2 Share of onshore and offshore wind total capacity by EU27 Member States in 2050.....	10
Figure 3 Generic (dashed) versus sector specific investment matrix for EU27 by asset type across 31 sectors using JRC-GEM-E3 classification.....	13
Figure 4 Individual EU Member States wind power generation investment by asset type using JRC-GEM-E3 classification	15
Figure 5 in Annex 2. - Difference between unprocessed (raw data) EU average and new gap-filled investment matrix.....	27

List of tables

Table 1 GFCF asset type matching.....	5
Table 2 Total count and summary colour scale of EU Member States reporting zero and positive (i.e., no negative or missing) GFCF data by industry and by asset type and their matching to JRC-GEM-E3 sectors.....	6
Table 3 Total count and summary colour scale of individual EU Member States reporting zero and positive GFCF data (i.e., no negative or missing) by industry and their matching to JRC-GEM-E3 sectors	8
Table 4 Summary of sources for power generation sectors' capital costs and composition of investment purchases	11
Table 5 in Annex 3. Mapping of power generation capital costs – Coal fired	28
Table 6 in Annex 3. Mapping of power generation capital costs – Gas fired.....	29
Table 7 in Annex 3. Mapping of power generation capital costs – Nuclear	30
Table 8 in Annex 3. Mapping of power generation capital costs – Biomass.....	31
Table 9 in Annex 3. Mapping of power generation capital costs – Hydroelectric	32
Table 10 in Annex 3. Mapping of power generation capital costs – Utility scale solar PV	33
Table 11 in Annex 3. Mapping of power generation capital costs – Wind offshore	34
Table 12 in Annex 3. Mapping of power generation capital costs – Wind onshore	35
Table 13 in Annex 4. Austria investment matrix for non-power sectors using JRC-GEM-E3 classification	36
Table 14 in Annex 4. Belgium investment matrix for non-power sectors using JRC-GEM-E3 classification...	36
Table 15 in Annex 4. Bulgaria investment matrix for non-power sectors using JRC-GEM-E3 classification ..	37
Table 16 in Annex 4. Cyprus investment matrix for non-power sectors using JRC-GEM-E3 classification.....	37
Table 17 in Annex 4. Croatia investment matrix for non-power sectors using JRC-GEM-E3 classification.....	38
Table 18 in Annex 4. Czech Rep. investment matrix for non-power sectors using JRC-GEM-E3 classification	38
Table 19 in Annex 4. Germany investment matrix for non-power sectors using JRC-GEM-E3 classification.	39
Table 20 in Annex 4. Denmark investment matrix for non-power sectors using JRC-GEM-E3 classification.	39
Table 21 in Annex 4. Spain investment matrix for non-power sectors using JRC-GEM-E3 classification.....	40
Table 22 in Annex 4. Estonia investment matrix for non-power sectors using JRC-GEM-E3 classification.....	40
Table 23 in Annex 4. Finland investment matrix for non-power sectors using JRC-GEM-E3 classification.....	41
Table 24 in Annex 4. France investment matrix for non-power sectors using JRC-GEM-E3 classification	41
Table 25 in Annex 4. Greece investment matrix for non-power sectors using JRC-GEM-E3 classification.....	42
Table 26 in Annex 4. Hungary investment matrix for non-power sectors using JRC-GEM-E3 classification ..	42
Table 27 in Annex 4. Ireland investment matrix for non-power sectors using JRC-GEM-E3 classification.....	43
Table 28 in Annex 4. Italy investment matrix for non-power sectors using JRC-GEM-E3 classification	43
Table 29 in Annex 4. Lithuania investment matrix for non-power sectors using JRC-GEM-E3 classification	44
Table 30 in Annex 4. Luxembourg investment matrix for non-power sectors using JRC-GEM-E3 classification	44
Table 31 in Annex 4. Latvia investment matrix for non-power sectors using JRC-GEM-E3 classification	45
Table 32 in Annex 4. Malta investment matrix for non-power sectors using JRC-GEM-E3 classification	45

Table 33 in Annex 4. Netherlands investment matrix for non-power sectors using JRC-GEM-E3 classification	46
Table 34 in Annex 4. Poland investment matrix for non-power sectors using JRC-GEM-E3 classification.....	46
Table 35 in Annex 4. Portugal investment matrix for non-power sectors using JRC-GEM-E3 classification..	47
Table 36 in Annex 4. Slovakia investment matrix for non-power sectors using JRC-GEM-E3 classification..	47
Table 37 in Annex 4. Slovenia investment matrix for non-power sectors using JRC-GEM-E3 classification..	48
Table 38 in Annex 4. Sweden investment matrix for non-power sectors using JRC-GEM-E3 classification.....	48
Table 39 in Annex 4. Romania investment matrix for non-power sectors using JRC-GEM-E3 classification .	49

Annexes

Annex 1. EU Member States GFCF Eurostat data availability in year

Full data

CZE, LVA, AUT, PRT, ROU, SVK, FIN

(but FIN misses 12 in A03 and 13 in K, estimates from difference with other categories are zero)

- Full data availability in Totals across all investment categories
- Full data availability in Total fixed assets investments in all NACE categories
- Full data in all individual investment categories in major industries (A, B-E, B, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U).
- Full data in individual investment categories across sub-industries.

Blanks in sub-industries

BEL

- Full data availability in Totals across all investment categories
- Full data availability in Total fixed assets investments in all NACE categories
- Full data in all individual investment categories in major industries (A, B-E, B, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U)
- Missing data in all individual investment categories across sub-industries

Blanks in total fixed assets, and sub-industries

FRA, ITA, LUX, NLD, SWE

- Full data availability in Totals across all investment categories
- Missing data in total fixed assets investments in most/some sub-industries. Data available in all major industries (A, B-E, B, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U).
- Full data in all individual investment categories in major industries (A, B-E, B, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U).
- Missing data in all individual investment categories across most/some sub-industries

EST, LTU, SVN

- Full data availability in Totals across all investment categories
- Missing total fixed assets investments in all sub-industries. Data available in all major industries (A, B-E, B, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U).
- Full data in all individual investment categories in major industries (A, B-E, B, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U)
- Missing data in all individual investment categories across sub-industries

Blanks in industries and sub-industries

GRC, HUN

- Full data availability in Totals across all investment categories
- Full data availability in Total fixed assets investments in all NACE categories
- Missing data in 2 investment categories; ICT equipment (GEM-E3 sector 12), and Other machinery (GEM-E3 sector 16) in major industries (A, B-E, B, C, D, E, F, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U). Other investment sectors are complete.
- Missing data in 2 investment categories; ICT equipment (GEM-E3 sector 12), and other machinery (GEM-E3 sector 16) in sub-industries. Other investment sectors are complete.

DNK

- Full data availability in Totals across all investment categories
- Full data availability in Total fixed assets investments in all NACE categories. EXCEPTION G-I is missing.
- Missing data in 2 investment categories; ICT equipment (GEM-E3 sector 12), and Other machinery (GEM-E3 sector 16) in major industries (A, B-E, B, C, D, E, F, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U). Other investment sectors are complete. EXCEPTION G-I is missing all investment sectors.
- Missing data in 2 investment categories; ICT equipment (GEM-E3 sector 12), and other machinery (GEM-E3 sector 16) in sub-industries. Other investment sectors are complete.

BGR

- Full data availability in Totals across all investment categories
- Full data availability in Total fixed assets investments in all NACE categories
- Missing data in 3 investment categories; ICT equipment (GEM-E3 sector 12), Other machinery (GEM-E3 sector 16) and Intellectual property products (GEM-E3 sector 20) in major industries (A, B-E, B, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U). Other investment sectors are complete. The missing sectors are reported as zero but they are missing values after totals.
- Missing data in 3 investment categories; ICT equipment (GEM-E3 sector 12), Other machinery (GEM-E3 sector 16) and Intellectual property products (GEM-E3 sector 20) in sub-industries. Other investment sectors are complete. The missing sectors are reported as zero but they are missing values after totals.

Blanks in total fixed assets, industries and sub-industries

MLT

- Full data availability in Totals across all investment categories
- Missing data in total fixed assets investments in industry B and all sub-industries. Data available in all major industries (A, B-E, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U).
- Full data in all individual investment categories in major industries (A, B-E, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U). Except industry B which is missing
- Missing data in all individual investment categories across sub-industries

DEU, ESP, POL

- Full data availability in Totals across all investment categories
- Missing data in total fixed assets investments in all sub-industries. Data available in all major industries (A, B-E, B, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U).
- Missing data in 2 investment categories; ICT equipment (GEM-E3 sector 12), and Other machinery (GEM-E3 sector 16) in major industries (A, B-E, B, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U). Other investment sectors are complete
- Missing data in all individual investment categories across sub-industries

CYP

- Full data availability in Totals across all investment categories
- Missing data in total fixed assets investments in most industries and all sub-industries.
- Missing data in 3 investment categories; ICT equipment (GEM-E3 sector 12), Other machinery (GEM-E3 sector 16) and Intellectual property products (GEM-E3 sector 20) in major industries (A, B-E, B, C,

D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U). Other investment sectors are complete.

- Missing data in 3 investment categories; ICT equipment (GEM-E3 sector 12), Other machinery (GEM-E3 sector 16) and Intellectual property products (GEM-E3 sector 20) in sub-industries. Other investment sectors are complete.

CRO

- Full data availability in Totals across all investment categories
- Missing total fixed assets investments in all industries and sub-industries.
- Missing data in 3 investment categories; ICT equipment (GEM-E3 sector 12), Other machinery (GEM-E3 sector 16) and Intellectual property products (GEM-E3 sector 20) in major industries (A, B-E, B, C, D, E, F, G-I, G, H, I, J, K, L, M-N, M, N, O-Q, O, P, Q, R-U, R, S, T, U). Other investment sectors are complete.
- Missing data in all individual investment categories across sub-industries

Blanks in totals across investment categories, total fixed assets, industries and sub-industries

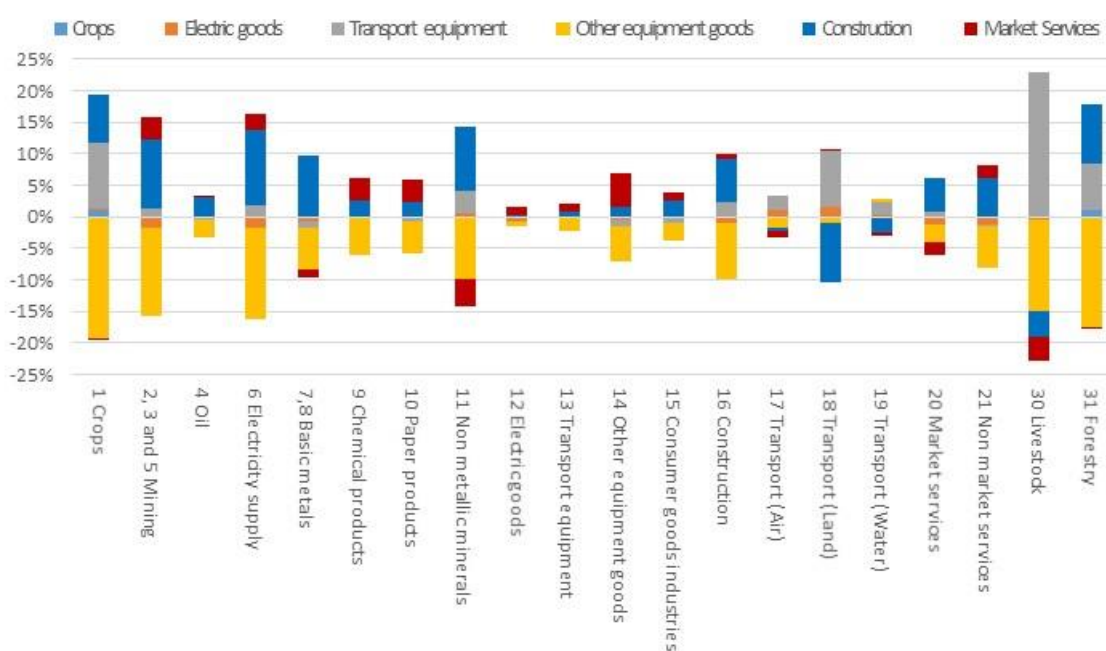
IRL

- Miss data in Total Construction (GEM-E3 sector 16) other totals in investment categories available
- Missing total fixed assets investments in all industries and sub-industries.
- Missing data in all individual investment categories across all industries
- Missing data in all individual investment categories across sub-industries

Annex 2. Comparison of EU-wide results pre- and post-data processing

The data processing method allows for correcting the bias against under-reported investment asset categories, since totals by asset type are respected across all EU27 Member States. **Figure 5 in Annex 2** highlights asset categories; “other equipment goods” and “electric goods” are under reported (i.e., negative values) in the raw data-set compared to the new gap-filled investment sector in most sectors. This result agrees with the counts of positive and zero GFCF data by Member State in Table 2, where fewer Member States report values in those two asset categories independently of the level of NACE aggregation. The impact of under-reporting these two asset categories, is that other asset categories will erroneously be inflated to a higher share value. Furthermore, the inflation effect becomes particularly significant due to the size of “other equipment goods”, when missing values are filled in using data available at higher levels of NACE aggregation.

Figure 5 in Annex 2. - Difference between unprocessed (raw data) EU average and new gap-filled investment matrix



Source: JRC, 2023

Annex 3. Breakdown of power generation capital costs

The breakdown of power generation capital costs for coal fired, gas-fired, nuclear, biomass without retrofit, hydro, utility-scale PV, wind offshore and onshore are available in the following tables.

Table 5 in Annex 3. Mapping of power generation capital costs – Coal fired

Coal fired - NREL assumption ultra-supercritical coal						
Cost component found in literature	NACE Rev. 2		GTAP sector	JRC-GEM-E3 sector		Shares without profit /tax
Boiler plant	25.3	Manufacture of steam generators	37	14	Machinery and equipment	37.9%
Electrical	27	Manufacture of electrical equipment	41	14	Machinery and equipment	6.7%
Turbine plant	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	6.5%
Balance of Plant	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	0.8%
Gas interconnection	42.21	Construction of utility projects for fluids	46	16	Construction	0.2%
Project indirects	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	13.5%
Electrical interconnection	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	0.1%
Project contingency	64.92	Other credit granting	52	20	Market Services	10.7%
Land	68	Real estate activities	54	20	Market Services	0.4%
Owner's services	70.1	Activities of head offices	54	20	Market Services	5.8%
Civil/structural/architectural	71.12	Engineering activities and related technical consultancy	54	20	Market Services	9.8%
EPC fee	71.12	Engineering activities and related technical consultancy	54	20	Market Services	7.5%

Source: JRC 2023 compilation using capital cost data from EIA (2020).

Table 6 in Annex 3. Mapping of power generation capital costs – Gas fired

Gas fired - NREL assumption for CCGT						
Cost component found in literature	NACE Rev. 2		GTAP sector	JRC-GEM-E3 sector		Shares without profit /tax
Mechanical major equipment	25.3	Manufacture of steam generators	37	14	Machinery and equipment	28.3%
Electrical	27	Manufacture of electrical equipment	41	14	Machinery and equipment	9.0%
Mechanical balance of plant	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	18.9%
Gas interconnection	42.21	Construction of utility projects for fluids	46	16	Construction	0.6%
Project indirects	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	14.5%
Electrical interconnection	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	0.2%
Project contingency	64.92	Other credit granting	52	20	Market Services	9.1%
Land	68	Real estate activities	54	20	Market Services	0.2%
Owner's services	70.1	Activities of head offices	54	20	Market Services	5.9%
EPC fee	71.12	Engineering activities and related technical consultancy	54	20	Market Services	7.6%
Civil /structural/ architectural	71.12	Engineering activities and related technical consultancy	54	20	Market Services	5.8%

Source: JRC 2023 compilation using capital cost data from EIA (2020).

Table 7 in Annex 3. Mapping of power generation capital costs – Nuclear

Nuclear - NREL assumption on advanced brownfield						
Cost component found in literature	NACE Rev. 2		GTAP sector	JRC-GEM-E3 sector		Shares without profit /tax
Nuclear island - steam generator & coolant pumps	25.3	Manufacture of steam generators	37	14	Machinery and equipment	13.2%
Electrical	27	Manufacture of electrical equipment	41	14	Machinery and equipment	6.1%
Conventional island	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	10.6%
Balance of Plant	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	6.1%
Gas interconnection	42.21	Construction of utility projects for fluids	46	16	Construction	0.0%
Project indirects	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	14.4%
Nuclear island - concrete building	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	5.7%
electrical interconnection	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	0.0%
Project contingency	64.92	Other credit granting	52	20	Market Services	9.1%
Land	68	Real estate activities	54	20	Market Services	0.0%
Owner's services	70.1	Activities of head offices	54	20	Market Services	15.1%
Civil/structural/architectural	71.12	Engineering activities and related technical consultancy	54	20	Market Services	12.9%
EPC fee	71.12	Engineering activities and related technical consultancy	54	20	Market Services	6.9%

Source: JRC 2023 compilation using capital cost data from EIA (2020).

Table 8 in Annex 3. Mapping of power generation capital costs – Biomass

Biomass - NREL assumption on biomass without retrofit						
Cost component found in literature	NACE Rev. 2		GTAP sector	JRC-GEM-E3 sector		Shares without profit /tax
Boiler plant	25.3	Manufacture of steam generators	37	14	Machinery and equipment	29.5%
Electrical	27	Manufacture of electrical equipment	41	14	Machinery and equipment	13.0%
Balance of Plant	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	9.8%
Turbine plant	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	4.0%
Gas interconnection	42.21	Construction of utility projects for fluids	46	16	Construction	0.0%
Project indirects	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	7.5%
Electrical interconnection	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	0.6%
Project contingency	64.92	Other credit granting	52	20	Market Services	10.7%
Land	68	Real estate activities	54	20	Market Services	0.7%
Owner's services	70.1	Activities of head offices	54	20	Market Services	5.8%
Civil/structural/architectural	71.12	Engineering activities and related technical consultancy	54	20	Market Services	10.9%
EPC fee	71.12	Engineering activities and related technical consultancy	54	20	Market Services	7.5%

Source: JRC 2023 compilation using capital cost data from EIA (2020).

Table 9 in Annex 3. Mapping of power generation capital costs – Hydroelectric

Hydroelectric						
Cost component found in literature	NACE Rev. 2		GTAP sector	JRC-GEM-E3 sector		Shares without profit /tax
Civil / Structural material and installation						
Installation	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	28.0%
Preparation	71.12	Engineering activities and related technical consultancy	54	20	Market Services	18.6%
Mechanical equipment supply and installation						
Electrical supply and installation	27	Manufacture of electrical equipment	41	14	Machinery and equipment	4.7%
Equipment supply	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	6.9%
Installation	33.2	Installation of industrial machinery and equipment	41	14	Machinery and equipment	6.9%
Project indirects	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	10.7%
Electrical interconnection	42.22	Construction of utility projects for electricity and telecommunications	46	16	Construction	0.2%
Project contingency	64.92	Other credit granting	52	20	Market Services	9.1%
Land	68	Real estate activities	54	20	Market Services	0.0%
Owner's services	70.1	Activities of head offices	54	20	Market Services	7.2%
EPC fee	71.12	Engineering activities and related technical consultancy	54	20	Market Services	7.6%

Source: JRC 2023 compilation using capital cost data from EIA (2020).

Table 10 in Annex 3. Mapping of power generation capital costs – Utility scale solar PV

Utility scale solar PV						
Cost component found in literature	NACE Rev. 2		GTAP sector	JRC-GEM-E3 sector		Shares without profit /tax
Module	26.11	Manufacture of electronic components	40	12	Electric goods	40.7%
Electrical BoS	27	Manufacture of electrical equipment	41	14	Machinery and equipment	8.6%
Inverter	27.9	Manufacture of other electrical equipment	41	14	Machinery and equipment	4.9%
Install labor & equipment	43.21	Electrical installation	46	16	Construction	13.6%
Structural BoS	43.99	Other specialised construction activities n.e.c	46	16	Construction	14.8%
Transmission line	43.99	Other specialised construction activities n.e.c	46	16	Construction	1.2%
Contingency	64.92	Other credit granting	52	20	Market Services	2.5%
Developer overhead	70.1	Activities of head offices	54	20	Market Services	2.5%
Permitting, inspection, interconnection	71.12	Engineering activities and related technical consultancy	54	20	Market Services	4.9%

Source: JRC 2023 compilation using capital cost data from Vignesh et al (2021).

Table 11 in Annex 3. Mapping of power generation capital costs – Wind offshore

Wind offshore - NREL assumption fixed						
Cost component found in literature	NACE Rev. 2		GTAP sector	JRC-GEM-E3 sector		Shares without profit /tax
Electrical infrastructure	27.32	Manufacture of other electronic and electric wires and cables	41	14	Machinery and equipment	18.7%
Turbine	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	31.9%
Substructure & foundation	43.99	Other specialised construction activities n.e.c	46	16	Construction	20.1%
Assembly and installation	43.99	Other specialised construction activities n.e.c	46	16	Construction	4.9%
Port and staging, logistics and transportation	52.22	Service activities incidental to water transportation	48	18	Land transport	1.4%
Lease price	64.91	Financial leasing	52	20	Market Services	2.2%
Contingency	64.92	Other credit granting	52	20	Market Services	7.7%
Construction finance	64.92	Other credit granting	52	20	Market Services	4.5%
Insurance during construction	65.12	Non-life insurance	53	20	Market Services	1.0%
Development	71.12	Engineering activities and related technical consultancy	54	20	Market Services	3.4%
Engineering Management	71.12	Engineering activities and related technical consultancy	54	20	Market Services	1.7%
Decommissioning	71.12	Engineering activities and related technical consultancy	54	20	Market Services	1.4%
Plant commissioning	71.12	Engineering activities and related technical consultancy	54	20	Market Services	1.1%

Source: JRC 2023 compilation using capital cost data from Tyler et al. (2020).

Table 12 in Annex 3. Mapping of power generation capital costs – Wind onshore

Wind onshore						
Cost component found in literature	NACE Rev. 2		GTAP sector	JRC-GEM-E3 sector		Shares without profit /tax
Electrical infrastructure	27.32	Manufacture of other electronic and electric wires and cables	41	14	Machinery and equipment	10.1%
Nacelle	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	34.0%
Rotor	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	20.0%
Tower	28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	41	14	Machinery and equipment	15.0%
Foundation	43.99	Other specialised construction activities n.e.c	46	16	Construction	4.1%
Assembly and installation	43.99	Other specialised construction activities n.e.c	46	16	Construction	3.1%
Site access and staging	52.21	Service activities incidental to land transportation	48	18	Land transport	3.0%
Contingency	64.92	Other credit granting	52	20	Market Services	6.0%
Construction finance	64.92	Other credit granting	52	20	Market Services	2.3%
Engineering management	71.12	Engineering activities and related technical consultancy	54	20	Market Services	1.3%
Development	71.12	Engineering activities and related technical consultancy	54	20	Market Services	1.1%

Source: JRC 2023 compilation using capital cost data from Tyler et al. (2020).

Annex 4. Investment matrix for JRC-GEM-E3 non-power sectors by Member States with filled in values when data is unavailable

In this annex we provide the derived investment matrix for the individual 27 Member States, reporting shares of investment purchases by JRC-GEM-E3 sector. The totals may not add up exactly to 1 due to rounding.

Table 13 in Annex 4. Austria investment matrix for non-power sectors using JRC-GEM-E3 classification

	JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
AUT	1 Crops	0.059	0.009	0.148	0.414	0.362	0.007
	2 Coal		0.007	0.073	0.778	0.076	0.067
	4 Oil		0		0.879	0.009	0.111
	6 Electricity supply		0.07	0.008	0.614	0.204	0.104
	7 Ferrous metals		0.021	0.016	0.539	0.136	0.288
	9 Chemical products		0.061	0.009	0.396	0.168	0.366
	10 Paper products		0.169	0.012	0.355	0.102	0.362
	11 Non metallic minerals		0.031	0.043	0.416	0.231	0.278
	12 Electric goods		0.037	0.003	0.217	0.053	0.691
	13 Transport equipment		0.015	0.004	0.279	0.08	0.622
	14 Other equipment goods		0.031	0.013	0.248	0.108	0.6
	15 Consumer goods industries		0.023	0.044	0.545	0.224	0.164
	16 Construction		0.056	0.172	0.353	0.179	0.24
	17 Transport (Air)		0.139	0.654	0.069	0.019	0.12
	18 Transport (Land)		0.045	0.188	0.122	0.581	0.064
	19 Transport (Water)		0.015	0.245	0.112	0.628	
	20 Market services		0.049	0.116	0.105	0.583	0.147
	21 Non market services		0.084	0.047	0.14	0.475	0.255
	30 Livestock		0.018	0.005	0.052	0.898	0.027
	31 Forestry		0.009	0.437	0.184	0.352	0.019

Source: JRC, 2023.

Table 14 in Annex 4. Belgium investment matrix for non-power sectors using JRC-GEM-E3 classification

	JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
BEL	1 Crops	0.059	0.022	0.084	0.522	0.302	0.013
	2 Coal		0.017	0.154	0.61	0.099	0.119
	4 Oil		0.006	0.008	0.193	0.583	0.21
	6 Electricity supply		0.124	0.039	0.399	0.381	0.058
	7 Ferrous metals		0.044	0.022	0.544	0.12	0.27
	9 Chemical products		0.021	0.006	0.308	0.115	0.55
	10 Paper products		0.055	0.004	0.251	0.088	0.603
	11 Non metallic minerals		0.022	0.072	0.556	0.128	0.222
	12 Electric goods		0.061	0.007	0.066	0.072	0.793
	13 Transport equipment		0.062	0.044	0.415	0.087	0.392
	14 Other equipment goods		0.069	0.049	0.407	0.096	0.38
	15 Consumer goods industries		0.024	0.031	0.671	0.145	0.128
	16 Construction		0.038	0.18	0.22	0.504	0.059
	17 Transport (Air)		0.081	0.658	0.14	0.031	0.091
	18 Transport (Land)		0.029	0.14	0.161	0.629	0.041
	19 Transport (Water)		0.001	0.747	0.032	0.175	0.044
	20 Market services		0.067	0.086	0.115	0.573	0.158
	21 Non market services		0.033	0.106	0.166	0.445	0.251
	30 Livestock		0.056	0.391	0.233	0.261	0.058
	31 Forestry	0.056	0.014	0.058	0.484	0.369	0.019

Source: JRC, 2023.

Table 15 in Annex 4. Bulgaria investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.099	0.001	0.066	0.601	0.223	0.01
2 Coal		0.003	0.288	0.387	0.256	0.065
4 Oil		0.002	0.011	0.535	0.386	0.066
6 Electricity supply	0	0.006	0.037	0.702	0.188	0.067
7 Ferrous metals		0.004	0.02	0.553	0.31	0.112
9 Chemical products	0.001	0.002	0.007	0.489	0.255	0.245
10 Paper products		0.006	0.013	0.435	0.149	0.397
11 Non metallic minerals		0.002	0.159	0.602	0.131	0.106
12 Electric goods		0.008	0.004	0.247	0.125	0.616
13 Transport equipment		0.003	0.003	0.539	0.063	0.391
14 Other equipment goods		0.004	0.028	0.514	0.191	0.263
15 Consumer goods industries	0.01	0.002	0.042	0.477	0.404	0.066
16 Construction		0.001	0.029	0.094	0.868	0.009
17 Transport (Air)		0.022	0.316	0.417	0.098	0.146
18 Transport (Land)		0.006	0.419	0.352	0.174	0.049
19 Transport (Water)			0.457	0.24	0.129	0.175
20 Market services	0	0.008	0.06	0.282	0.501	0.148
21 Non market services		0.004	0.065	0.208	0.622	0.102
30 Livestock		0.006	0.033	0.708	0.13	0.124
31 Forestry		0.001	0.048	0.867	0.06	0.024

Source: JRC, 2023.

Table 16 in Annex 4. Cyprus investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.216	0.003	0.022	0.297	0.462	
2 Coal		0.016	0.056	0.216	0.627	0.084
4 Oil		0.028	0.044	0.815	0.066	0.047
6 Electricity supply		0.032	0.012	0.422	0.443	0.092
7 Ferrous metals		0.049		0.767	0.11	0.074
9 Chemical products		0.023	0.009	0.546	0.292	0.13
10 Paper products		0.017	0.003	0.136	0.045	0.798
11 Non metallic minerals		0.013	0.15	0.551	0.241	0.046
12 Electric goods		0.109		0.403	0.009	0.478
13 Transport equipment		0.032		0.717	0.004	0.247
14 Other equipment goods		0.042	0.049	0.652	0.099	0.158
15 Consumer goods industries		0.018	0.083	0.552	0.311	0.036
16 Construction		0.024	0.077	0.383	0.513	0.002
17 Transport (Air)		0.295		0.656		0.049
18 Transport (Land)		0.064	0.119	0.458	0.346	0.013
19 Transport (Water)		0	0.998	0.002		0
20 Market services		0.018	0.028	0.069	0.758	0.127
21 Non market services		0.053	0.024	0.318	0.476	0.13
30 Livestock			0.18	0.019	0.801	
31 Forestry	0.232	0.002		0.221	0.546	

Source: JRC, 2023.

Table 17 in Annex 4. Croatia investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.186	0.01	0.08	0.591	0.124	0.01
2 Coal		0.072	0.084	0.63	0.115	0.099
4 Oil	0.006	0.021	0.021	0.403	0.503	0.046
6 Electricity supply		0.05	0.009	0.44	0.462	0.039
7 Ferrous metals	0.001	0.058	0.029	0.599	0.2	0.113
9 Chemical products	0.006	0.03	0.025	0.473	0.244	0.221
10 Paper products	0.003	0.073	0.025	0.566	0.224	0.11
11 Non metallic minerals	0.004	0.02	0.115	0.569	0.2	0.093
12 Electric goods	0.007	0.099	0.014	0.241	0.079	0.56
13 Transport equipment	0.011	0.032	0.03	0.474	0.134	0.32
14 Other equipment goods	0.004	0.046	0.051	0.476	0.198	0.226
15 Consumer goods industries	0.003	0.029	0.05	0.58	0.263	0.075
16 Construction	0	0.018	0.085	0.187	0.693	0.016
17 Transport (Air)		0.061	0.791	0.09	0.028	0.029
18 Transport (Land)	0.001	0.025	0.194	0.119	0.646	0.015
19 Transport (Water)		0.001	0.823	0.019	0.144	0.013
20 Market services	0.001	0.065	0.114	0.117	0.615	0.089
21 Non market services	0	0.048	0.065	0.206	0.583	0.098
30 Livestock		0.033	0.458	0.325	0.132	0.053
31 Forestry	0.186	0.007	0.058	0.575	0.159	0.015

Source: JRC, 2023.

Table 18 in Annex 4. Czech Rep. investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.102	0.042	0.298	0.374	0.171	0.013
2 Coal	0	0.038	0.042	0.329	0.378	0.214
4 Oil		0.058	0.012	0.523	0.372	0.035
6 Electricity supply		0.067		0.415	0.454	0.064
7 Ferrous metals	0	0.047	0.017	0.538	0.326	0.072
9 Chemical products		0.05	0.011	0.537	0.293	0.109
10 Paper products		0.055	0.002	0.481	0.162	0.3
11 Non metallic minerals		0.026	0.431	0.341	0.135	0.067
12 Electric goods		0.551	0.001	0.2	0.053	0.195
13 Transport equipment		0.059	0.023	0.495	0.102	0.321
14 Other equipment goods	0	0.07	0.013	0.559	0.187	0.172
15 Consumer goods industries	0.001	0.051	0.029	0.59	0.232	0.096
16 Construction		0.076	0.268	0.387	0.213	0.057
17 Transport (Air)		0.005	0.918	0.041		0.036
18 Transport (Land)		0.023	0.369	0.099	0.454	0.055
19 Transport (Water)		0.042	0.583	0.375		
20 Market services	0	0.033	0.098	0.146	0.51	0.213
21 Non market services	0	0.054	0.061	0.179	0.541	0.166
30 Livestock		0.031	0.25	0.313	0.354	0.052
31 Forestry	0.003	0.033	0.348	0.273	0.31	0.034

Source: JRC, 2023.

Table 19 in Annex 4. Germany investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.004	0.012	0.023	0.776	0.165	0.019
2 Coal		0.084	0.019	0.823	0.023	0.05
4 Oil		0.026	0.027	0.562	0.216	0.169
6 Electricity supply		0.059	0.025	0.58	0.303	0.033
7 Ferrous metals		0.05	0.025	0.578	0.059	0.287
9 Chemical products		0.023	0.019	0.401	0.064	0.493
10 Paper products		0.053	0.029	0.385	0.044	0.489
11 Non metallic minerals		0.018	0.103	0.571	0.062	0.246
12 Electric goods		0.048	0.007	0.131	0.013	0.801
13 Transport equipment		0.02	0.019	0.335	0.029	0.597
14 Other equipment goods		0.034	0.038	0.39	0.05	0.489
15 Consumer goods industries		0.028	0.049	0.624	0.087	0.212
16 Construction		0.047	0.199	0.548	0.147	0.059
17 Transport (Air)		0.043	0.834	0.071	0.021	0.031
18 Transport (Land)		0.022	0.253	0.115	0.59	0.02
19 Transport (Water)		0	0.865	0.015	0.106	0.014
20 Market services		0.031	0.119	0.078	0.684	0.089
21 Non market services		0.033	0.057	0.161	0.563	0.186
30 Livestock		0.044	0.153	0.486	0.201	0.116
31 Forestry	0.004	0.008	0.017	0.737	0.207	0.028

Source: JRC, 2023.

Table 20 in Annex 4. Denmark investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops		0.021	0.03	0.661	0.21	0.078
2 Coal		0.04	0.002	0.195	0.671	0.092
4 Oil		0.065	0.001	0.697	0.206	0.03
6 Electricity supply		0.05	0.005	0.247	0.656	0.042
7 Ferrous metals		0.116	0.002	0.67	0.182	0.03
9 Chemical products		0.013	0.001	0.109	0.129	0.749
10 Paper products		0.081	0.019	0.268	0.064	0.568
11 Non metallic minerals		0.029	0.082	0.471	0.231	0.186
12 Electric goods		0.088	0.003	0.12	0.037	0.752
13 Transport equipment		0.097	0.004	0.817	0.024	0.057
14 Other equipment goods		0.051	0.014	0.295	0.14	0.5
15 Consumer goods industries		0.043	0.019	0.489	0.296	0.153
16 Construction		0.065	0.138	0.38	0.32	0.097
17 Transport (Air)		0.01	0.939	0.015	0.005	0.031
18 Transport (Land)		0.008	0.29	0.041	0.606	0.054
19 Transport (Water)		0	0.895	0.001	0.083	0.021
20 Market services		0.04	0.122	0.037	0.599	0.202
21 Non market services		0.05	0.027	0.118	0.475	0.33
30 Livestock		0.014	0.792	0.075	0.004	0.115
31 Forestry		0.018	0.033	0.876		0.073

Source: JRC, 2023.

Table 21 in Annex 4. Spain investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries		Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
ESP	1 Crops	0.418	0.006	0.076	0.226	0.261	0.013
	2 Coal		0.068	0.033	0.428	0.277	0.193
	4 Oil		0.027	0.022	0.372	0.538	0.041
	6 Electricity supply		0.065	0.006	0.41	0.291	0.228
	7 Ferrous metals		0.077	0.031	0.568	0.22	0.103
	9 Chemical products		0.041	0.028	0.455	0.272	0.204
	10 Paper products		0.059	0.014	0.265	0.112	0.55
	11 Non metallic minerals		0.026	0.124	0.543	0.222	0.085
	12 Electric goods		0.135	0.016	0.235	0.089	0.525
	13 Transport equipment		0.044	0.033	0.467	0.153	0.303
	14 Other equipment goods		0.062	0.055	0.456	0.219	0.208
	15 Consumer goods industries		0.038	0.054	0.55	0.29	0.068
	16 Construction		0.012	0.058	0.09	0.826	0.014
	17 Transport (Air)		0.041	0.909	0.043	0.006	
	18 Transport (Land)		0.038	0.499	0.128	0.334	
	19 Transport (Water)		0	0.957	0.009	0.034	
	20 Market services	0	0.038	0.102	0.067	0.596	0.197
	21 Non market services	0	0.045	0.036	0.145	0.557	0.216
	30 Livestock	0.002	0.019	0.47	0.133	0.299	0.077
	31 Forestrv	0.397	0.003	0.053	0.209	0.318	0.02

Source: JRC, 2023.

Table 22 in Annex 4. Estonia investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries		Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
EST	1 Crops	0.062	0.051	0.098	0.497	0.287	0.005
	2 Coal		0.051	0.145	0.557	0.215	0.032
	4 Oil		0.028	0.017	0.334	0.601	0.02
	6 Electricity supply		0.011		0.619	0.321	0.049
	7 Ferrous metals		0.086	0.026	0.562	0.27	0.055
	9 Chemical products		0.048	0.024	0.468	0.347	0.113
	10 Paper products		0.069	0.012	0.225	0.13	0.564
	11 Non metallic minerals		0.03	0.105	0.543	0.276	0.046
	12 Electric goods		0.192	0.017	0.296	0.139	0.356
	13 Transport equipment		0.055	0.031	0.52	0.212	0.182
	14 Other equipment goods		0.072	0.049	0.476	0.285	0.117
	15 Consumer goods industries		0.042	0.044	0.531	0.347	0.035
	16 Construction		0.039	0.346	0.449	0.141	0.025
	17 Transport (Air)		0.105	0.705	0.097	0.006	0.087
	18 Transport (Land)		0.084	0.335	0.248	0.245	0.088
	19 Transport (Water)		0.001	0.892	0.025	0.034	0.047
	20 Market services		0.056	0.07	0.081	0.665	0.128
	21 Non market services		0.051	0.055	0.162	0.598	0.133
	30 Livestock		0.123	0.423	0.205	0.229	0.02
	31 Forestry	0.06	0.033	0.07	0.472	0.358	0.007

Source: JRC, 2023.

Table 23 in Annex 4. Finland investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.018	0.016	0.222	0.181	0.557	0.007
2 Coal		0.018	0.028	0.309	0.391	0.253
4 Oil		0.015	0.007	0.487	0.182	0.309
6 Electricity supply		0.017	0.023	0.398	0.487	0.074
7 Ferrous metals		0.07	0.024	0.544	0.186	0.175
9 Chemical products		0.091	0.016	0.306	0.132	0.454
10 Paper products		0.045	0.007	0.365	0.113	0.47
11 Non metallic minerals		0.011	0.004	0.597	0.154	0.234
12 Electric goods		0.026	0.01	0.08	0.013	0.871
13 Transport equipment				0.522	0.125	0.353
14 Other equipment goods		0.022	0.022	0.214	0.092	0.65
15 Consumer goods industries		0.059	0.028	0.495	0.223	0.195
16 Construction		0.009	0.107	0.655	0.124	0.105
17 Transport (Air)			0.781	0.015	0.037	0.167
18 Transport (Land)		0.015	0.445	0.139	0.35	0.052
19 Transport (Water)		0.01	0.754	0.12	0.084	0.031
20 Market services		0.035	0.014	0.074	0.774	0.104
21 Non market services	0.001	0.014	0.014	0.169	0.579	0.223
30 Livestock				0.543	0.457	
31 Forestry		0.006		0.455	0.517	0.022

Source: JRC, 2023.

Table 24 in Annex 4. France investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.089	0.005	0.038	0.536	0.289	0.043
2 Coal		0.038	0.13	0.343	0.128	0.361
4 Oil		0.064	0.115	0.387	0.094	0.34
6 Electricity supply		0.043	0.184	0.519	0.177	0.076
7 Ferrous metals		0.092	0.05	0.334	0.109	0.415
9 Chemical products		0.03	0.049	0.253	0.08	0.589
10 Paper products		0.012	0.02	0.079	0.033	0.857
11 Non metallic minerals		0.013	0.12	0.321	0.116	0.431
12 Electric goods		0.004	0.009	0.053	0.012	0.922
13 Transport equipment		0.015	0.035	0.116	0.027	0.807
14 Other equipment goods		0.03	0.059	0.23	0.102	0.578
15 Consumer goods industries		0.032	0.086	0.379	0.237	0.265
16 Construction		0.015	0.177	0.381	0.289	0.139
17 Transport (Air)		0.026	0.757	0.076	0.015	0.126
18 Transport (Land)		0.015	0.259	0.14	0.494	0.092
19 Transport (Water)		0	0.839	0.017	0.084	0.06
20 Market services		0.021	0.055	0.073	0.642	0.209
21 Non market services		0.019	0.054	0.119	0.659	0.149
30 Livestock	0	0.015	0.204	0.274	0.286	0.221
31 Forestry	0.082	0.003	0.026	0.483	0.343	0.063

Source: JRC, 2023.

Table 25 in Annex 4. Greece investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.039	0.033	0.228	0.624	0.076	0
2 Coal		0.103	0.02	0.302	0.518	0.058
4 Oil		0.053	0.002	0.341	0.162	0.442
6 Electricity supply		0.216	0.012	0.639	0.056	0.077
7 Ferrous metals		0.163	0.016	0.562	0.167	0.091
9 Chemical products		0.107	0.007	0.557	0.15	0.178
10 Paper products		0.221	0.009	0.425	0.07	0.276
11 Non metallic minerals		0.071	0.062	0.68	0.117	0.07
12 Electric goods		0.439		0.359	0.011	0.191
13 Transport equipment		0.163		0.815	0.014	0.008
14 Other equipment goods		0.177	0.013	0.614	0.075	0.121
15 Consumer goods industries		0.086	0	0.58	0.248	0.085
16 Construction		0.018	0.124	0.061	0.637	0.16
17 Transport (Air)		0.167	0.604	0.082	0.01	0.137
18 Transport (Land)		0.061	0.498	0.096	0.301	0.045
19 Transport (Water)		0.001	0.918	0.012		0.069
20 Market services		0.154	0.046	0.101	0.448	0.252
21 Non market services	0	0.052	0.031	0.077	0.598	0.242
30 Livestock		0.033	0.774	0.109	0.073	0.011
31 Forestry		0.034		0.966		

Source: JRC, 2023.

Table 26 in Annex 4. Hungary investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.122	0.007	0.115	0.467	0.276	0.013
2 Coal		0.048	0.019	0.49	0.44	0.003
4 Oil		0.015	0.03	0.325	0.525	0.106
6 Electricity supply		0.062	0.007	0.641	0.267	0.022
7 Ferrous metals		0.063	0.007	0.753	0.143	0.034
9 Chemical products		0.029	0.022	0.527	0.255	0.167
10 Paper products		0.074	0.028	0.619	0.115	0.163
11 Non metallic minerals		0.021	0.047	0.707	0.205	0.02
12 Electric goods		0.101	0.006	0.286	0.208	0.4
13 Transport equipment		0.023	0.005	0.405	0.238	0.329
14 Other equipment goods		0.049	0.034	0.594	0.232	0.091
15 Consumer goods industries	0	0.031	0.036	0.732	0.179	0.021
16 Construction		0.03	0.261	0.361	0.304	0.044
17 Transport (Air)		0.005	0.975	0.008	0	0.012
18 Transport (Land)		0.013	0.367	0.069	0.524	0.027
19 Transport (Water)		0.01	0.241	0.317	0.394	0.038
20 Market services	0	0.03	0.107	0.082	0.601	0.179
21 Non market services	0	0.016	0.052	0.095	0.793	0.043
30 Livestock		0.061	0.059	0.696	0.117	0.067
31 Forestry		0.008	0.041	0.831	0.109	0.01

Source: JRC, 2023.

Table 27 in Annex 4. Ireland investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops		0.012	0.14	0.138	0.657	0.054
2 Coal		0.041	0.003	0.073	0.61	0.273
4 Oil		0.02	0.049	0.08	0.632	0.218
6 Electricity supply		0.047	0.004	0.085	0.685	0.179
7 Ferrous metals		0.055	0.065	0.115	0.244	0.521
9 Chemical products		0.019	0.038	0.061	0.199	0.682
10 Paper products		0.056	0.044	0.085	0.197	0.617
11 Non metallic minerals		0.018	0.242	0.104	0.231	0.406
12 Electric goods		0.033	0.011	0.016	0.034	0.906
13 Transport equipment		0.016	0.036	0.05	0.09	0.808
14 Other equipment goods		0.028	0.074	0.06	0.157	0.681
15 Consumer goods industries		0.03	0.122	0.122	0.351	0.376
16 Construction		0.025	0.179	0.052	0.637	0.108
17 Transport (Air)		0.033	0.858	0.01	0.02	0.079
18 Transport (Land)		0.019	0.287	0.018	0.62	0.056
19 Transport (Water)		0	0.866	0.002	0.098	0.034
20 Market services		0.039	0.304	0.024	0.164	0.469
21 Non market services		0.029	0.035	0.031	0.65	0.255
30 Livestock		0.02	0.422	0.04	0.365	0.154
31 Forestry		0.007	0.088	0.115	0.719	0.072

Source: JRC, 2023.

Table 28 in Annex 4. Italy investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.064	0.003	0.026	0.602	0.3	0.005
2 Coal		0.079	0.007	0.297	0.5	0.117
4 Oil		0.002	0.003	0.407	0.564	0.024
6 Electricity supply		0.012	0.004	0.209	0.676	0.099
7 Ferrous metals		0.031	0.015	0.719	0.087	0.149
9 Chemical products		0.015	0.006	0.715	0.064	0.201
10 Paper products		0.061	0.01	0.496	0.082	0.351
11 Non metallic minerals		0.013	0.04	0.736	0.084	0.127
12 Electric goods		0.016	0.006	0.326	0.038	0.614
13 Transport equipment		0.007		0.494	0.049	0.45
14 Other equipment goods		0.041	0.031	0.542	0.093	0.294
15 Consumer goods industries		0.023	0.024	0.699	0.092	0.163
16 Construction		0.064	0.207	0.451	0.2	0.078
17 Transport (Air)		0.03	0.805	0.069	0.02	0.076
18 Transport (Land)		0.015	0.249	0.115	0.571	0.05
19 Transport (Water)		0	0.849	0.015	0.102	0.034
20 Market services		0.053	0.068	0.104	0.606	0.168
21 Non market services	0.001	0.037	0.04	0.365	0.409	0.148
30 Livestock	0	0.011	0.176	0.397	0.383	0.033
31 Forestry	0.06	0.002	0.018	0.551	0.361	0.007

Source: JRC, 2023.

Table 29 in Annex 4. Lithuania investment matrix for non-power sectors using JRC-GEM-E3 classification

	JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
LTU	1 Crops	0.108	0.009	0.074	0.393	0.389	0.027
	2 Coal		0.027	0.131	0.309	0.475	0.058
	4 Oil		0.015	0.016	0.154	0.787	0.028
	6 Electricity supply		0.035	0.013	0.029	0.882	0.04
	7 Ferrous metals		0.062	0.033	0.339	0.465	0.102
	9 Chemical products		0.03	0.026	0.245	0.518	0.182
	10 Paper products		0.063	0.018	0.184	0.258	0.476
	11 Non metallic minerals		0.021	0.126	0.315	0.456	0.082
	12 Electric goods		0.111	0.017	0.145	0.193	0.534
	13 Transport equipment		0.036	0.035	0.287	0.333	0.308
	14 Other equipment goods		0.047	0.055	0.259	0.442	0.196
	15 Consumer goods industries		0.028	0.051	0.3	0.559	0.061
	16 Construction		0.067	0.192	0.178	0.419	0.145
	17 Transport (Air)		0.048	0.84	0.03	0.008	0.073
	18 Transport (Land)		0.04	0.414	0.079	0.391	0.077
	19 Transport (Water)		0.001	0.914	0.007	0.045	0.034
	20 Market services		0.077	0.135	0.102	0.562	0.125
	21 Non market services		0.074	0.056	0.143	0.594	0.133
	30 Livestock		0.024	0.344	0.175	0.336	0.122
	31 Forestry	0.099	0.005	0.049	0.351	0.456	0.039

Source: JRC, 2023.

Table 30 in Annex 4. Luxembourg investment matrix for non-power sectors using JRC-GEM-E3 classification

	JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
LUX	1 Crops			0.199	0.039	0.762	
	2 Coal		0.011	0.217	0.446	0.315	0.011
	6 Electricity supply		0.02	0.033	0.391	0.517	0.038
	7 Ferrous metals		0.016	0.034	0.536	0.302	0.111
	9 Chemical products		0.006	0.012	0.323	0.378	0.28
	10 Paper products		0.049	0.052	0.379	0.266	0.255
	11 Non metallic minerals		0.005	0.128	0.488	0.29	0.088
	12 Electric goods		0.03	0.018	0.233	0.128	0.592
	13 Transport equipment		0.009	0.035	0.431	0.206	0.319
	14 Other equipment goods		0.013	0.058	0.418	0.293	0.218
	15 Consumer goods industries		0.006	0.035	0.514	0.371	0.074
	16 Construction		0.056	0.296	0.182	0.448	0.018
	17 Transport (Air)		0.061	0.859	0.05	0.008	0.023
	18 Transport (Land)		0.029	0.49	0.065	0.388	0.027
	19 Transport (Water)		0.001	0.935	0.011	0.042	0.011
	20 Market services		0.065	0.206	0.05	0.599	0.08
	21 Non market services		0.014	0.029	0.074	0.756	0.127
	31 Forestry			0.211	0.105	0.632	0.053

Source: JRC, 2023.

Table 31 in Annex 4. Latvia investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.018	0.003	0.119	0.515	0.343	0.002
2 Coal		0.024	0.134	0.626	0.203	0.012
4 Oil		0.944			0.056	
6 Electricity supply	0	0.287	0.054	0.263	0.352	0.044
7 Ferrous metals			0.033	0.767	0.2	
9 Chemical products		0.021	0.044	0.509	0.171	0.256
10 Paper products		0.028	0.032	0.757	0.06	0.124
11 Non metallic minerals		0.016	0.028	0.579	0.274	0.104
12 Electric goods		0.006		0.436	0.106	0.453
13 Transport equipment		0.006		0.586	0.248	0.159
14 Other equipment goods		0.016	0.051	0.621	0.169	0.142
15 Consumer goods industries	0.002	0.011	0.079	0.604	0.266	0.038
16 Construction		0.026	0.174	0.185	0.605	0.011
17 Transport (Air)		0.684	0.042	0.213	0.04	0.021
18 Transport (Land)	0	0.033	0.45	0.144	0.36	0.014
19 Transport (Water)					0.917	0.083
20 Market services	0.001	0.031	0.038	0.189	0.618	0.123
21 Non market services		0.053	0.033	0.172	0.697	0.046
30 Livestock			0.159	0.365	0.333	0.143
31 Forestry	0.086	0.014	0.219	0.323	0.337	0.02

Source: JRC, 2023.

Table 32 in Annex 4. Malta investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.14	0.01	0.051	0.665	0.121	0.012
2 Coal		0.004	0.011	0.434	0.536	0.016
4 Oil		0.002	0.01	0.5	0.478	0.01
6 Electricity supply		0.004	0.014	0.444	0.529	0.009
7 Ferrous metals		0.006	0.013	0.761	0.194	0.026
9 Chemical products		0.003	0.013	0.665	0.263	0.056
10 Paper products		0.015	0.005	0.3	0.086	0.594
11 Non metallic minerals		0.002	0.053	0.727	0.196	0.021
12 Electric goods		0.018	0.012	0.581	0.145	0.243
13 Transport equipment		0.004	0.016	0.732	0.159	0.089
14 Other equipment goods		0.005	0.027	0.69	0.219	0.059
15 Consumer goods industries		0.003	0.022	0.711	0.247	0.017
16 Construction		0.001	0.084	0.355	0.53	0.029
17 Transport (Air)		0.006	0.717	0.233	0.005	0.04
18 Transport (Land)		0.004	0.288	0.504	0.17	0.034
19 Transport (Water)			0.892	0.059	0.028	0.021
20 Market services		0.033	0.009	0.167	0.667	0.124
21 Non market services		0.039	0.047	0.157	0.426	0.331
30 Livestock		0.036	0.331	0.411	0.145	0.077
31 Forestry	0.139	0.006	0.037	0.644	0.155	0.019

Source: JRC, 2023.

Table 33 in Annex 4. Netherlands investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.01	0.005	0.046	0.535	0.366	0.038
2 Coal		0.003	0.034	0.348	0.459	0.156
4 Oil		0.005	0.001	0.882	0.066	0.046
6 Electricity supply		0.005	0	0.361	0.524	0.109
7 Ferrous metals		0.02	0.023	0.501	0.161	0.295
9 Chemical products		0.011	0.002	0.415	0.404	0.168
10 Paper products		0.049	0.017	0.318	0.058	0.559
11 Non metallic minerals		0.02	0.074	0.598	0.105	0.203
12 Electric goods		0.009	0.003	0.067	0.023	0.898
13 Transport equipment		0.03	0.041	0.324	0.128	0.477
14 Other equipment goods		0.018	0.027	0.282	0.102	0.572
15 Consumer goods industries		0.019	0.02	0.548	0.183	0.23
16 Construction		0.026	0.296	0.234	0.236	0.207
17 Transport (Air)		0.039	0.712	0.082	0.009	0.157
18 Transport (Land)		0.028	0.295	0.184	0.356	0.138
19 Transport (Water)		0	0.846	0.02	0.054	0.079
20 Market services		0.032	0.087	0.093	0.621	0.167
21 Non market services		0.059	0.021	0.117	0.476	0.327
30 Livestock		0.013	0.227	0.251	0.333	0.176
31 Forestry	0.009	0.003	0.031	0.475	0.428	0.054

Source: JRC, 2023.

Table 34 in Annex 4. Poland investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.045	0.003	0.152	0.298	0.496	0.006
2 Coal		0.018	0.047	0.319	0.578	0.038
4 Oil		0.012	0.021	0.478	0.472	0.017
6 Electricity supply		0.028	0.011	0.493	0.44	0.028
7 Ferrous metals		0.034	0.029	0.708	0.187	0.042
9 Chemical products	0	0.02	0.028	0.613	0.25	0.089
10 Paper products		0.039	0.023	0.534	0.154	0.25
11 Non metallic minerals		0.011	0.112	0.659	0.184	0.034
12 Electric goods	0	0.092	0.022	0.447	0.115	0.324
13 Transport equipment	0	0.022	0.035	0.658	0.147	0.139
14 Other equipment goods	0	0.03	0.056	0.619	0.203	0.092
15 Consumer goods industries	0	0.017	0.048	0.668	0.24	0.027
16 Construction		0.015	0.134	0.314	0.521	0.017
17 Transport (Air)		0.026	0.799	0.077	0.073	0.025
18 Transport (Land)		0.005	0.098	0.05	0.84	0.006
19 Transport (Water)		0	0.674	0.013	0.304	0.009
20 Market services		0.026	0.17	0.118	0.568	0.118
21 Non market services	0	0.023	0.071	0.217	0.563	0.126
30 Livestock	0	0.005	0.543	0.102	0.328	0.022
31 Forestry	0.041	0.002	0.102	0.266	0.581	0.009

Source: JRC, 2023.

Table 35 in Annex 4. Portugal investment matrix for non-power sectors using JRC-GEM-E3 classification

	JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
PRT	1 Crops	0.441	0.001	0.04	0.387	0.12	0.011
	2 Coal		0.006	0.027	0.218	0.667	0.082
	4 Oil		0.01		0.081	0.829	0.08
	6 Electricity supply		0.003	0.003	0.208	0.733	0.052
	7 Ferrous metals		0.006	0.01	0.654	0.261	0.068
	9 Chemical products		0.011	0.012	0.358	0.399	0.219
	10 Paper products		0.013	0.008	0.4	0.434	0.145
	11 Non metallic minerals		0.025	0.02	0.484	0.31	0.16
	12 Electric goods		0.086	0.003	0.494	0.239	0.178
	13 Transport equipment		0.016	0.015	0.557	0.297	0.115
	14 Other equipment goods		0.023	0.028	0.526	0.297	0.126
	15 Consumer goods industries		0.014	0.022	0.427	0.422	0.115
	16 Construction		0.037	0.08	0.545	0.276	0.062
	17 Transport (Air)		0.02	0.813	0.078	0.01	0.08
	18 Transport (Land)		0.016	0.564	0.057	0.325	0.037
	19 Transport (Water)		0.01	0.93	0.01	0.04	0.011
	20 Market services		0.067	0.081	0.08	0.616	0.156
	21 Non market services		0.057	0.066	0.173	0.418	0.286
	30 Livestock		0.006	0.302	0.374	0.267	0.053
	31 Forestry	0.555	0.003	0.09	0.247	0.075	0.031

Source: JRC, 2023.

Table 36 in Annex 4. Slovakia investment matrix for non-power sectors using JRC-GEM-E3 classification

	JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
SVK	1 Crops	0.136	0.002	0.292	0.35	0.211	0.007
	2 Coal	0.036	0.003	0.13	0.598	0.216	0.018
	4 Oil	0.019	0.055	0.001	0.575	0.28	0.07
	6 Electricity supply	0.006	0.039	0.007	0.511	0.39	0.048
	7 Ferrous metals	0.004	0.021	0.017	0.752	0.137	0.068
	9 Chemical products	0.038	0.008	0.03	0.682	0.162	0.081
	10 Paper products	0.012	0.016	0.074	0.754	0.113	0.031
	11 Non metallic minerals	0.016	0.026	0.098	0.743	0.092	0.025
	12 Electric goods	0.072	0.056	0.025	0.729		0.118
	13 Transport equipment	0.015	0.006	0.009	0.644	0.225	0.101
	14 Other equipment goods	0.013	0.013	0.052	0.613	0.19	0.119
	15 Consumer goods industries	0.005	0.008	0.149	0.575	0.241	0.021
	16 Construction	0.01	0.005	0.393	0.331	0.253	0.008
	17 Transport (Air)	0.2			0.8		
	18 Transport (Land)	0.005	0.01	0.301	0.039	0.628	0.017
	19 Transport (Water)	0.019		0.462	0.173	0.327	0.019
	20 Market services	0.054	0.036	0.161	0.118	0.531	0.099
	21 Non market services	0.006	0.02	0.068	0.198	0.527	0.181
	30 Livestock	0.067		0.4	0.267	0.267	
	31 Forestry	0.068	0.006	0.32	0.204	0.348	0.054

Source: JRC, 2023.

Table 37 in Annex 4. Slovenia investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops	0.112	0.012	0.176	0.304	0.39	0.005
2 Coal		0.017	0.061	0.594	0.209	0.119
4 Oil		0.009	0.014	0.479	0.445	0.053
6 Electricity supply	0.001	0.028	0.018	0.504	0.386	0.062
7 Ferrous metals		0.023	0.018	0.671	0.166	0.122
9 Chemical products	0	0.012	0.015	0.53	0.203	0.239
10 Paper products		0.042	0.015	0.483	0.139	0.321
11 Non metallic minerals		0.008	0.071	0.649	0.17	0.103
12 Electric goods	0	0.039	0.009	0.273	0.066	0.613
13 Transport equipment	0	0.012	0.018	0.521	0.11	0.34
14 Other equipment goods	0	0.018	0.031	0.537	0.166	0.247
15 Consumer goods industries	0	0.011	0.031	0.655	0.221	0.082
16 Construction		0.015	0.398	0.4	0.166	0.021
17 Transport (Air)		0.055	0.838	0.046	0.007	0.054
18 Transport (Land)		0.048	0.43	0.127	0.337	0.059
19 Transport (Water)		0.001	0.926	0.01	0.038	0.025
20 Market services		0.075	0.083	0.124	0.537	0.181
21 Non market services	0	0.043	0.055	0.124	0.661	0.117
30 Livestock		0.023	0.608	0.101	0.25	0.017
31 Forestry	0.106	0.008	0.122	0.281	0.475	0.008

Source: JRC, 2023.

Table 38 in Annex 4. Sweden investment matrix for non-power sectors using JRC-GEM-E3 classification

JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
1 Crops		0.006	0.054	0.564	0.369	0.006
2 Coal		0.008	0.009	0.386	0.475	0.122
4 Oil		0.168	0.008	0.517	0.219	0.088
6 Electricity supply		0.103	0.008	0.361	0.425	0.102
7 Ferrous metals		0.113	0.011	0.416	0.068	0.392
9 Chemical products		0.047	0.023	0.303	0.078	0.55
10 Paper products		0.04	0.006	0.145	0.032	0.777
11 Non metallic minerals		0.033	0.111	0.656	0.09	0.108
12 Electric goods		0.033	0.014	0.194	0.004	0.754
13 Transport equipment		0.047	0.026	0.232	0.035	0.66
14 Other equipment goods		0.037	0.047	0.271	0.043	0.603
15 Consumer goods industries		0.073	0.046	0.617	0.146	0.118
16 Construction		0.016	0.323	0.553	0.07	0.038
17 Transport (Air)		0.018	0.854	0.098	0.005	0.025
18 Transport (Land)		0.032	0.171	0.208	0.529	0.06
19 Transport (Water)		0.032	0.782	0.138	0.002	0.047
20 Market services		0.042	0.064	0.087	0.577	0.23
21 Non market services	0.003	0.049	0.03	0.2	0.502	0.217
30 Livestock		0.218	0.518	0.178	0.064	0.022
31 Forestry	0.144	0.005	0.075	0.305	0.455	0.016

Source: JRC, 2023.

Table 39 in Annex 4. Romania investment matrix for non-power sectors using JRC-GEM-E3 classification

	JRC-GEM-E3 sectors \ industries	Crops	Electric goods	Transport equipment	Other equipment goods	Construction	Market services
ROU	1 Crops	0.058	0.027	0.034	0.439	0.433	0.009
	2 Coal		0.011	0.032	0.338	0.389	0.231
	4 Oil		0.001		0.034	0.955	0.01
	6 Electricity supply		0.009	0.005	0.399	0.561	0.026
	7 Ferrous metals		0.009	0.01	0.462	0.386	0.133
	9 Chemical products		0.012	0.024	0.549	0.31	0.106
	10 Paper products		0.039	0.032	0.482	0.332	0.115
	11 Non metallic minerals		0.011	0.069	0.592	0.312	0.016
	12 Electric goods		0.012	0.006	0.474	0.218	0.29
	13 Transport equipment		0.015	0.02	0.744	0.166	0.055
	14 Other equipment goods		0.011	0.032	0.547	0.352	0.058
	15 Consumer goods industries		0.011	0.043	0.542	0.373	0.032
	16 Construction		0.001	0.065	0.073	0.84	0.02
	17 Transport (Air)		0.009	0.82	0.046	0.045	0.08
	18 Transport (Land)		0.138	0.342	0.131	0.385	0.004
	19 Transport (Water)		0.022	0.821	0.153	0.004	
	20 Market services		0.046	0.046	0.118	0.714	0.075
	21 Non market services		0.085	0.156	0.166	0.357	0.236
	30 Livestock			0.006		0.988	0.006
	31 Forestry	0.002		0.015	0.186	0.797	

Source: JRC, 2023.

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