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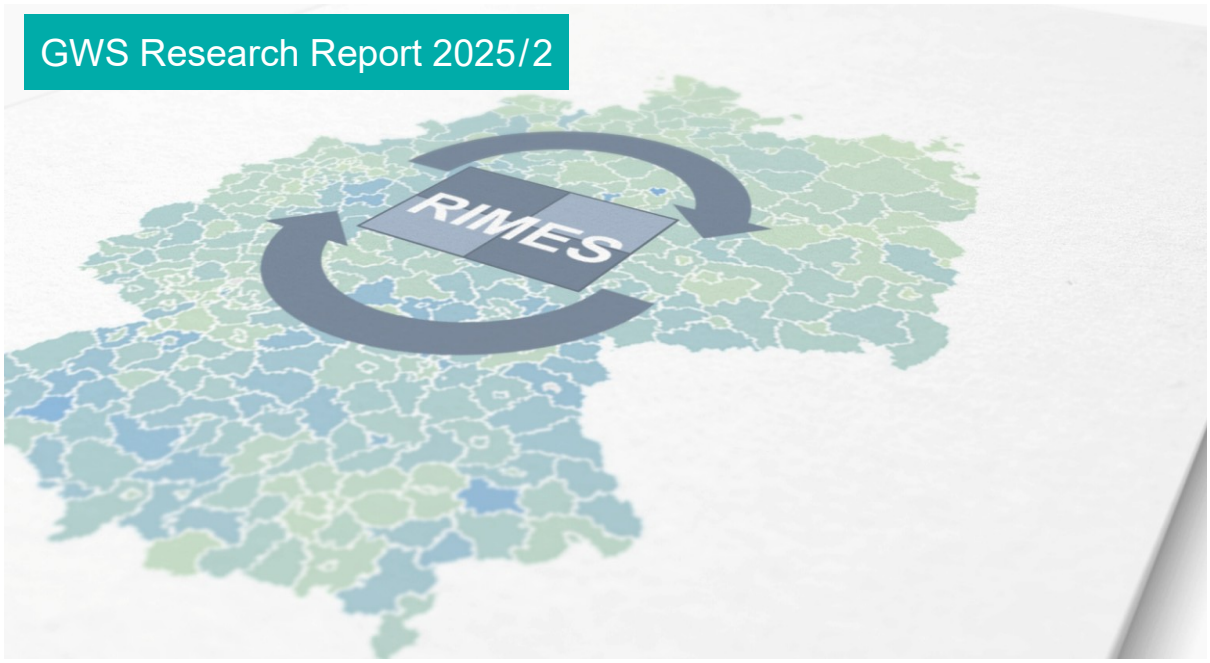

The new RIMES model

Input-output tables and a scenario framework at the German district level

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Abstract

A successful energy transition requires systemic changes and long-term investment in energy, heating and mobility systems. It must be implemented successfully at a regional level. To demonstrate the regional impact, detailed modelling of regional conditions is necessary. To this end, we have developed a multi-regional input-output model (RIMES), which maps regional dependencies and sectoral structures at district level in Germany. This model covers all 400 NUTS 3 regions (districts and independent cities), each comprising 37 industries. The modelling follows the principles of the standard MRIO approach. Trade structures between sectors in various districts are determined using a gravity trade model.The RIMES model is a powerful tool for linking regional economic structures with the challenges and opportunities of Germany's energy transition. This enables strategic planning and policy evaluation.

Imprint

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Title

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1 Introduction

Context of the project

Achieving a successful energy transition requires systemic changes and long-term investments in energy, heating, and mobility systems. The success of these transformations is determined at the regional level, with regional actors playing a key role.

The interdisciplinary project Info-EW supports these regional actors by developing a data-driven information system to assess the social and economic impacts of the energy transition and structural change. Funded by the German Federal Ministry for Economic Affairs and Energy (BMWE), the project combines a macroeconomic multiregional input-output (MRIO) model and household microsimulations, enabling scenario analyses of the energy transition at the regional level.[1]

Results of the scenario analyses are presented in an open-access interactive dashboard that assists local decision-makers in identifying energy and emission hotspots, assessing affected industries and population groups and exploring regional participation potentials. Through a stakeholder-driven process, the project bridges the gap between research and the realities of regional decision-making, empowering regions to advance their sustainability transitions. Please see https://www.info-ew.de/ for further information on the overall project.

What is a MRIO?

A multi-regional Input-Output (MRIO) model enables a detailed analysis of economic interdependencies and environmental impacts across multiple regions. The standard approach to MRIO modelling is based on linking national input-output tables, supplemented by interregional trade data and satellite accounts (Leontief and Strout 1963; Wiedmann 2009; Miller and Blair 2009; Bertelsmann Stiftung 2023). The goal is to provide a holistic analysis of interregional supply chains, integrating economic, social, and environmental dimensions.

The newly developed RIMES-model is an MRIO model that maps the economic interconnections, regional dependencies, and sectoral structures at the district level in Germany. It covers all 400 NUTS 3 regions (districts and independent cities), each with 37 industries. The modelling follows the principles of the standard MRIO approach. Trade structures between sectors in the different districts are determined using a gravity trade model.

The MRIO in RIMES is calculated for the base year of 2023 and can be projected into the future through links with GWS-models PANTA RHEI (Distelkamp et al. 2009; Lutz et al. 2025), INFORGE/LÄNDER (Ulrich et al. 2022; Becker et al. 2022) and QMORE (Bernardt et al. 2023). This allows for diverse scenario analyses, such as assessing the

[1] Project partners are Potsdam Institute for Climate Impact Research, EWAS-Institute and HahnIT. BMWK funding number is….

implications of decarbonization for the existing structures in a given region or evaluating regional policy measures.

The compilation of the MRIO database follows a six-step process, which also forms the structure of this paper. Chapter 2 give a short methodological introduction and outlines the preparation of the regionalisation factor, using employment data. Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.** (Step A) covers the regionalisation of production and intermediate uses. Chapter 4 (Step B) and Chapter 5 (Step C) focus on regional final demand and international imports and exports, respectively. These two chapters address the question: Where in Germany are which goods in demand and being used? Chapters 6 and 7 shift the focus to the origins of these goods. Chapter 6 (Step D) models inter- and intra-regional trade flows within Germany, while Chapter 7 (Step E) discusses the harmonisation and closure of the MRIO model. Together, these steps answer the question: Where in Germany do the demanded and used goods come from?

This structure allows for a systematic exploration of regional economic interdependencies and provides a robust foundation for analysing the spatial effects of decarbonisation policies.

2 Methodology

To set up our multi-regional input-output (MRIO) model RIMES for the 400 German districts and independent cities, we regionalised the symmetric input-output tables by production area. Regionalising the input-output tables by production area allowed us the direct combination of the regionalised MRIO model with the existing inter-industry forecasting Germany (INFORGE) model for scenario analyses (Becker et al. 2022). However, one challenge of our approach was data availability as most of the regional data is only available for economic sectors, but not for production areas. In the following, we describe the process of setting up our regionalised MRIO. Thereby, we refer to the 400 districts and independent cities as regions.

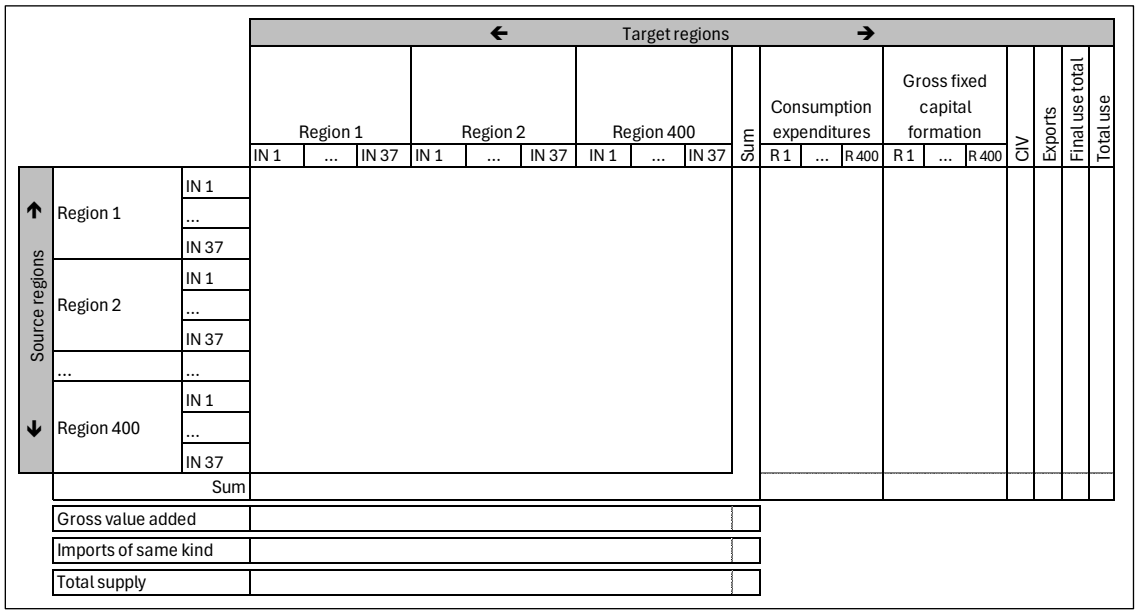
We create the multi-regional data model for the 400 German regions based on a national German input-output (IO) table (StBA 2021) and 16 input-output tables of the 16 German federal states generated in the LÄNDER module of the INFORGE model (Ulrich et al. 2022). The Federal Statistical Office provides an IO table only for Germany, the LÄNDER module breaks down national values to state level for each of 16 federal states (ibid.). The regional input-output table in RIMES is partly linked to the state input tables and final use vectors in the LÄNDER model. This two-stage process allows regionalization factors to be used that are only available at the federal state level, such as value added and GDP components (Ulrich et al. 2022).

The MRIO model used in RIMES comprises two main components. First, it includes input-output tables for each region, which, analogous to the national input-output table, represent the use of goods and services regardless of their regional origin. The district-level tables are structurally similar to the national version, with the key difference being the inclusion of additional rows and columns to account for imports from and total exports

to other regions. Second, the model incorporates a trade matrix that captures the volume of goods and services exchanged between regions. This matrix reveals interregional supply patterns, with the diagonal entries indicating intra-regional deliveries. Last, in the multiregional system foreign imports are treated separately from domestic trade (Kronenberg 2012).

At the heart of the MRIO model is the **first quadrant**, which maps the flows of intermediate goods and services between industries (Figure 1). This quadrant is critical for understanding how industries are interlinked and is used to compute technical coefficients (input-output coefficients). These coefficients form the basis for deriving Leontief inverse matrices, which are essential tools in assessing economic impacts, supply chain dynamics, trade dependencies, and vulnerabilities to economic shocks. The model also enables the calculation of gross value added, defined as production minus intermediate inputs, with total production serving as the row sum in the input-output table.

Figure 1: MRIO structure of RIMES



Notes: Regions are the 400 German districts (NUTS 3 level). IN are the 37 industries. CIV are Changes in inventories and valuables.
Source: Own image.

In the following we describe the steps that were undertaken to set up the regionalised input-output tables. We used the programming software R (Chacon and Straub 2014; Wickham et al. 2019; Barrett et al. 2024; R Core Team 2024).

3 Step A: Regionalisation of Production

The GWS model INFORGE/LÄNDER provides information on production for 37 industries in all 16 German federal states (NUTS 1). The following describes the regionalisation of production. This approach is based on two central assumptions: Firstly, the regional employment structure reflects the regional production structure. Secondly,

regional production methods correspond to national production methods; in other words, regional and national input structures are the same.

3.1 Employment as Regionalisation Factor

We used the number of employees by economic sector as the primary regionalisation factor for regionalised production. Employment data is well documented and published by the Federal Employment Agency. It provides the best level of detail on industry structures in Germany at the NUTS 3 level. The Classification of Economic Activities 2008 (WZ 08) is currently used for official statistics in Germany (Statistisches Bundesamt 2008). The WZ 08 comprises five hierarchical levels. The first four levels correspond to the EU classification of economic activities NACE Rev. 2 (Nomenclature statistique des activités économiques dans la Communauté Européenne, Revision 2).

We have ordered data from the Federal Employment Agency on employees in the workplace for Germany and its 400 districts and independent cities in accordance with the classification of economic activities (WZ 08), broken down into 21 economic sectors (WZ-1 digits from A to U) and 25 specially compiled aggregates based on WZ-2 digits from 01 to 99, for the years 2014 to 2023 (Statistik der Bundesagentur für Arbeit 2024a). The 25 specially compiled aggregates were selected to align with the data structure of the 37 industries used in the LÄNDER module of the INFORGE model. (Ulrich et al. 2022). Please see Table A1 in Appendix A for the data structure of the statistical data and Table A2 for a structural list of the 37 sectors used in RIMES.

The employee data are based on the social security notification system, covering all individuals subject to compulsory health, pension, or unemployment insurance under SGB III. This includes trainees, part-time retirees, interns, working students, and those temporarily called to statutory service. Excluded are civil servants, the self-employed, assisting family members, professional and temporary soldiers, and those in military or civilian service (Bundesagentur für Arbeit 2025).

The year 2023 serves as the base year for the analysis. Due to statistical disclosure control, 960 out of 14,800 entries in the dataset were left blank to protect confidential information. To address this, a two-step gap-filling routine was applied, using adjustments to known subtotals and overall totals to estimate the missing values.

Firstly, we filled in data gaps at the section WZ-1-digit level. We started by filling in missing values for 2023 with the last available values of the time series. Remaining gaps were filled by setting values based on the employment shares from the federal state based on the share of the economic sector in total employment in the respective federal state. We then carried out a scaling routine based on the sum of employment in the federal state and sum of the economic sectors in Germany. The scaling routine ensures that the aggregation of employment by economic activities across the regions reflects the federal value. The total number of employees in each region, across all economic activities, should differ as little as possible from the actual total employment in that federal state.

Secondly, we filled in data gaps at the WZ-2-digits division level. Again, we first used the last available values of the time series. Next, we calculated the residual value if only one

value of the WZ-1-section was still unknown. Remaining gaps were filled by setting values with employee shares in the section (WZ-1-digit) level for the respective federal state. In the end, we scaled the values within the sections based on the sum of the WZ-1-digit sections in the district and sum of the WZ-2-digits divisions in Germany.

Based on the completed dataset, regional employment shares were calculated for each economic activity.

3.2 Regional Production

3.2.1 Step A1: Regionalised Production

We calculated regional production $\boldsymbol{x}^r$ for each sector j by allocating sectoral production in the federal states x_j^l from the LÄNDER module to the regions based on the regional employment structure:

$$x_j^r = x_j^l \frac{empl_j^r}{empl_j^l} \tag{1}$$

where j denotes the sector, r the region and l the respective federal state. We assumed that labour productivity of a sector in any given region is equal to the national average.

3.2.2 Step A2: Regionalised Intermediate Inputs

In order to regionalise intermediate inputs, it is assumed that the same technologies and production processes are used in the regions as at the federal level. Thus, intermediate input structures are the same across all regions in Germany. Any differences in the use of intermediate inputs arise solely from the regions' different production specialisations.

Regional intermediate consumption $\boldsymbol{z}^{\bullet r}$ is derived from weighted national intermediate consumption $\boldsymbol{z}^{\bullet n}$, with the weights corresponding to the regional production structure $\boldsymbol{x}^r$ from A1:

$$z_{ij}^{\bullet r} = z_{ij}^{\bullet n} \frac{x_j^r}{x_j^n} \tag{3}$$

where z is the intermediate input from sector i of all regions ($\bullet$) to sector j in region r (or n for the federal government). x denotes the production of sector j in region r or on national level n respectively.

By using input shares (a certain share of the output of one industry is allocated as input to another industry), the cost distribution remains unchanged.

This step initially enables the regionalisation of the supply side of the intermediate interrelations. The regionalisation of the complete matrix of intermediate inputs and outputs is performed by balancing the demand and supply sides in steps D and E.

4 Step B: Regionalization of Final Demand

In Chapter 4, we outline the methodology used to regionalise the components of final demand within RIMES. The goal is to assign consumption and investment activities to 37 industries across the 400 regions (R1–R400), enabling high-resolution modelling of economic flows and environmental impacts at the NUTS 3 level.

As shown in Figure 2, the regionalization process covers six key components of final demand:

1. Consumption expenditure of private households (Step B1)
2. Consumption expenditure of non-profit institutions serving households (NPISH) (Step B2)
3. Government consumption expenditures (Step B3)
4. Gross fixed capital formation (GFCF) in equipment (Step B4)
5. Gross fixed capital formation (GFCF) in construction (Step B4)
6. Changes in inventories (CIV) (Step B5)

Figure 2: Overview of assumptions and procedure to regionalise final demand

<table>
<tr><th></th><th>Cons. exp. private households
R1 ... R400</th><th colspan="2">Cons. exp. NPISH
R1 ... R400</th><th>Cons. exp. government
R1 ... R400</th><th>GFCF equipment
R1 ... R400</th><th>GFCF construction
R1 ... R400</th><th>CIV
R1 ... R400</th></tr>
<tr><td>Industry 1</td><td rowspan="6">Income and Expenditure Survey (EVS), Destatis: Assign consumer purposes to 37 industries

Regionalisation based on SynPop (PIK)</td><td colspan="3" rowspan="2">INFORGE/LÄNDER

Weighted consumption patterns

Same per capita values as averages of the respective federal state;
Same consumption patterns as in national average for all regions</td><td>INFORGE/LÄNDER

National investment patterns between industries
&</td><td>INFORGE/LÄNDER

Product group structure of respective investment activities
&</td><td rowspan="6">Share of production is assumed to be equal to national average in all NUTS 3 regions</td></tr>
<tr><td>...</td><td rowspan="5">Regionalised production (Step A)</td><td rowspan="5">Regionalisation based on NUTS 3 statistics on construction completion, Destatis</td></tr>
<tr><td>...</td><td colspan="3"></td></tr>
<tr><td>...</td><td colspan="3"></td></tr>
<tr><td>...</td><td colspan="3"></td></tr>
<tr><td>Industry 37</td><td colspan="3"></td></tr>
</table>

Notes: **Consumption expenditures by private households** is based on EVS data mapped to the product group structure using the ECOICOP classification (LÄNDER assignment). This reflects the standard translation from EVS to national accounts as provided by Destatis, with the 2018 base year projected to 2023 (see: Institut für Wirtschaftsforschung Halle 2013, p. 223). Regionalisation is based on the synthetic population model provided by PIK. **NPISH** is Non-profit institutions serving households/government. **GFCF** is Gross Fixed Capital Formation. **CIV** is Changes in Inventories and Valuables and included according to national accounting conventions.

Source: Own compilation.

Each component requires a tailored approach based on the nature of available data. The methods draw on a combination of microdata (e.g., from the Income and Expenditure Survey, EVS (Destatis 2021)), macroeconomic models (INFORGE/LÄNDER (Ulrich et

al. 2022; Becker et al. 2022)), and official statistics (e.g., from the regional database of Statistische Ämter des Bundes und der Länder, www.regionalstatistik.de), supported by synthetic population modelling (SynPop provided by PIK) where applicable.

Private household consumption, for instance, is regionalized using expenditure data from EVS and spatial distribution patterns generated through a synthetic sampling method (Chapter 4.1). In contrast, NPISH and government consumption rely on state-level averages and uniform per capita values (Chapters 4.2 and 4.3). Investment in equipment and construction (GFCF equipment and construction) is distributed based on sectoral investment patterns and construction activity statistics, respectively (Chapter 4.4). Finally, changes in inventories are assumed to follow national average production shares across all regions.

4.1 Step B1: Consumption Expenditure of Private Households

The information on regional private consumption is provided as a data set compiled by the Potsdam Institute for Climate Impact Research (PIK). Since the classification of this data set follows that of the Household Budget Survey (EVS), consumption expenditure has then been converted to the classification of the input-output tables. Both steps – the estimation of regional private consumption and the reclassification – are described in the next sections.

4.1.1 Disaggregated, regional expenditure dataset

To support regionalized analysis of private household consumption in Germany, a procedure was developed by Dr. Peter Paul Pichler (Potsdam Institute for Climate Impact Research, PIK) that downscales expenditure data from the federal state to the district level. The method combines official statistical aggregates with microdata from household surveys to generate synthetic, district-level expenditure profiles by purpose, fully aligned with national accounting standards and the Classification of Individual Consumption According to Purpose (COICOP). The procedure is based on methods described in Többen et al. (2023).

Data sources and Inputs

The following statistics (from the 2022 Census) are collected at district level:

- Region type (agglomeration, urbanised, rural)
- Household size (average)
- Household income and income per capita (average)
- Living space (Average residential floor area per household)
- Distribution of heating energy sources (gas, oil, solid fuels, electricity, renewables [solar, geothermal, etc excluding biomass], district heating)

These indicators capture essential socio-demographic and infrastructural characteristics that are expected to correlate with household consumption behaviour.

Sampling and Optimization Procedure

For each district, a synthetic sample of 5,000 households is drawn from the 2018 *Einkommens- und Verbrauchsstichprobe* (EVS) microdata. Households are selected based on matching regional typology and the distribution of heating energy sources, aligning with the profile of the target district.

To improve representativeness, the initial sample undergoes a hill-climbing optimization process. In this iterative procedure, small subsets of the sample are continuously replaced with alternative observations from the same region type and energy group. A replacement is retained if it reduces the deviation from the target district's census statistics. The process is repeated until the synthetic sample matches the target profile within a predefined error tolerance.

Normalization and Scaling

Once optimized, the household expenditure vectors from the sample are aggregated and scaled to match district-level demographic totals. This normalization step ensures that the calculated expenditure levels reflect both the number of households and the population in each district.

To ensure national consistency, the aggregated results are validated against official EVS-based consumption statistics published by Destatis at the federal state level. Sector-specific scaling factors are then applied to align the synthetic sample totals with these official benchmarks.

The resulting dataset includes total and per-household consumption values by sector for each district. The metadata fields include district and federal state identifiers, sector codes and descriptions, including hierarchical classification and aggregated expenditure values in euros. This format allows for further integration of the final demand vector of households into the multi-regional input-output model.

Assumptions and Limitations

Several assumptions underlie this method of deriving the household expenditure at the district level:

- It is assumed that region type, household size, income level, and heating energy source are sufficiently correlated with household consumption patterns to serve as proxies in sample matching.
- The demographic structure of households is assumed to have remained relatively stable between the 2018 EVS (Destatis 2021) and the 2022 Census.
- Unlike the Destatis evaluation, which aggregates data strictly within federal state boundaries, this approach selects households by region type and heating profile, allowing for a more granular representation of local characteristics. However, this may introduce some spatial mismatches.

A key limitation lies in the treatment of energy consumption: since official EVS statistics do not differentiate by fuel type, a single scaling factor is applied to the entire energy sector. As a result, regional price variations or differences in consumption intensity across energy types (e.g., gas vs. wood) are not fully captured.

Nonetheless, this methodology offers a robust framework for generating spatially explicit household consumption estimates that can support socio-economic scenario modelling, regional sustainability assessments, and policy evaluation.

4.1.2 Assigning Consumption Expenditures to Industries

In a two-step approach the consumption expenditures of private households provided by PIK and based on the EVS-72 classification is, first, translated to the VZ-26 classification of consumption used in the INFORGE/LÄNDER model and second, translated to the 37 groups of goods and services represented in the IOTs of the INFORGE/LÄNDER model. This provides us with regionalized household consumption expenditures by goods groups on the district level.

Mapping EVS data to the product group structure using the ECOICOP classification (LÄNDER assignment) reflects the standard translation from EVS to national accounts as provided by Destatis, with the 2018 base year projected to 2023 (see: Institut für Wirtschaftsforschung Halle 2013, p. 223).

To further align the regionalized household consumption with the aggregated federal state consumption matrix and provided by INFORGE/LÄNDER, a scaling approach based on proportional distribution is applied. Specifically, the share of each district within its respective federal state – by goods group – derived from the disaggregated expenditure data is used as a scaling factor. These proportions reflect the relative weight of each district's consumption within a given group of goods and services.

4.2 Step B2: Consumption Expenditures of Non-Profit Institutions Serving Households (NPISH)

There is no data available in the VGRdL (National Accounts of the Federal States of Germany) for the consumption expenditures of private non-profit organizations; therefore, scaling is based on population size ($inhabitants$) (Bernardt et al. 2023). The generated values of private non-profit organizations for the federal states $lcpon_l$ from the LÄNDER module are distributed across the 400 German regions r according to their respective population figures. Thus, the regional generated values of private non-profit organizations $cpon_r$ is:

$$cpon_r = lcpon_l * \frac{inhabitants_r}{inhabitants_l}$$

4.3 Step B3: Government consumption expenditures

The variable csn_r denotes the government consumption at the regional level. It is calculated based on the government consumption at the federal state level $lcsn_l$ taken from LÄNDER, which is distributed to the regions r using the regional share of the population ($inhabitants$) (Bernardt et al. 2023):

$$csn_r = lcsn_l * \frac{inhabitants_r}{inhabitants_l}$$

4.4 Step B4: Construction and equipment investments

Gross fixed capital formation (GFCF) in equipment and construction are regionalized separately.

4.4.1 Gross fixed capital formation in equipment

It is assumed that investments in equipment are made along production priorities. This means that investment interdependence iax between industry i and j is weighted according to regional production shares x_j^r (see Step A1) in order to obtain a regionally adjusted investment interdependence $ianw$.

This approach reflects that every industry has a specific structure of goods and services that typically is needed for the investment. Using this procedure the investment by industry j is transferred into an investment by goods i.

$$ianw_i^r = \sum_j iax_{i,j}^n * x_j^r$$

The weight $ianw$ is then used to distribute the good-specific final demand in GFCF in equipment of the Federal state (ian_i^l) to the region:

$$ian_i^r = ian_i^l \frac{ianw_i^r}{\sum_r ianw_i^r}$$

4.4.2 Gross fixed capital formation in construction

Construction investment in Germany as a whole ($ib37$) is allocated to the regions based on specific criteria (distribution factor), primarily the number of construction completions. Completions is counted as the sum of residential and non-residential building completions. As the number of construction completions is highly volatile, particularly in small areas, and does not accurately reflect continuous new construction activity, the average number of completions over the last three years is used instead.

Three distribution factors are applied to account for the three main types of construction investment (residential, non-residential and civil engineering) as recorded in national accounts data. For residential construction, the distribution is based on the size of 'completed living space in residential and non-residential buildings'; for non-residential construction, on 'completed usable space'; and for civil engineering, on the distribution of the population.

The result is a region specific investment in construction (ibn^r):

$$ibn_i^r = ib37n_i^n * distribution\ factor$$

5 Step C: International Trade

For exports, we assume that the share of production allocated to export use is equal to the national average across all regions. Specific weighting for industrial products is

applied based on federal state-level export statistics to reflect regional industry-specific export orientation (see Ulrich et al. 2022).

For imports, the assumption is that the import share in total domestic use is also uniform across regions, following the national average. However, different weights are applied depending on the type of use: for intermediate use, weights are based on regionalised production data (Step A), while for final demand, weights are derived from regionalised final demand data (Step B).

6 Step D: Modelling Intra- and Inter-Regional Trade in Germany – A Two-Step Gravity Approach

To estimate trade flows between regions, we apply a gravity model using a two-step approach based on EU data, particularly the FIGARO input-output tables. This approach was described in Ulrich et al. (2012; 2013).

6.1 Step D1: Intra-Regional Trade Shares

The first step estimates the share of used goods and services that originate within the same NUTS 3 region. The underlying assumption is that intra-regional trade is more likely when local production is strong—self-sufficiency increases with the regional presence of relevant industries. This step uses a goods group-specific approach, drawing on EU FIGARO data on trade by product type. Coefficients are estimated based on national market shares at the EU level, reflecting the probability of intra-regional trade depending on the nature of the good. This allows us to determine, for each region, how much of its demand can be met locally.

We use the derived coefficients from the EU-level to apply them to domestic regional distribution of production. Furthermore, the good-specific domestic shares of final demand from the national IO-Table are used to compile the intraregional quotas to the national scheme and regional system.

6.2 Step D2: Inter-Regional Trade Flows

The second step focuses on sourcing the remaining goods not provided locally or through international trade. The question becomes: *Which other regions supply the residual demand?* To estimate these flows, we again use EU-level trade shares and a regional distance matrix. This matrix is derived from the EU airline distance dataset and is used to calibrate good-specific distance-decay functions—reflecting the empirical observation that trade volumes typically decrease with increasing distance. These decay parameters are assigned to regions and product groups accordingly, capturing the tendency of certain goods to be traded over longer or shorter distances.

In order to take into account the heterogeneous administrative structures for the regions within Germany, the distance matrices are derived from traffic interconnection data

rather than the airline distance. A data set from the KBA shows traffic volume and traffic performance between the regions and allows an estimation for the average distance travelled (Kraftfahrt-Bundesamt 2024).

For many services, international data does not provide a good basis for estimating sub-national trade patterns. Therefore, available data on domestic regional trade patterns is used here. This data includes commuter flows between regions (Statistik der Bundesagentur für Arbeit 2024b). Commuter patterns are a good approximation of regional trade, especially for personal services.

Together, these two steps offer a comprehensive estimation of domestic trade flows: intra-regional trade is determined by local production capacities, while inter-regional flows are guided by the remaining demand, either with distance effects and trade patterns observed at the EU level or commuter flow patterns. Step 2 is directly dependent on the output of Step 1, ensuring internal consistency of the model.

6.3 Step D3: Regional Trade Balancing Procedure

The regional trade matrices used in the model are initially preliminary and subject to adjustment. In their first iteration, an imbalance between total use and total supply often occurs due to unbalanced regional allocation of production and demand.

To address this, marginal totals are derived from an initial assessment of total domestic use and supply. A key assumption in this step is that changes in inventories (CIV) and exports are not traded among regions. Accordingly, it is assumed that the point of production equals the point of use for these components.

A trade share assessment is then performed based on observed total use patterns across all 400 regions. This is followed by a rebalancing process, where domestic trade flows are adjusted and reallocated among regions through an iterative correction procedure. The convergence of deviations in marginal totals is evaluated for every group of good or service. If deviations don’t’ converge the initial trade shares are readjusted to repeat the process.

The result is a set of balanced trade share matrices, which ensure that regional supply and use patterns are consistent across all industries and regions in the model.

7 Step E: RIMES Model Closure and Final Balancing

The final stage of the RIMES model involves the closure and balancing of the multi-regional input-output (MRIO) system. This step ensures that all regional and sectoral flows are internally consistent and aligned with national accounting principles. The procedure integrates intermediate production flows, final demand, and value-added components across 400 German districts and 37 industries.

7.1 Step E1: Final Demand

First, the distribution of domestic final demand, the second quadrant of the MRIO table, is constructed. This means that final demand (from Step B) is fully regionalised, i.e. final demand that is traded interregionally from source regions s to target region t via trade shares is mapped. This figure takes into account trade in final goods, but not exports or intermediate consumption. Traded final demand is therefore calculated as the sum of private consumption ($pchh$), government consumption (cgn), non-profit institutions' consumption ($cpon$) as well as investment in equipment (ian) and construction (ibn) in the target region t. Subsequently, exports (*exn*) and changes in inventories (*civ*), which are assumed not to be traded, are added. The result is total traded and non-traded final demand in the target region t, or put differently the final demand matrix, detailing the consumption and investment activities across all regions and industries:

$$final\ demand_t = \sum_s (pchh + cpon + cgn + ian + ibn)_s * tradeshare_{s,t} + civ_t + exn_t$$

7.2 Step E2: Inter-Industry Transactions (First Quadrant of the MRIO)

In the second step, the first quadrant of the MRIO table is constructed, which captures inter-industry transactions, that is the flows of intermediate goods and services exchanged between industries. This quadrant forms the analytical backbone of the model, revealing the structure of regional and inter-regional production linkages.

It is based on the regionalised intermediate inputs estimated in Step A2. This intermediate inputs are redistributed depending on trade flows:

$$x_{ij}^{st} = tradeshare_{ij}^{st} * x_{ij}^{t}$$

x_{ij}^{st} represents the flow of goods from sector i in source region s to sector j in target region t. $tradeshare_{ij}^{st}$ is the trade share indicating the proportion of goods from sector i in region s that are traded to sector j in region t. Finally, x_{ij}^{t} represents the total intermediate input flow from sector i to sector j before considering regional trade patterns. Essentially, this equation distributes the total intermediate input (x_{ij}^{t}) across regions based on the observed trade shares ($tradeshare_{ij}^{st}$).

From these flows, technology coefficients (also referred to as technical input-output coefficients) are calculated. These coefficients express the amount of input from each sector required to produce one unit of output in a given industry. The complete matrix of coefficients provides a quantitative description of the production technologies across all sectors and regions.

7.3 Step E2: Leontief Inverse and Rebalancing

Using the technology coefficient matrix T, the $Leontief\ Inverse$ is derived. This inverse matrix quantifies the total (direct and indirect) production required to meet a unit of final demand. It is a fundamental tool in input-output analysis, enabling the model to assess how final consumption, investment, government spending, and exports translate into upstream production across the entire economy.

$$Leontief\ Inverse = (I - T)^{-1}$$

By multiplying the $Leontief\ Inverse$ with the final demand matrix, the model computes the total production output required in each region and sector to meet final demand.

Iterative Evaluation and Rebalancing

Once the full MRIO system is assembled, an evaluation and readjustment loop is initiated. This involves checking for imbalances between regional supply and use, inconsistencies in trade flows, or deviations from macroeconomic control totals. If such inconsistencies are identified, we go back to previous stages – such as trade balancing or regionalization of demand – to refine the inputs. This iterative process continues until all components of the MRIO are balanced and coherent.

Importance of the First Quadrant

The first quadrant is central to the RIMES framework, as it determines the interdependencies between industries. It reflects the structure of supply chains and the extent to which industries rely on each other, both within and across regions. This quadrant is not only essential for the calculation of technical coefficients and the $Leontief\ Inverse$ but also for analysing economic shocks, regional supply chain vulnerabilities, and trade dependencies.

By capturing intermediate demand flows, the first quadrant enables researchers and policymakers to trace how regional production systems respond to changes in consumption, investment, or external trade conditions.

Gross Value Added Calculation

In the final balancing step, the model computes Gross Value Added (GVA) for each industry and region. GVA is defined as:

$$GVA = Total\ Production - Intermediate\ Inputs$$

This metric represents the economic value generated by each industry after accounting for the cost of intermediate goods and services. GVA is calculated consistently across the model and aggregated to validate alignment with national accounts. The sum of GVA across all regions and sectors equals the total value of production minus total intermediate consumption, ensuring economic consistency within the MRIO framework.

8 Outlook and Future Use of RIMES

The RIMES model represents a powerful tool for linking regional economic structures with the challenges and opportunities of the energy transition in Germany. With its detailed spatial and sectoral resolution, RIMES enables scenario-based assessments of structural change and environmental impacts across all 400 German districts and 37 economic sectors. This provides a valuable foundation for evidence-based regional policy design.

Looking forward, the model will continue to support both strategic planning and policy evaluation through application-oriented scenario analysis. Key areas of focus include:

- **Development of future-oriented scenarios** for the clean energy and heat transition, aligned with national climate targets and international obligations.
- **Integration of demographic change** into regional consumption patterns to project household demand and structure in 2030, 2040, and 2050.
- **Identification of regional transformation pathways**, including implications for employment, energy demand, and industrial restructuring.
- **Refinement of trade flows and production structures**, improving the robustness of interregional dependencies and value-added calculations.

Importantly, the results generated by RIMES are not confined to academic analysis. The model is designed for practical use by stakeholders, including municipal authorities, regional planners, and policy advisors. An interactive dashboard makes selected results publicly available, providing access to regional projections, sectoral developments, and comparative insights.

As the energy transition deepens and regional disparities become more pronounced, the relevance of spatially detailed tools like RIMES will continue to grow. Future developments will aim to further enhance the model's transparency, methodological depth, and usability, ensuring that RIMES remains a key instrument for shaping a just and sustainable transformation across Germany’s diverse regional landscapes.

References

Barrett, T., Dowle, M., Srinivasan, A., Gorecki, J., Chirico, M., Hocking, T., Schwendinger, B. & Krylov, I. (2024): data.table – Extension of 'data.frame'. R package version 1.15.4. https://CRAN.R-project.org/package=data.table.

Becker, L., Bernardt, F., Bieritz, L., Mönnig, A., Parton, F., Ulrich, P. & Wolter, M. I. (2022): INFORGE in a Pocket. GWS mbH Osnabrück (Ed.). GWS-Kurzmitteilung 2022/02, Osnabrück. https://www.gws-os.com/de/publikationen/gws-kurzmitteilungen/detail/inforge-in-a-pocket, last access 27.09.2023.

Bernardt, F., Parton, F. & Ulrich, P. (2023): Das Regionalmodell QMORE. In: Zika, G., Hummel, M., Maier, T. & Wolter, M. I. (Hg.): Das QuBe-Projekt: Modelle, Module, Methoden. 1. Auflage. IAB-Bibliothek 374. wbv Publikation, Bielefeld, pp. 149–175.

Bertelsmann Stiftung (Hg.) (2023): Energising EU Cohesion – Powering up lagging regions in the renewable energy transition. With the collaboration of J. Többen, M. Banning, K. Hembach-Stunden, B. Stöver, P. Ulrich und T. Schwab.

Bundesagentur für Arbeit (2025): Datenquellen. Bundesagentur für Arbeit (Ed.). https://statistik.arbeitsagentur.de/DE/Navigation/Grundlagen/Datenquellen/Datenquellen-Nav.html;jsessionid=C7D80B93BF04C3F41871B015EDA68D1C, zuletzt aktualisiert am 13.11.2025, last access 13.11.2025.

Chacon, S. & Straub, B. (2014): Pro git. Apress (Ed.).

Distelkamp, M., Großmann, A., Hohmann, F., Lutz, C., Ulrich, P. & Wolter, M. I. (2009): PANTA RHEI REGIO – Ein Modellsystem zur Projektion der künftigen Flächeninanspruchnahme in Deutschland und zur Folgenabschätzung fiskalischer Maßnahmen. GWS Discussion Paper 09-7. https://ideas.repec.org/p/gws/dpaper/09-7.html.

Institut für Wirtschaftsforschung Halle (2013): Neuere Anwendungsfelder der Input-Output-Analyse – Beiträge zum Halleschen Input-Output-Workshop 2012. Sonderheft / Institut für Wirtschaftsforschung Halle 1, Halle (Saale). http://www.iwh-halle.de/d/publik/sh/PDF/SH_13-1.pdf.

Kraftfahrt-Bundesamt (2024): Verflechtung VE 7, Zeitreihe 2010 - 2023. DOI: 10.25525/KBA-ASFRDOWN.VE7D31VERZEIT.2023.1.

Kronenberg, T. (2012): Regional input-output models and the treatment of imports in the European System of Accounts (ESA). Review of Regional Research 32 (2), pp. 175–191. DOI: 10.1007/s10037-012-0065-2.

Leontief, W. & Strout, A. (1963): Multiregional Input-Output Analysis. In: NA, N. (Hg.): Structural Interdependence & Economic Development. 1st ed. 1963. Palgrave Macmillan UK; Imprint Palgrave Macmillan, London, pp. 119–150. https://link.springer.com/chapter/10.1007/978-1-349-81634-7_8.

Lutz, C., Becker, L., Hembach-Stunden, K. & Ulrich, Philip, Kenkel, Luisa (2025): Welche gesamtwirtschaftlichen Auswirkungen hat die Strompreissenkung um 5

Cent je Kilowattstunde? – Simulationsrechnungen zum Koalitionsvertrag mit PANTA RHEI. GWS - Institute of Economic Structures Research (Ed.). GWS Kurzmitteilung 2025/5. https://gws-os.com/fileadmin/downloads/GWS-Kurzmitteilung_2025_5.pdf, last access 15.07.2025.

Miller, R. E. & Blair, P. D. (2009): Input-output analysis – Foundations and extensions. 2nd ed. Cambridge University Press, Cambridge, New York.

R Core Team (2024): R – A Language and Environment for Statistical Computing. R Foundation for Statistical Computing (Ed.), Vienna, Austria. https://www.R-project.org/, last access 11.11.2025.

Statistik der Bundesagentur für Arbeit (2024a): Beschäftigte am Arbeitsort nach der Klassifikation der Wirtschaftszweige 2008. Auftragsnummer 357116.

Statistik der Bundesagentur für Arbeit (2024b): Pendlerverflechtungen der sozialversicherungspflichtigen Beschäftigten nach Kreisen, Stichtag 30. Juni 2023. https://statistik.arbeitsagentur.de/SiteGlobals/Forms/Suche/Einzelheftsuche_Formular.html;jsessionid=9E3E077F89D68572C803C58CDEC557FB?nn=20934&topic_f=beschaeftigung-pendler-krpend&dateOfRevision=202306-202306, last access 17.11.2025.

Statistisches Bundesamt (2008): Klassifikation der Wirtschaftszweige. (WZ 2008). Statistisches Bundesamt (Ed.), Wiesbaden. https://www.destatis.de/DE/Methoden/Klassifikationen/Gueter-Wirtschaftsklassifikationen/Downloads/klassifikation-wz-2008-3100100089004-aktuell.pdf?__blob=publicationFile, last access 11.11.2025.

Statistisches Bundesamt (2022): Zensus 2022. Statistisches Bundesamt (Ed.). https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Zensus2022/_inhalt.html, zuletzt aktualisiert am 14.07.2025, last access 13.11.2025.

Statistisches Bundesamt (Destatis) (2021): Einkommens- und Verbrauchsstichprobe (EVS) 2018.

Statistisches Bundesamt (StBA) (2021): VGR des Bundes – Input-Output-Rechnung – Fachserie 18, Reihe 2.

Többen, J., Pichler, P.-P., Jaccard, I. S., Kratena, K., Moran, D., Zheng, H. & Weisz, H. (2023): Unequal carbon tax impacts on 38 million German households: assessing spatial and socio-economic hotspots. Environ. Res.: Climate (2), p. 45006. DOI: 10.1088/2752-5295/aceea0.

Ulrich, P. (2013): Regionalisierung indirekter Effekte unter Verwendung nationaler Input-Output-Tabellen und eines räumlichen Allokationsmodells. In: Neuere Anwendungsfelder der Input-Output-Analyse. Beiträge zum Halleschen Input-Output-Workshop 2012. Sonderheft / Institut für Wirtschaftsforschung Halle 1, Halle (Saale).

Ulrich, P., Bernardt, F., Parton, F., Sonnenburg, A. & Többen, J. (2022): Das neue LÄNDER-Modell – Beispielszenario zum Ausbau der Photovoltaik. Gesellschaft für Wirtschaftliche Strukturforschung mbH (GWS) (Ed.). GWS Discussion Paper 2022/02, Osnabrück. https://www.gws-os.com/de/publikationen/alle-publikationen/detail/das-neue-laender-modell, last access 27.09.2023.

Ulrich, P., Distelkamp, M. & Lehr, U. (2012): Employment Effects of Renewable Energy Expansion on a Regional Level – First Results of a Model-Based Approach for Germany. Sustainability 4 (2), pp. 227–243. http://doi.org/10.3390/su4020227.

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L., François, R., Grolemund, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T., Miller, E., Bache, S., Müller, K., Ooms, J., Robinson, D., Seidel, D., Spinu, V., Takahashi, K., Vaughan, D., Wilke, C., Woo, K. & Yutani, H. (2019): Welcome to the Tidyverse. JOSS 4 (43), p. 1686. DOI: 10.21105/joss.01686.

Wiedmann, T. (2009): A review of recent multi-region input–output models used for consumption-based emission and resource accounting. Ecological Economics 69 (2), pp. 211–222. DOI: 10.1016/j.ecolecon.2009.08.026.

Appendix A: Employment data

Table A1: Structure of the data on employees at the place of work according to the classification of economic sectors 2008 (WZ 08), Employment statistics of the Federal Employment Agency

Wirtschaftsabschnitte, -abteilungen	English
Insgesamt	
A Land- und Forstwirtschaft, Fischerei	Agriculture, forestry, fishing
B Bergbau und Gewinnung von Steinen und Erden	Mining and quarrying
C Verarbeitendes Gewerbe	Manufacturing
10-12 Herstellung von Nahrungs- und Futtermitteln, Getränken, Tabak	Manufacture of food products, beverages, tobacco products
13-19, 31-33 Sonstiges verarbeitendes Gewerbe	Other manufacturing
20-21 Herstellung von chemischen und von pharmazeutischen Erzeugnissen	Manufacture of chemical and pharmaceutical products
22-23 Herstellung von Gummi-, Kunststoff-, Glaswaren, Keramik ...	Manufacture of rubber, plastic and other non-metallic mineral products
24-25 Metallerzeugung und -bearbeitung, Herstellung von Metallerzeugnissen	Manufacture of basic metals, fabricated metal products, except machinery and equipment
26-27 Herstellung von DV-Geräten, elektronischen und optischen Erzeugnissen und eletronischen Ausrüstungen	Manufacture of computer, electronic and optical products and electrical equipment
28 Maschinenbau	Manufacture of machinery and equipment n.e.c.
29, 30 Herstellung von Kfz und Kfz-Teilen sowie sonstiger Fahrzeugbau	Manufacture of motor vehicles, trailers, semi-trailers and other transport equipment
D Energieversorgung	Electricity, gas, steam and air conditioning supply
E Wasserversorgung; Abwasser- und Abfallentsorgung und Beseitigung von Umweltverschmutzungen	Water supply; sewerage, waste management and remediation activities
F Baugewerbe	Construction
G Handel; Instandhaltung und Reparatur von Kraftfahrzeugen	Wholesale and retail trade; repair of motor vehicles and motorcycles
45 Handel mit Kraftfahrzeugen; Instandhaltung und Reparatur von Kraftfahrzeugen	Wholesale and retail trade and repair of motor vehicles and motorcycles
46 Großhandel (ohne Handel mit Kraftfahrzeugen)	Wholesale trade, except of motor vehicles and motorcycle
47 Einzelhandel (ohne Handel mit Kraftfahrzeugen)	Retail trade, except of motor vehicles and motorcycles
H Verkehr und Lagerei	Transportation and storage
49 Landverkehr und Transport in Rohrfernleitungen	Land transport and transport via pipelines
50-52 Schifffahrt, Luftfahrt, Lagerei sowie sonstige Dienstleistungen für den Verkehr	Water transport, air transport, warehousing and support activities for transportation
53 Post-, Kurier- und Expressdienste	Postal and courier activities
I Gastgewerbe	Accommodation and food service activities
J Information und Kommunikation	Information and communication
58-61 Sonstige Information und Kommunikation	Other information and communication
62-63 Dienstleistungen der Informationstechnologie, Informationsdienstleistungen	Computer programming, consultancy, related activities and information service activities
K Finanz- und Versicherungsdienstleistungen	Financial and insurance activities
L Grundstücks- und Wohnungswesen	Real estate activities
M Freiberufliche, wissenschaftliche und technische Dienstleistungen	Professional, scientific and technical activities
69-70 Rechts- und Steuerberatung, Wirtschaftsprüfung, Unternehmensführung, Unternehmensberatung	Legal and accounting activities, activities of head offices; management consultancy activities
71 Architektur- und Ingenieurbüros; technische, physikalische und chemische Untersuchung	Architectural and engineering activities; technical testing and analysis

72-75 Forschung, Entwicklung, Werbung, Marktforschung; sonstige freiberufliche wissenschaftliche und technische Tätigkeiten	Scientific research and development, advertising, market research, other professional, scientific, technical activities and veterinary activities
N Sonstige wirtschaftliche Dienstleistungen	Administrative and support service activities
77, 79-82 Sonstige wirtschaftliche Unternehmensdienstleister	Other economic business service provider
78 Vermittlung und Überlassung von Arbeitskräften	Employment activities
O Öffentliche Verwaltung, Verteidigung; Sozialversicherung	Public administration and defence; compulsory social security
P Erziehung und Unterricht	Education
Q Gesundheits- und Sozialwesen	Human health and social work activities
86 Gesundheitswesen	Human health activities
87-88 Heime und Sozialwesen	Residential care and social work activities
R Kunst, Unterhaltung und Erholung	Arts, entertainment and recreation
S Sonstige Dienstleistungen	Other service activities
94 Interessenvertretungen sowie kirchliche und sonstige religiöse Vereinigungen (ohne Sozialwesen und Sport)	Activities of membership organisations
95-96 Reparatur von Datenverarbeitungsgeräten und Gebrauchsgütern, sonstige Dienstleister	Repair of computers and personal and household goods, other personal service activities
T Private Haushalte mit Hauspersonal; Warenherstellung und Dienstleistungen für den Eigenbedarf	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U Exterritoriale Organisationen und Körperschaften	Activities of extraterritorial organisations and bodies

Table A2: List of 37 industries and corresponding goods / services in the model

LfdNr	WZ08_2	Bezeichnung_37	Bezeichnung_Gütergruppen(CPA)
1	01–03	Land- und Forstwirtschaft, Fischerei (A) (Agriculture, forestry, fishing)	Erzeugnisse der Landwirtschaft, Forstwirtschaft und Fischerei (Agricultural, forestry and fishery products)
2	05–09	Bergbau und Gewinnung von Steinen und Erden (B) (Mining and quarrying)	Bergbauerzeugnisse, Steine und Erden (Mining products, stones and earths)
3	10–12	Herst. von Nahrungs- und Futtermitteln; Getränkeherst.; Tabakverarbeitung (CA) (Manufacture of food products, beverages, tobacco products)	Nahrungs- und Futtermittel, Getränke und Tabakerzeugnisse (food products, beverages, tobacco products)
4	20–21	H.v. chemischen und pharmazeutischen Erzeugnissen (CE-F) (Manufacture of chemical and pharmaceutical products)	Chemische und pharmazeutische Erzeugnisse (chemical and pharmeceutical products)
5	22–23	H.v. Gummi-, Kunststoff-, Glaswaren, Keramik u.Ä. (CG) (Manufacture of rubber, plastic and other non-metallic mineral products)	Gummi-, Kunststoffwaren, Glaswaren, Keramik, bearb. Steine und Erden (rubber, plastic and other non-metallic mineral products, processed stones and earths)
6	24–25	Metallerzeugung und -bearbeitung, Herstellung von Metallerzeugnissen (CH) (Manufacture of basic metals, fabricated metal products, except machinery and equipment)	Metalle und Metallerzeugnisse (basic metals, fabricated metal products)
7	26–27	H.v. DV-Geräten, elektronischen u. optischen Erzeugnissen und eletronischen Ausrüstungen (CI-J) (Manufacture of computer, electronic and optical products and electrical equipment)	DV-geräte, elektronische u. optische Erzeugnisse, elektrische Ausrüstungen (computer, electronic and optical products and electrical equipment)
8	28	Maschinenbau (CK) (Manufacture of machinery and equipment n.e.c)	Maschinen (machinery and equipment)
9	29-30	Fahrzeugbau (CL) (Manufacture of motor vehicles, trailers, semi-trailers and other transport equipment)	Fahrzeuge (motor vehicles, trailers, semi-trailers and other transport equipment)
10	13-19, 31-33	übriges Verarbeitendes Gewerbe (CX) (Other manufacturing)	Sonstige Erzeugnisse des Verarbeitenden Gewerbes (Other manufacturing products)
11	35	Energieversorgung (D) (Electricity, gas, steam and air conditioning supply)	Dienstlg. der Energieversorgung (Energy supply services)
12	36–39	Wasserversorgung; Abwasser- und Abfallentsorgung u.Ä. (E) (Water supply; sewerage, waste management and remediation activities)	Dienstlg. der Wasserversorg., der Entsorgung, usw. (Water supply, waste disposal and other services)

13	41–43	Baugewerbe (F) (Construction)	Bauarbeiten (construction work)
14	45	Kfz-Handel; Instandhaltung u. Rep. v. Kfz (GA) (Wholesale and retail trade and repair of motor vehicles and motorcycles)	Handelsleistungen mit Kfz, Instandhaltung und Reparatur an Kfz (Trade services involving motor vehicles, maintenance and repair of motor vehicles)
15	46	Großhandel (oh. Handel mit Kfz) (GB) (Wholesale trade, except of motor vehicles and motorcycle)	Großhandelsleistungen (ohne Handelsleistungen mit Kfz) (Wholesale services, except of motor vehicles and motorcycle)
16	47	Einzelhandel (oh. Handel mit Kfz) (GC) (Retail trade, except of motor vehicles and motorcycles)	Einzelhandelsleistungen (ohne Handelsleistungen mit Kfz) (Retail services, except of motor vehicles and motorcycles)
17	49	Landverkehr u. Transport in Rohrfernleitungen (HA) (Land transport and transport via pipelines)	Landverkehrs- und Transportleistungen in Rohrfernleitungen (services of land transport and transport via pipelines)
18	53	Post-, Kurier- und Expressdienste (HE) (Postal and courier activities)	Post-, Kurier- und Expressdienstleistungen (Postal and courier services)
19	50–52	Übrige Verkehr und Lagerei (HX) (Other transportation and storage)	Schifffahrts-, Luftfahrtleistungen, Lagereileistungen, sonst. Dienstlg. für den Verkehr (Shipping, aviation services, warehousing services, other transport services)
20	55–56	Gastgewerbe (I) (Accomodation, food and beverage service activities)	Beherbergungs- und Gastronomiedienstleistungen ((Accomodation, food and beverage services)
21	62–63	IT- und Informationsdienstleister (JC) (Computer programming, consultancy, related activities and information service activities)	IT- und Informationsdienstleistungen (Computer programming, consultancy, related and information services)
22	58–61	Übrige Information und Kommunikation (JX) (Other information and communication)	Sonstige Informations-, Kommunikationsdienstlg. (Other information and communication services)
23	64–66	Finanz- und Versicherungsdienstleister (K) (Financial and insurance activities)	Finanz- und Versicherungsdienstleistungen (Financial and insurance services)
24	68	Grundstücks- und Wohnungswesen (L) (Real estate activities)	Dienstlg. des Grundstücks- und Wohnungswesens ((Real estate services)
25	69–70	Rechts- u. Steuerberatung, Unternehmensberatung (MAA) (Legal and accounting activities, management consultancy activities)	Dienstleistungen der Rechts-, Steuer- und Unternehmensberatung (Legal, accounting and management consultancy services)
26	71	Architektur- u. Ing.büros; techn. Untersuchung (MAB) (Architectural and engineering activities; technical testing and analysis)	Dienstleistg. v. Architektur- u. Ing.büros u.d..techn.,physik.U.suchung (Architectural and engineering services; technical testing and analysis)
27	72–75	Übrige Freiberufl., wissenschaftl. u. techn. Dienstleister (MX) (Scientific research and development, advertising, market research, other professional, scientific, technical activities and veterinary activities)	Übrige freiberufl., wissenschaftl. und technische Dienstleistungen (Scientific research and development, advertising, market research, other professional, scientific, technical, veterinary services)
28	78	Vermittlung und Überlassung von Arbeitskräften (78) (Employment activities)	Dienstleistungen der Vermittlung und Überlassung von Arbeitskräften (Employment services)
29	77, 79–82	Sonstige wirtschaftliche Unternehmensdienstleister (NX) (Other economic business service provider)	Dienstlg. d. Vermietung, v. Reisebüros, - veranstaltern, Wach-, Sicherheitsdienstlg.(Services related to rental, travel agencies, tour operators, security services)
30	84	Öffentliche Verwaltung, Verteidigung; Sozialversicherung (O) (Public administration and defence; compulsory social security)	Dienstlg. der öffentlichen Verwaltung, der Verteidigung und Sozialversicherung (services of public administration, defence and social security)
31	85	Erziehung und Unterricht (P) (Education)	Erziehungs- und Unterrichtsdienstleistungen (Educational services)
32	86	Gesundheitswesen (QA) (Human health activities)	Dienstleistungen des Gesundheitswesens (Healthcare services)
33	87–88	Heime und Sozialwesen (QB) (Residential care and social work activities)	Dienstleistungen von Heimen und des Sozialwesens (Services provided by residential homes and social services)
34	90–93	Kunst, Unterhaltung und Erholung (R) (Arts, entertainment and recreation)	Dienstlg. der Kunst, der Kultur, des Sports, der Unterhaltung und der Erholung (Services of arts, entertainment and recreation)
35	94	Interessenvertretungen, religiöse Vereinigungen (SB) (Activities of membership organisations)	Dienstleistg. d. Interessenvertr., kirchl. u. sonst. Vereinigungen (Services of membership organisations)
36	95–96	Sonstige Dienstleister a.n.g. (SX) (Other service activities)	Sonstige überwiegend persönliche Dienstleistungen (Other predominantly personal services)
37	97–98	Private Haushalte mit Hauspersonal (T) (Activities of households as employers)	Waren und Dienstleistungen privater Haushalte o.a.S. (Goods and services of private households)