Guidelines for employment impact assessment of renewable energy deployment - Gross employment studies

Carsten Nathani, Barbara Breitschopf, Gustav Resch

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Overview

- Objective of gross employment studies
- System boundaries of the RE industry
- Approaches for gross employment studies
  - Employment factor approach
  - Gross IO modelling approach
- Discussion of approaches
- Country results
Objective of gross employment studies

- To estimate employment in a country that can be related to renewable energy use (“RE industry”)
- To answer questions like e.g.:
  - Which part of total employment in a country is related to RE use?
  - Relevance of domestic RE use vs. RE technology exports for employment?
  - Relevance of various RE technologies?
  - Relevance of indirect employment in industries supplying the RE industry
System boundaries of the renewable energy industry

- RE industry: cross-sectional industry that comprises all activities related to RE use
- All life cycle phases of a RE facility:
  - Manufacturing, construction and installation (incl. reinvestment)
  - Operation and maintenance
  - Demolition
- Breakdown of life cycle phases into economic activities (important for capturing imports and exports)
System boundaries of the renewable energy industry

CONSTRUCTION AND INSTALLATION

- Project development and planning
  - Site preparation
    - Foundations for WPP
  - Connection to the net
    - Assembly of WPP

OPERATION

- WPP: Wind power plant
  - Operation of WPP
    - Replacement of WPP parts
  - Demolition of WPP

TRANSPORT

MANUFACTURING

- Manuf. of WT tower
- Manuf. of WT nacelle
- Manuf. of WT rotor blades
- Manuf. of other components

WTP: Wind turbine
Approaches chosen for guidelines

- Enterprise survey
- Employment factor approach
- Gross IO modelling approach
- Supply chain analysis

=> Methodological Guidelines
1. Employment factor approach: methodology

- Employment factor: employment needed to perform an activity in the RE facility life cycle (e.g. 3 FTE-years per MW wind power plant installed)

- Calculation steps:
  - Determine system boundaries
  - Determine activity values and employment factors
  - Determine domestic activity level by incorporating imports and exports
  - Calculate direct employment
  - Document methodology and results
1. Employment factor approach: data requirements and sources

- Annual data on installed capacities, net capacity increase (MW), biomass fuel input and power generation (GWh) by technology
  - Sources: RES statistics (e.g. IEA), industry associations, RES studies

- Data on import and export (shares) by activity
  - Data are only partly available from trade statistics; other sources: industry associations and enterprises, RES studies

- Employment factors by technology and activity
  - Sources: employment requirement / cost analyses, estimates from associations, enterprises, experts
1. Employment factor approach: example wind power plant

<table>
<thead>
<tr>
<th>Activity</th>
<th>Activity level parameter</th>
<th>Activity value</th>
<th>Domestic share (incl. net exports)</th>
<th>Employ-ment factor</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project development and planning</td>
<td>New capacity installed</td>
<td>1,500 MW</td>
<td>100%</td>
<td>0.8</td>
<td>(FTE * a) / MW</td>
</tr>
<tr>
<td>Manufacture of WT towers</td>
<td>New capacity installed</td>
<td>1,500 MW</td>
<td>80%</td>
<td>1.2</td>
<td>(FTE * a) / MW</td>
</tr>
<tr>
<td>Manufacture of WT nacelles</td>
<td>New capacity installed</td>
<td>1,500 MW</td>
<td>110%</td>
<td>1.3</td>
<td>(FTE * a) / MW</td>
</tr>
<tr>
<td>Manufacture of WT rotor blades</td>
<td>New capacity installed</td>
<td>1,500 MW</td>
<td>180%</td>
<td>0.7</td>
<td>(FTE * a) / MW</td>
</tr>
<tr>
<td>Construction and installation of WPP</td>
<td>New capacity installed</td>
<td>1,500 MW</td>
<td>100%</td>
<td>3.0</td>
<td>(FTE * a) / MW</td>
</tr>
<tr>
<td>Operation of WPP</td>
<td>New capacity installed</td>
<td>10’000 MW</td>
<td>100%</td>
<td>0.2</td>
<td>FTE / MW</td>
</tr>
</tbody>
</table>

This example shows exemplary employment factors and activity levels for the MCI and the O&M phase of a wind power plant.

Abbreviations:
- WT: Wind turbine
- WPP: Wind power plant
- FTE: Full time equivalent
- a: year
- MCI: Manufacturing, construction and installation
2. Gross IO modelling: methodology

- Combines techno-economic data for RE technologies with economic input-output modelling
- Calculation steps:
  - Determine system boundaries
  - Determine expenditures for RE use, allocate to cost components and industries
  - Calculate domestic output by RE technology and by industry
  - Calculate direct and indirect employment
  - Document methodology and results
2. Gross IO modelling: data requirements and sources

- Annual data on installed capacities, net capacity increase (MW) and power generation (GWh) by technology
  - Sources: RES statistics (e.g. IEA), industry associations, RES studies
- Techno-economic data
  - Specific installation, O&M, fuel (and demolition) costs by technology (e.g. EUR/kW or EUR/MWh)
  - Cost structures: breakdown of specific costs by cost component / activity
  - Allocation of cost components to industries of IOT
  - Sources: Techno-economic studies, expert’s estimates
- Input-output table (IOT) of a country and sectoral employment data
  - Sources: usually published by statistical office
2. Gross IO modelling: example wind power plant

Input data for the example calculations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total installed capacity</td>
<td>MW</td>
<td>10,000</td>
</tr>
<tr>
<td>New capacity installed</td>
<td>MW</td>
<td>1,500</td>
</tr>
<tr>
<td>Specific installation cost</td>
<td>EUR/MW</td>
<td>1,553</td>
</tr>
<tr>
<td>Specific O&amp;M cost</td>
<td>EUR/MW</td>
<td>37</td>
</tr>
<tr>
<td>Specific capital cost</td>
<td>EUR/MW</td>
<td>147</td>
</tr>
</tbody>
</table>
2. Gross IO modelling: example wind power plant

Input data for the example calculations

<table>
<thead>
<tr>
<th>Cost components</th>
<th>Cost shares</th>
<th>Import shares</th>
<th>Export shares</th>
<th>Allocation to industries of IOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction of WPP</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>4%</td>
<td>0%</td>
<td>0%</td>
<td>Business services (74)</td>
</tr>
<tr>
<td>Manufacture of WT towers</td>
<td>15%</td>
<td>20%</td>
<td>30%</td>
<td>Man. of metal structures (28)</td>
</tr>
<tr>
<td>Manufacture of WT nacelles</td>
<td>37%</td>
<td>20%</td>
<td>100%</td>
<td>Machinery (28)</td>
</tr>
<tr>
<td>Manufacture of WT rotor blades</td>
<td>15%</td>
<td>30%</td>
<td>80%</td>
<td>Plastics processing (25)</td>
</tr>
<tr>
<td>Transport</td>
<td>4%</td>
<td>0%</td>
<td>0%</td>
<td>Ground transport (60)</td>
</tr>
<tr>
<td>Site preparation</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>Construction works (45)</td>
</tr>
<tr>
<td>Foundations of WPP</td>
<td>6%</td>
<td>0%</td>
<td>0%</td>
<td>Construction works (45)</td>
</tr>
<tr>
<td>Assembly of WPP</td>
<td>6%</td>
<td>0%</td>
<td>0%</td>
<td>Machinery (28)</td>
</tr>
<tr>
<td>Connection to the net</td>
<td>10%</td>
<td>0%</td>
<td>0%</td>
<td>Electrical industry (31)</td>
</tr>
</tbody>
</table>
# 2. Gross IO modelling: example wind power plant

Results of the example calculations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit</th>
<th>Construction of domestic WPP</th>
<th>Operation of domestic WPP</th>
<th>Export</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure</td>
<td>m EUR</td>
<td>2,329</td>
<td>1,834</td>
<td>0</td>
<td>4,163</td>
</tr>
<tr>
<td>Domestic output</td>
<td>m EUR</td>
<td>1,982</td>
<td>1,834</td>
<td>1,246</td>
<td>5,062</td>
</tr>
<tr>
<td>Direct employment</td>
<td>EP</td>
<td>13,737</td>
<td>3,517</td>
<td>6,689</td>
<td>23,943</td>
</tr>
<tr>
<td>Indirect</td>
<td>EP</td>
<td>10,820</td>
<td>2,118</td>
<td>6,779</td>
<td>19,718</td>
</tr>
<tr>
<td>employment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total employment</td>
<td>EP</td>
<td>24,557</td>
<td>5,636</td>
<td>13,468</td>
<td>43,661</td>
</tr>
</tbody>
</table>
Discussion: Employment factor approach

- **Strengths:**
  - Potentially technology-specific, if reliable data available
  - Low-cost approach and easy to use, if employment factors available
  - Good for fast estimates and updates

- **Limitations:**
  - Reliable sources for country specific employment factors are scarce
  - Exports are difficult to integrate
  - Only direct employment
Discussion: Gross IO modelling

- **Strengths:**
  - Comprehensive and consistent framework
  - Allows to calculate other economic impacts within the same framework (e.g. value added)
  - Open for integration of results from other sources (e.g. enterprise surveys)
  - Direct and indirect employment

- **Limitations:**
  - Aggregation bias due to assumption: industries in the IO model are adequate proxies for companies in the RE industry but: detailed technology specific information can be integrated in the framework
Application of gross IO modelling approach to RETD countries

- **Aim**: to test and demonstrate feasibility of approach
- **Input data and results documented in annex to guidelines and excel files**
- **Technology data on capacities, electricity generation, biomass inputs and costs taken from Green-X database as default**
- **Country-specific data from existing studies used where feasible (esp. data on expenditures, imports and exports)**
- **Simplifying assumptions for some data due to restricted project resources (esp. on imports and exports of RE technology)**
Application of gross IO modelling approach to RETD countries: tentative results 2009

<table>
<thead>
<tr>
<th>Country</th>
<th>Direct employment</th>
<th>Indirect employment</th>
<th>Total RE related employment</th>
<th>Share of total employment in the country</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Employed persons</td>
<td>Employed persons</td>
<td>Employed persons</td>
<td>direct employment</td>
</tr>
<tr>
<td>Canada</td>
<td>32'000</td>
<td>21'700</td>
<td>53'700</td>
<td>0.19%</td>
</tr>
<tr>
<td>Denmark</td>
<td>27'200</td>
<td>21'700</td>
<td>48'900</td>
<td>0.95%</td>
</tr>
<tr>
<td>France</td>
<td>29'800</td>
<td>19'100</td>
<td>48'900</td>
<td>0.11%</td>
</tr>
<tr>
<td>Germany</td>
<td>150'100</td>
<td>120'500</td>
<td>270'600</td>
<td>0.37%</td>
</tr>
<tr>
<td>Ireland</td>
<td>2'600</td>
<td>700</td>
<td>3'300</td>
<td>0.13%</td>
</tr>
<tr>
<td>Japan</td>
<td>27'600</td>
<td>33'000</td>
<td>60'600</td>
<td>0.04%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>9'200</td>
<td>11'600</td>
<td>20'800</td>
<td>0.11%</td>
</tr>
<tr>
<td>Norway</td>
<td>10'200</td>
<td>6'200</td>
<td>16'400</td>
<td>0.39%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>16'200</td>
<td>11'000</td>
<td>27'200</td>
<td>0.06%</td>
</tr>
</tbody>
</table>
For additional information on EID Employ:


Contact:  IEA_RETD@ecofys.com or barbara.breitschopf@isi.fhg.de

Fraunhofer-Institut für Systems and Innovation Research (ISI), Karlsruhe, Barbara Breitschopf
Rütter + Partner Socioeconomic Research + Consulting, Switzerland, Carsten Nathani
Vienna University of Technology, Energy Economics Group (EEG), Austria, Gustav Resch

THANK YOU!