Data Article

An extensive data set on energy, economy, environmental pollution and institutional quality in the petroleum-reliant developing and transition economies

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\textbf{A B S T R A C T}

Petroleum-reliant developing and transition economies account for 15–20\% of global greenhouse gas emissions. This group of countries have a disproportionately high share of oil and natural gas in their energy mix and a relatively high carbon footprint over their petroleum value chains. The present data set is an extensive compilation of the essential indicators related to economy, energy, environmental pollution, and institutional quality of 37 oil and gas producing developing and transition economies in the time interval spanning between 1989 and 2019. The data set can serve as a basis for the macroeconomic analysis of...
energy, environment, social and institutional issues in this group of countries and draft further industry explorations as well as sustainable development policy analyses and recommendations. Furthermore, based on the mentioned data series, we propose three novel indexes – i.e. Energy Sector Development Indexes I, II, and III. Those indexes are developed in the context of fossil fuel abundant settings. Despite focusing on the fossil fuel abundant settings, the Energy Sector Development Indexes could be expanded for petroleum and coal scarce countries as well.

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Specifications Table

| Subject | Climate and Energy Economics |
|---------|-----------------------------|
| Specific subject area | Environmental Macroeconomics |
| Type of data | Panel data |
| How data were acquired | The data set has been compiled over the following statistical databases: The World Bank World Development Indicators (WDI), The Freedom House, World Bank Ease of Doing Business Data and individual statistical agencies and committees. |
| Data format | Secondary Data. |
| Parameters for data collection | The rationale for collecting the variables was to select indicators related to economy, energy, environmental pollution, and institutional quality of 37 oil and gas producing developing and transition economies for an extensive time-span. |
| Description of data collection | Secondary data – The data series encompass level, growth rate and share series. Most of the economic and environmental series are presented in per capita terms. This is in line with the studies on income-environment relationship. |
| Data source location | Secondary data sources: World Bank. 2019. World Development Indicators. Available online: https://databank.worldbank.org/source/world-development-indicators (accessed on January 7, 2021) [1]. European Commission, Joint Research Centre (JRC) /Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), 2008. https://data.jrc.ec.europa.eu/collection/edgar (accessed on January 7, 2021) [2]. Carbon Dioxide Information Analysis centre, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States, 2020. https://cdiac.ess-dive.lbl.gov/ (accessed on January 7, 2021) [3]. OECD / IEA. Data and Statistics, 2014. https://www.iea.org/data-and-statistics?country=WORLD&fuel=Energy%20supply&indicator=TPESbySource (accessed on January 7, 2021) [4]. Key GHG Data. United Nations Framework Convention on Climate Change, 2020. https://di.unfccc.int/time_series (accessed on January 7, 2021) [5]. World Bank. 2011. The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium. Environment and Development, World Bank. https://openknowledge.worldbank.org/handle/10986/2252 (accessed on January 7, 2021) [6]. World Bank national accounts data, and OECD National Accounts data files, 2020. https://data.worldbank.org/indicator/NY.GDP.MKTP.CD (accessed on January 7, 2021) [7]. International Comparison Program, World Bank, 2020 | World Development Indicators database, World Bank | Eurostat-OECD PPP Programme. |

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Value of the Data

• Based on the theory of economic development and selected data series in the compiled data set, the authors propose three novel Energy Sector Development Indexes (ESDI), i.e. ESDI I, ESDI II, and ESDI III.
• The data set enables statistical analysis of a broad spectrum of issues that belong to the realm of economy, energy, sustainable development and environmental pollution.
• Data basis for the scholars working on econometric modelling, analysis and forecasting of economy-energy-environment relationship as well as energy, development and resource policy.
• The data set could be employed both for country-specific time series, worldwide cross-section analyses, and panel data estimations.

1. Data Description

The current data set covers 37 oil-producing developing and transition economies in the time frame spanning between 1989 and 2019. The list of countries which are represented in the data set is given in Table 1. A selected sample of data series from the data set have been employed in Sadik-Zada & Gatto [12] and Sadik-Zada & Loewenstein [13]. The data set at hand is built on the wake of extensive panel data sets on sustainable energy economics and policy [14–17].

The proposed Energy Sector Development Indexes have been first presented in this enquiry, which is predicated on the preliminary works of the authors on the theory of economic development and carbon footprint of fossil fuel abundance. ESDI is a measure of reliance on fossil fuels in the electricity mix in the face of cost advantage and availability of large fossil fuel deposits. ESDI is an indicator for energy transition in the fossil fuel abundant settings, whereby energy transition is expressed here in the composition of electricity mix. We propose ESDI I, which indicates the impact of oil abundance on the reliance on oil in electricity production; ESDI II, which indicates the role of the natural gas in the enhancement of the tendency to rely on natural gas in powering power plants; and ESDI III, which indicates how natural resource abundance shapes electricity mix. Due to the dominance of fossils in the natural resource revenues of the countries in the data set, ESDI III could be interpreted as a measure of fossil fuels on the fossils’

Table 1
List of countries in the estimations.

| Algeria, Angola, Argentina, Australia, Azerbaijan, Bahrain, Brazil, Brunei, Cameroon, Chad, Congo Rep., Ecuador, Egypt, Equatorial Guinea, Gabon, Ghana, Indonesia, Iran, Iraq, Kazakhstan, Kuwait, Libya, Malaysia, Mexico, Nigeria, Norway, Oman, Pakistan, Qatar, Russia, Saudi Arabia, Syria, Thailand, Trinidad and Tobago, Turkmenistan, UAE, Venezuela, Vietnam |
bias in the energy mix. The validity of ESDI III is confined to the countries in the data set. The mentioned indicators are calculated in accordance with the following equations:

\[
ESDI_{I_{it}} = \left( \frac{\text{Percentage of Oil in Electricity Mix}_{it}}{\text{Percentage of Oil in GDP}_{it}} \right) \times \text{Percentage of Manufacturing Value Added in GDP}
\]

\[
ESDI_{II_{it}} = \left( \frac{\text{Percentage of Natural Gas in Electricity Mix}_{it}}{\text{Percentage of Natural Gas in GDP}_{it}} \right) \times \text{Percentage of Manufacturing Value Added in GDP}
\]

\[
ESDI_{III_{it}} = \left( \frac{\text{Percentage of Fossils in Electricity Mix}_{it}}{\text{Percentage of Fossils in GDP}_{it}} \right) \times \text{Percentage of Manufacturing Value Added in GDP}
\]

whereby \(i\) indicates the respective country and \(t\) stands for the respective time period.

The authors employ the percentage of the manufacturing sector in GDP to account for the level of economic development because in the literature on economic development growth of the manufacturing sector is deemed to be the measure of economic development. Without this multiplier the ratio \(\left( \frac{\text{Percentage of Fossils in Electricity Mix}_{it}}{\text{Percentage of Fossils in GDP}_{it}} \right)\) ignores differences in its magnitude, which can be attributed to the differences in the level of economic development [18,19]. To normalize the ESDI I, II, and III, we recommend using the natural logarithm if these series within the panel data analyses.

Table 1 sketches the analysed countries.

The data series in the panel data set can be clustered in four groups. These are:

i) indicators of economic development;
ii) environmental pollution;
iii) energy sector and energy mix;
iv) institutions.

All data refer to the last available year – i.e. the last issued year per each respective database. The variables that indicate the level of institutional development cover both economic and political institutions. This corresponds with the trend of separation of economic and political institutions in the economic literature of the last two decades [20].

The individual series in the data set are described in the Appendix and refer to the different exploited databases. A cursory analysis of the description could efficiently support the applied climate and energy economists for the available data prior to the operationalization of their research hypotheses.

2. Experimental Design, Materials and Methods

The built data set gathers data from 11 sources in the domain of energy economics. Along with the 11 existing sources, three new indexes are calculated – the ESDI indexes. The three novel simple indexes have been computed as indicators which account for the essential elements of the series of: economic development, resource curse conjecture and environmental Kuznets curve hypothesis in a specific context – i.e. energy sector development [12]. The distinctive feature of the proposed indexes is that they represent the result of a novel juxtaposition of the three mentioned strands of literature review. The data set suits well for cross-country panel data analysis. The proposed ESDI indexes have been calculated and presented in the data description section.
Appendix. Description of data.

| Variable | Description / Transformation | Source |
|----------|------------------------------|--------|
| Index of Energy Sector Development (ESDI) I | The ratio of the percentage of oil in GDP and the percentage of oil in electricity mix multiplied by the percentage of the manufacturing sector in GDP. | Author's own calculations. |
| Index of Energy Sector Development (ESDI) II | The ratio of the percentage of the natural gas in GDP and the percentage of the natural gas in the electricity mix multiplied by the percentage of the manufacturing sector in GDP. | Author's own calculations. |
| Index of Energy Sector Development (ESDI) III | The ratio of the percentage of the fossil fuels in GDP and the percentage of the fossil fuels in the electricity mix multiplied by the percentage of the manufacturing sector in GDP. | Author's own calculations. |
| Agricultural Methane Emissions | Agricultural methane emissions (thousand metric tons of CO2 equivalent). | European Commission, Joint Research Centre (JRC) /Netherlands Environmental Assessment Agency (PBL) Emission Database for Global Atmospheric Research (EDGAR), 2008. Research [2]. |
| CO2 emissions (kg per 2010 US$ of GDP) | CO2 emissions from the burning of fossil fuels and the manufacture of cement. | Carbon Dioxide Information Analysis centre, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States, 2020 [3]. |
| CO2 emissions (kg per 2011 PPP $ of GDP) | CO2 emissions from the burning of fossil fuels and the manufacture of cement. | Carbon Dioxide Information Analysis centre, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States, 2020. |
| CO2 emissions from electricity and heat production, total (% of total fuel combustion) | CO2 emissions from electricity and heat production as: Main Activity Producer Electricity and Heat; Unallocated Autoproducers; Other Energy Industries contains various emissions. | IEA Statistics © OECD/IEA, 2014[4]. |
| CO2 emissions (metric tons per capita) | Carbon dioxide emissions from the burning of fossil fuels and the manufacture of cement. | Carbon Dioxide Information Analysis centre, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States, 2020. |
| CO2 emissions from manufacturing industries and construction (% of total fuel combustion) | CO2 emissions from manufacturing industries and construction contain the emissions from the combustion of fuels in industry. | IEA Statistics © OECD/IEA, 2014. |
| CO2 emissions from other sectors, excluding residential buildings and commercial and public services (% of total fuel combustion) | CO2 emissions from other sectors, less residential buildings and commercial and public services. | IEA Statistics © OECD/IEA, 2014. |
| CO2 intensity (kg per kg of oil equivalent energy use) | Carbon dioxide emissions from solid fuel consumption refer mainly to emissions from the use of coal as an energy source. | Carbon Dioxide Information Analysis centre, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States, 2020 [5]. |

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| Variable                                                                 | Description / Transformation                                                                                                                                                                                                 | Source                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methane emissions (kt of CO2 equivalent)                                | Methane emissions are those stemming from human activities such as agriculture and from industrial methane production.                                                                                                                                                                     | European Commission, Joint Research Centre (JRC) /Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), 2008.                                                                                   |
| Methane emissions in energy sector (thousand metric tons of CO2 equivalent) | Methane emissions from energy processes are emissions from the production, handling, transmission, and combustion of fossil fuels and biofuels.                                                                                                                                         | European Commission, Joint Research Centre (JRC) /Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), 2008.                                                                                   |
| Total greenhouse gas emissions (kt of CO2 equivalent)                   | Total greenhouse gas emissions in kt of CO2 equivalent are composed of CO2 totals excluding short-cycle biomass burning and other biomass burning, all anthropogenic.                                                                                                                   | European Commission, Joint Research Centre (JRC) /Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), 2008.                                                                                   |
| Other greenhouse gas emissions, HFC, PFC and SF6 (thousand metric tons of CO2 equivalent) | Other greenhouse gas emissions are by-product emissions of hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.                                                                                                                                                | European Commission, Joint Research Centre (JRC) /Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), 2008.                                                                                   |
| PFC gas emissions (thousand metric tons of CO2 equivalent)              | Perfluorocarbons, used as a replacement for chlorofluorocarbons in manufacturing semiconductors, are a byproduct of aluminium smelting and uranium enrichment.                                                                                                                   | European Commission, Joint Research Centre (JRC) /Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), 2008.                                                                                   |
| SF6 gas emissions (thousand metric tons of CO2 equivalent) - Hong Kong SAR, China, Latin America & Caribbean (excluding high income) | Sulfur hexafluoride is used largely to insulate high-voltage electric power equipment.                                                                                                                                                                                                 | European Commission, Joint Research Centre (JRC) /Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), 2008.                                                                                   |
| GHG net emissions/removals by LUCF (Mt of CO2 equivalent)              | GHG net emissions/removals by Land Use Change and Forestry (LUCF) refers to changes in atmospheric levels of all greenhouse gases attributable to forest and land-use change activities.                                                                                                             | United Nations Framework Convention on Climate Change, 2020 [5].                                                                                                                                                                           |
| Adjusted net national income per capita (current US$)                  | Adjusted net national income is GNI minus consumption of fixed capital and natural resources depletion.                                                                                                                                                                         | World Bank, The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium, 2011 [6].                                                                                                                                 |
| Adjusted net national income per capita (constant 2010 US$)            | Adjusted net national income is GNI minus consumption of fixed capital and natural resources depletion.                                                                                                                                                                         | World Bank, The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium, 2011 [6].                                                                                                                                 |
| GDP per unit of energy use (constant 2017 PPP $ per kg of oil equivalent) | GDP per unit of energy use is the PPP GDP per kilogram of oil equivalent of energy use.                                                                                                                                                                                               | IEA Statistics © OECD/IEA, 2014.                                                                                                                                                                                                           |

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| Variable                                                                 | Description / Transformation                                                                 | Source                                                                                           |
|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| GDP per capita, PPP (constant 2017 international $)                     | GDP per capita based on purchasing power parity (PPP).                                       | International Comparison Program, World Bank | World Development Indicators database, World Bank | Eurostat-OECD PPP Programme, 2020 [8]. |
| GDP per capita growth (annual%)                                        | Annual percentage growth rate of GDP per capita based on constant local currency.            | World Bank national accounts data, and OECD National Accounts data files, 2020 [7].             |
| GDP per capita, PPP (current international $)                          | This indicator provides per capita values for gross domestic product (GDP) expressed in current international dollars converted by purchasing power parity (PPP) conversion factor. | International Comparison Program, World Bank | World Development Indicators database, World Bank | Eurostat-OECD PPP Programme, 2020. |
| GDP per person employed (constant 2017 PPP $)                          | GDP per person employed as gross domestic product (GDP) divided by total employment in the economy. | International Labour Organization, ILOSTAT, 2020 [9].                                           |
| GDP per capita (constant 2010 US$)                                     | GDP per capita is gross domestic product divided by midyear population.                      | World Bank national accounts data, and OECD National Accounts data files, 2020.                 |
| GDP per capita (constant LCU)                                          | GDP per capita is gross domestic product divided by midyear population.                     | World Bank national accounts data, and OECD National Accounts data files, 2020.                 |
| GDP per capita (current US$)                                           | GDP per capita is gross domestic product divided by midyear population.                     | World Bank national accounts data, and OECD National Accounts data files, 2020.                 |
| CPIA policy and institutions for environmental sustainability rating    | Policy and institutions for environmental sustainability assess the extent to which environmental policies foster the protection and sustainable use of natural resources and the management of pollution. | World Bank Group, CPIA database, 2020 [11].                                                    |
| CPIA public sector management and institutions cluster average         | The public sector management and institutions cluster includes property rights and rule-based governance, quality of budgetary and financial management, efficiency of revenue mobilization, quality of public administration, and transparency, accountability, and corruption in the public sector. | World Bank Group, CPIA database, 2020.                                                          |
| CPIA quality of budgetary and financial management rating              | Quality of budgetary and financial management assesses the extent to which there is a comprehensive and credible budget linked to policy priorities, effective financial management systems, and timely and accurate accounting and fiscal reporting, including timely and audited public accounts. | World Bank Group, CPIA database, 2020.                                                          |
| CPIA transparency, accountability, and corruption in the public sector | Transparency, accountability, and corruption in the public sector assess the extent to which the executive can be held accountable for its use of funds and for the results of its actions by the electorate and by the legislature and judiciary, and the extent to which public employees within the executive are required to account for administrative decisions, use of resources, and results obtained. | World Bank Group, CPIA database, 2020.                                                          |

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| Variable                                      | Description / Transformation                                                                                                                                                                                                 | Source                                                                                                                                 |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| CPIA macroeconomic management rating (1=low to 6=high) | Macroeconomic management assesses the monetary, exchange rate, and aggregate demand policy framework. Fiscal policy assesses the short- and medium-term sustainability of fiscal policy (taking into account monetary and exchange rate policy and the sustainability of the public debt) and its impact on growth. | World Bank Group, CPIA database, 2020.                                                                                                                                                           |
| CPIA fiscal policy rating (1=low to 6=high)    | Fiscal policy assesses the short- and medium-term sustainability of fiscal policy (taking into account monetary and exchange rate policy and the sustainability of the public debt) and its impact on growth.                                    | World Bank Group, CPIA database, 2020.                                                                                                                                                           |
| CPIA equity of public resource use rating (1=low to 6=high) | Equity of public resource use assesses the extent to which the pattern of public expenditures and revenue collection affects the poor and is consistent with national poverty reduction priorities.                                                      | World Bank Group, CPIA database, 2020.                                                                                                                                                           |
| Manufacturing, value added (% of GDP)         | Manufacturing refers to industries belonging to ISIC divisions 15–37. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs.                                                        | World Bank national accounts data, and OECD National Accounts data files, 2020.                                                                                                             |
| Machinery and transport equipment (% of value added in manufacturing) | Value added in manufacturing is the sum of gross output less the value of intermediate inputs used in production for industries classified in ISIC major division D.                                                                 | United Nations Industrial Development Organization, International Yearbook of Industrial Statistics, 2020 [10].                                                                             |
| Services, value added (% of GDP)              | Services correspond to ISIC divisions 50–99 and they include value added in wholesale and retail trade, transport, and government, financial, professional, and personal services such as education, health care, and real estate services. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. | World Bank national accounts data, and OECD National Accounts data files, 2020.                                                                                                             |
| Services, value added (annual% growth)        | Annual growth rate for value added in services based on constant local currency. Aggregates are based on constant 2010 U.S. dollars.                                                                                                   | World Bank national accounts data, and OECD National Accounts data files, 2020.                                                                                                             |
| Natural gas rents (% of GDP)                  | Natural gas rents are the difference between the value of natural gas production at world prices and total costs of production.                                                                                                  | World Bank, The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium, 2011.                                                                                       |
| Total natural resources rents (% of GDP)      | Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.                                                                                           | World Bank, The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium, 2011.                                                                                       |
| Electricity production from natural gas sources (% of total) | Sources of electricity refer to the inputs used to generate electricity. Gas refers to natural gas but excludes natural gas liquids.                                                                                           | IEA Statistics © OECD/IEA, 2014.                                                                                                                                                               |
| Oil rents (% of GDP)                          | Oil rents are the difference between the value of crude oil production at world prices and total costs of production.                                                                                                      | World Bank, The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium, 2011.                                                                                       |

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| Variable                                                                 | Description / Transformation                                                                                                                                                                                                                                                                                                                                                     | Source                                                                 |
|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Energy use (kg of oil equivalent) per $10000 GDP (constant 2017 PPP)      | Energy use per PPP GDP is the kilogram of oil equivalent of energy use per constant PPP GDP. Energy use refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.                                                                                     | IEA Statistics © OECD/IEA, 2014.                                       |
| Electricity production from oil sources (% of total)                     | Sources of electricity refer to the inputs used to generate electricity. Oil refers to crude oil and petroleum products.                                                                                                                                                                                                                                                   | IEA Statistics © OECD/IEA, 2014.                                       |
| Electricity production from oil, gas and coal sources (% of total)       | Sources of electricity refer to the inputs used to generate electricity. Oil refers to crude oil and petroleum products. Gas refers to natural gas but excludes natural gas liquids. Coal refers to all coal and brown coal, both primary and derived fuels.                                                                                                                                   | IEA Statistics © OECD/IEA, 2014.                                       |
| Energy use (kg of oil equivalent per capita)                             | Energy use refers to use of primary energy before transformation to other end-use fuels.                                                                                                                                                                                                                                                                                          | IEA Statistics © OECD/IEA, 2014.                                       |

Sources: [1–11]

**Ethics Statement**

The work did not involve the use of human subjects nor animal experiments.

**CRediT Author Statements**

_Andrea Gatto_: Conceptualization, Methodology, Software, Data curation, Writing - original draft, Writing - review & editing; _Wilhelm Loewenstein_: Investigation, Supervision; _Elkhan Richard Sadik-Zada_: Conceptualization, Methodology, Software, Data curation, Writing - original draft, Investigation, Writing - review & editing.

**Declaration of Competing Interest**

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article.

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**Supplementary Materials**

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.dib.2021.106766.
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