

G20 Energy End-Use Data and Energy Efficiency Metrics initiative: Uncovering the role of digitalization for energy efficiency indicators

INSTITUTIONAL FRAMEWORKS FOR DATA COLLECTION IN BRAZIL

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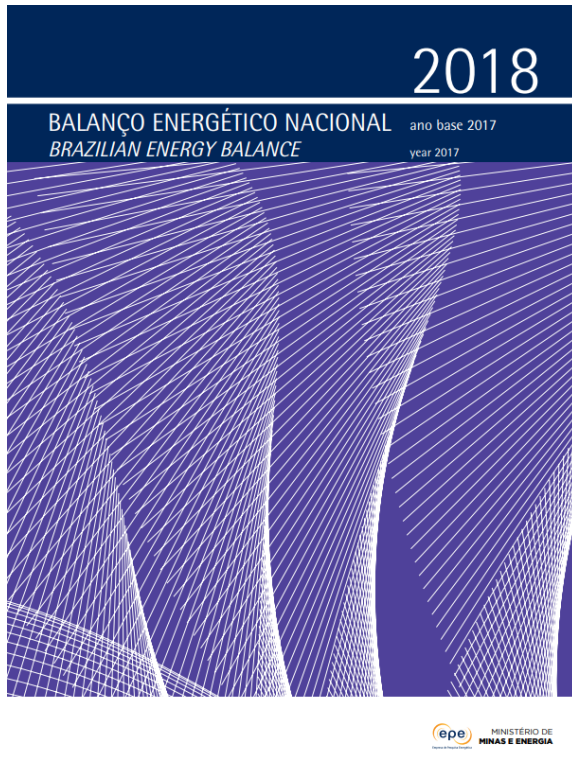
AGENDA

- *National Energy Statistics and data collection*
- *Energy efficiency Indicators database*
- *Main Challenges*

NATIONAL ENERGY STATISTICS AND DATA COLLECTION

Brazilian Energy Statistics

Institutional role of EPE includes to **implement** and **keep National Energy Statistics** as well as to **publish the Brazilian Energy Balance** (Law 10.847/2004)



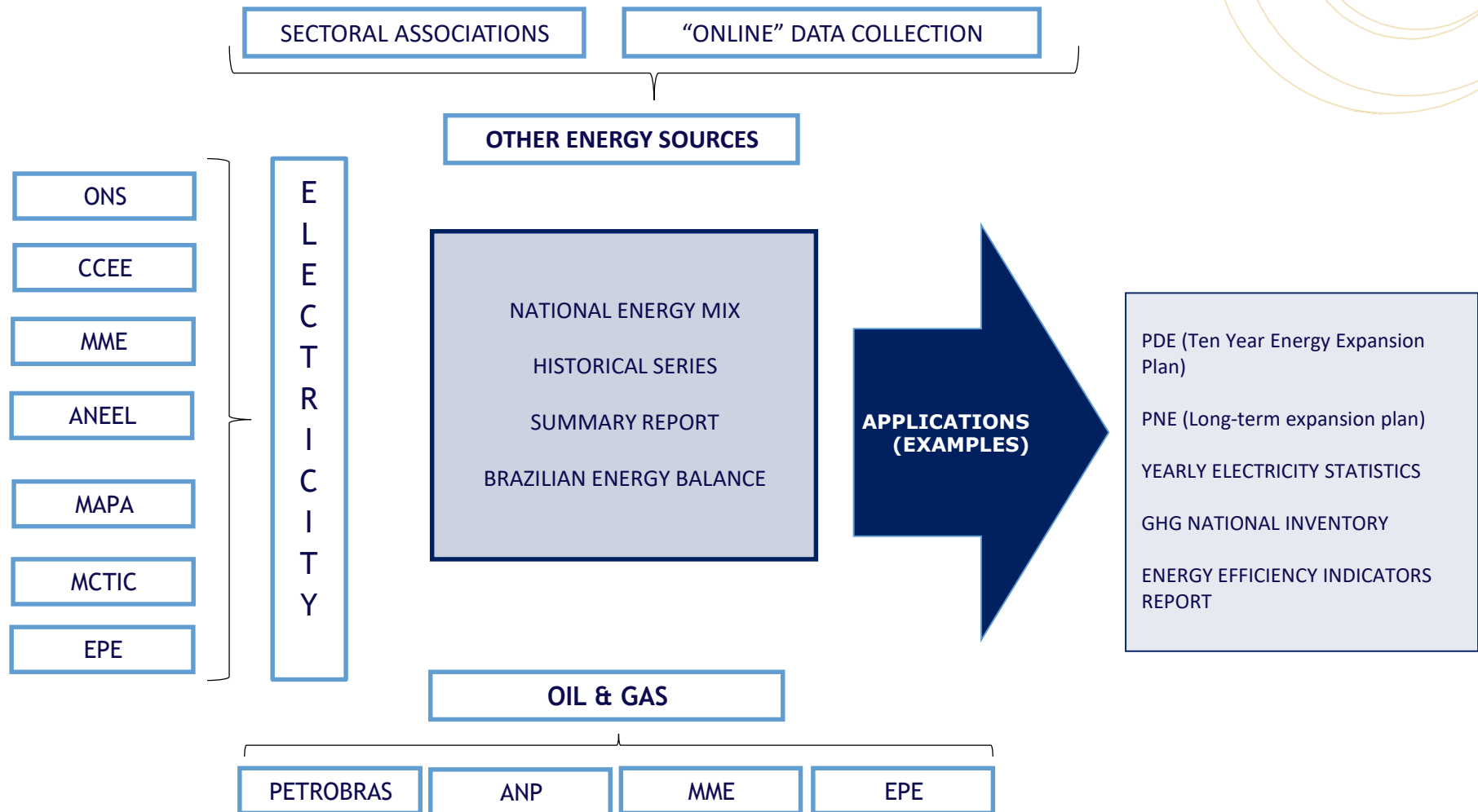
National Statistics on:

- Energy Supply and consumption by source and sector
 - International energy trades;
 - Transformation centers;
 - Energy Resources and Reserves;
 - Energy Statistics by State;
 - Total Primary Energy Supply (TPES).
-
- Historical data from 1970
 - Yearly permanent methodological updates

Brazilian Energy Balance as an important tool to monitor effects of energy policies in Brazil

Website: <http://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/balanco-energetico-nacional-ben/>

Data Collection Process: Institutional Framework



Data Collection Process: Stakeholder Inputs

| INFORMATION/DATA | STAKEHOLDER |
|---|--|
| OIL AND OIL PRODUCTS CRUDE OIL INPUTS: PRODUCTION, IMPORTS, EXPORTS REFINERIES INPUTS AND OUTPUTS SECTORAL CONSUMPTION SELF-CONSUMPTION BUNKER BIODIESEL | ANP (OIL & GAS, BIOFUELS REGULATORY AGENCY) PETROBRAS |
| NATURAL GAS SUPPLY: DOMESTIC PRODUCTION, IMPORTS, EXPORTS, REINJECTED SECTORIAL CONSUMPTION | MME/NATURAL GAS LDC |
| SUGAR CANE PRODUCTS PRODUCTION: SUGAR CANE, ETHANOL, SUGAR PRODUCTION INDICATORS | AGRICULTURE & LIVESTOCK MINISTRY (MAPA) |
| URANIUM SUPPLY: PRODUCTION, STOCKS INTERNATIONAL TRADE: IMPORTS, EXPORTS (UF ₆) INTERMEDIATES: UO ₂ PRODUCTION ELECTRICITY GENERATION | INB (BRAZILIAN NUCLEAR INDUSTRY) |
| ELECTRICITY POWER PLANT DATA GENERATION INTERNATIONAL TRADE: IMPORTS, EXPORTS FUEL CONSUMPTION FOR ELECTRICITY GENERATION ELECTRICITY CONSUMPTION BY SECTOR | ANEEL (ELECTRICITY REGULATORY AGENCY) (CCEE) BRAZILIAN CHAMBER OF ELECTRICITY ONS (NATIONAL ELECTRIC SYSTEM OPERATOR) MCTIC (MINISTRY OF SCIENCE, TECHNOLOGY, INNOVATION AND COMMUNICATION) EPE (ENERGY RESEARCH OFFICE) |
| COAL PRODUCTION SECTORAL CONSUMPTION | COAL PRODUCERS |

DISTRIBUTED SOLAR PV GENERATION ESTIMATION

- i. For new plants, which gradually come into operation over the base year of the Brazilian Energy Balance, the estimation of total electricity production considers operation in half of the year. This criterion was adopted for the purpose of simplifying calculations. For plants registered in previous years (n-1, n-2, ...) the operation during the whole year is considered.
- ii. The capacity factor (FC) for distributed photovoltaic generation varies according to the Brazilian State (UF). These values were obtained from the average radiation level of each state, based on the Brazilian Solar Energy Atlas - 2nd edition . Additionally, a performance ratio of 75% was used to calculate the capacity factor.
- iii. Annual degradation factor (D) of photovoltaic modules: 0.5% per year. Value is the median of the studies analyzed by Jordan and Kurtz (2012).
- iv. Equation for calculating generation for each Brazilian state:

$$E_b = [P_b \quad P_{b-1} \quad P_{b-2} \cdots P_{b-n}] \times \begin{bmatrix} 1/2 \\ (1-D)^1 \\ (1-D)^2 \\ \vdots \\ (1-D)^n \end{bmatrix} \times FC_{UF} \times H$$

Where:

P_b = Installed power of the state in the base year

D = Annual degradation factor

n = number of operational years prior to base year

FC_{UF} = Capacity Factor of the state (UF)

H = Hours per year

Firewood consumption in households: Estimation process

- For non-commercial energy sources (e.g. firewood, black liquor, biomass sources etc.) some estimation procedures are needed
 - If not available from on line data gathering or industrial associations, this estimation involves average energy consumption from surveys
 - It's worthwhile to note that the amount of estimated energy consumption in National Energy Balance is not representative when compared to on line data gathering however.
- An example: Firewood for household consumption

Yearly consumption in the Brazilian Household Sector is evaluated through following calculation:

$$LE = [[qfu * ceu] + [qfou * ceou] + [qfr * cer] + [qfor * ceor]] . pci . 10^{-4}$$

LE – firewood or charcoal consumption for household sector

qfu – number of stoves in urban dwellings exclusively using firewood

ceu – specific consumption of firewood on urban dwellings exclusively using firewood (kg/year/dwelling)

qfou – number of stoves in urban dwellings using firewood and other fuel

ceou – specific consumption of firewood on urban dwellings exclusively using firewood and other fuel (kg/year/dwelling)

qfr – number of stoves in rural dwellings exclusively using firewood

cer –specific consumption of firewood in rural dwellings exclusively using firewood (kg/year/dwelling)

qfor – number of stoves in rural dwellings using firewood and other fuel

ceor – specific consumption of firewood on rural dwellings exclusively using firewood and other fuel (kg/year/dwelling)

pci – lower calorific value (kcal/kg)

Brazilian Energy Statistics: Main differences with IRES approach

- Biodiesel and alcohol are considered secondary sources in the Brazilian Energy Balance.
- BEB includes nonenergy use of ethanol.
- Solar Thermal not included in BEB.
- Blast Furnace is not a transformation centre.
- Consumption of natural gas in pipelines is recorded in energy sector in BEB.

ENERGY EFFICIENCY INDICATORS DATABASE

Brazilian EEID – Structure Harmonisation with ODYSSEE

| Sector | Branches/Sectors/End uses | | Technical & Economic Data | Energy Efficiency Indicators |
|----------|--|--|---|--|
| Macro | <ul style="list-style-type: none"> - Total - Industry - Transport - Residential-Tertiary-Agriculture | | <ul style="list-style-type: none"> - Primary consumption - Final consumption - Demography - GDP, Value added | <ul style="list-style-type: none"> - Primary energy intensity - Final energy intensity - Energy efficiency index - CO2 emissions - CO2 intensity |
| Industry | <ul style="list-style-type: none"> - Chemical industry - Primary metals <ul style="list-style-type: none"> - Steel - Non ferrous - Non metallic mineral <ul style="list-style-type: none"> - Cement - Glass * - Paper & Printing - Food & beverages | <ul style="list-style-type: none"> - Textile - Machinery & Fabricated metals - Transport * - equipment - Wood - Mining - Construction - Misc. Industries | <ul style="list-style-type: none"> - Energy consumption by branch - Production index by branch - Value added by branch - Physical production for intensive products | <ul style="list-style-type: none"> - Energy efficiency Index - Energy intensity by branch - Energy intensity at adjusted structure - Specific consumption by intensive products (toe/ton) - CO2 intensity by sector |

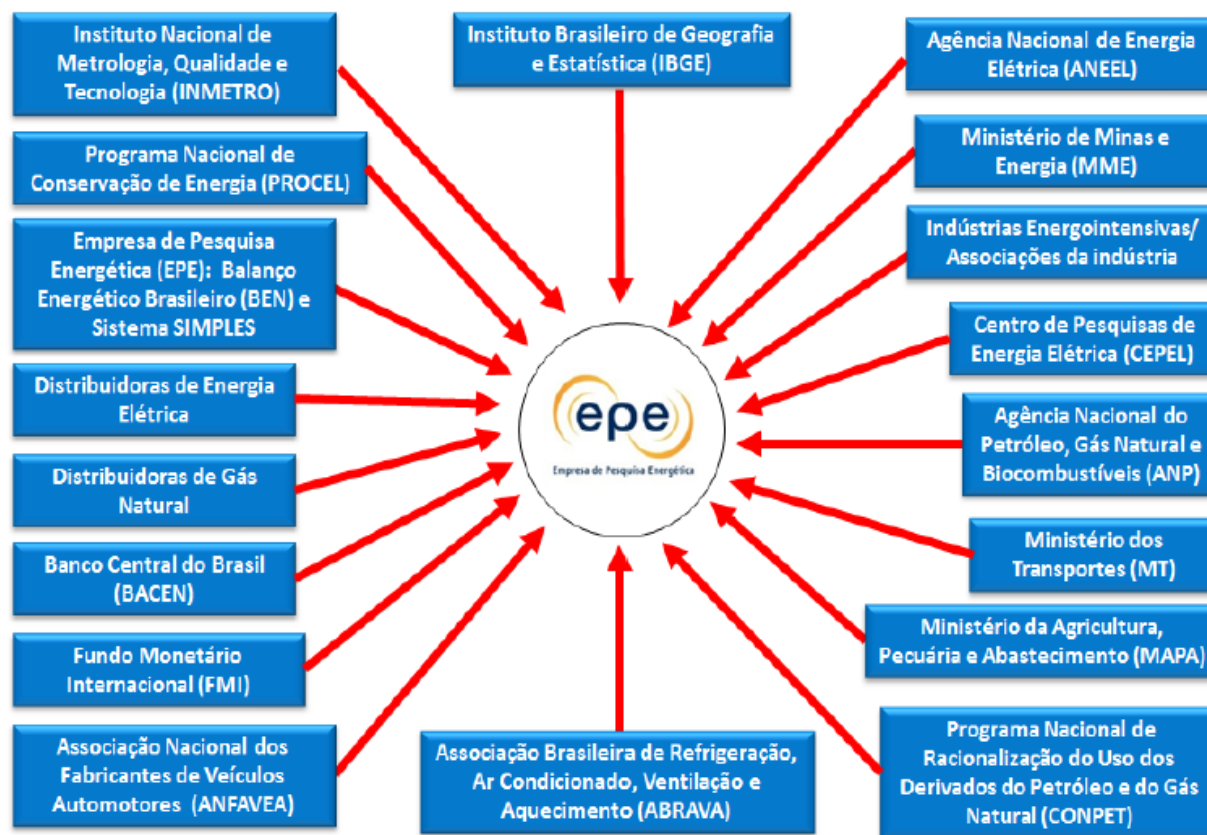
Customization to Brazil: split energy production industry (refining, O&G Production, ethanol distilleries, etc.); some sectors included in misc. industries (*)

Brazilian EEID – Structure Harmonisation with ODYSSEE

| Sector | Branches/Sectors/End uses | | Technical & Economic Data | Energy Efficiency Indicators |
|-----------------------|--|--|--|---|
| Transport | 4 Transport modes: <ul style="list-style-type: none"> - Road - Rail - Water - Air | 6 Road vehicles types: <ul style="list-style-type: none"> - Cars - Two-wheels - Bus - Trucks & light vehicles - Light vehicles - Trucks | <ul style="list-style-type: none"> - Energy consumption by fuel and by mode - Stock of vehicles by fuel - Registrations by type of vehicle - Traffic by mode - Annual distance travelled by type of vehicle | <ul style="list-style-type: none"> - Energy efficiency index - Specific consumption by vehicle, in liters/100km - Specific emissions of CO2 by mode and vehicle |
| Residential | 4 end-uses: <ul style="list-style-type: none"> - Space heating - Water heating - Cooking - Electrical appliances | 5 Appliances: <ul style="list-style-type: none"> - Refrigerators - Freezers - Washing machine - Dish washing machine - TV - Lamps | <ul style="list-style-type: none"> - Energy consumption - Stock of dwellings - New dwellings - Floor area of dwelling - Stock of appliances - Equipment rate - Degree day | <ul style="list-style-type: none"> - Energy efficiency index - Specific consumption by dwelling, end uses and by equipment - Specific emissions of CO2 - CO2 indicators |
| Services, agriculture | 7 branches: <ul style="list-style-type: none"> - Hotels & Restaurants - Health - Education - Administration - Wholesale & retail trade - Private offices - Agriculture | | <ul style="list-style-type: none"> - Energy consumption - Value added - Floor area - Employment | <ul style="list-style-type: none"> - Energy intensity - Electric intensity - Specific consumption per employee, floor area - CO2 emissions |

Customization to Brazil: include public and livestock in agriculture

Data sources for Brazilian EEID: an overview



Energy Efficiency Monitoring: historical summary

- 1st REPORT: 2014

[http://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-251/topico-311/DEA%2010-14%20Consumo%20de%20Energia%20no%20Brasil\[1\].pdf#search=estudos%20setoriais](http://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-251/topico-311/DEA%2010-14%20Consumo%20de%20Energia%20no%20Brasil[1].pdf#search=estudos%20setoriais)

- 2nd REPORT: 2017

<http://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-251/topico-311/DEA%2025-17%20-%20Indicadores%20de%20Efici%C3%Aancia%20Energ%C3%A9tica.pdf#search=monitorando>

- 3rd REPORT 2019

Launching at the end of November. 1st report with IEA partnership (benchmarking chapter)

MAIN CHALLENGES

Main Challenges

- ✓ *Keep Brazilian Institutions that provide data engaged with this work*
- ✓ *Improve online data collection in some sectors*
- ✓ *Promote best link between energy efficiency policies and indicators evaluation*

Thank you!



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