

REPÚBLICA FEDERATIVA DO BRASIL

**MINISTRY OF MINES AND ENERGY
SECRETARIAT OF ENERGY PLANNING AND DEVELOPMENT
DEPARTMENT OF ENERGY PLANNING**

International Workshop in Energy Statistics

Session 7 – Energy Balance

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The Brazilian Energy Balance Institutional Framework

In the Brazilian federal government, the **Ministry of Mines and Energy – MME** is the office responsible for developing long term actions and indicate the potentialities of the energy sector, establishing and implementing sectorial policies, formulating the principles and orienting national energy politics.

The **Brazilian Energy Balance - BEB**, published for more than 30 years by the MME, is a traditional document in the Brazilian energy sector, which annually divulges extensive research and accounting regarding the supply and consumption of energy in Brazil, contemplating the exploration and production of primary energy resources, their conversion into secondary forms, imports and exports, distribution and final energy consumption.

One of the most complete and systemized energy data bases available in the country, BEB is a fundamental reference for any study of the Brazilian energy planning.



The Brazilian Energy Balance Creating a Research Organization

To accomplish its objectives, MME promotes oriented studies and analysis to subsidize the energy sector planning, as those relatives to energy data and information.

As part of the institutional changes occurred in the Brazilian energy sector over the last years, in 2004 the Energy Research Company – EPE was created as a federal company, and its mission is to render studies and researches to subsidize the energy sector planning.

As part of its attributions, EPE is responsible for publishing the Brazilian Energy Balance - BEB.



The Brazilian Energy Balance

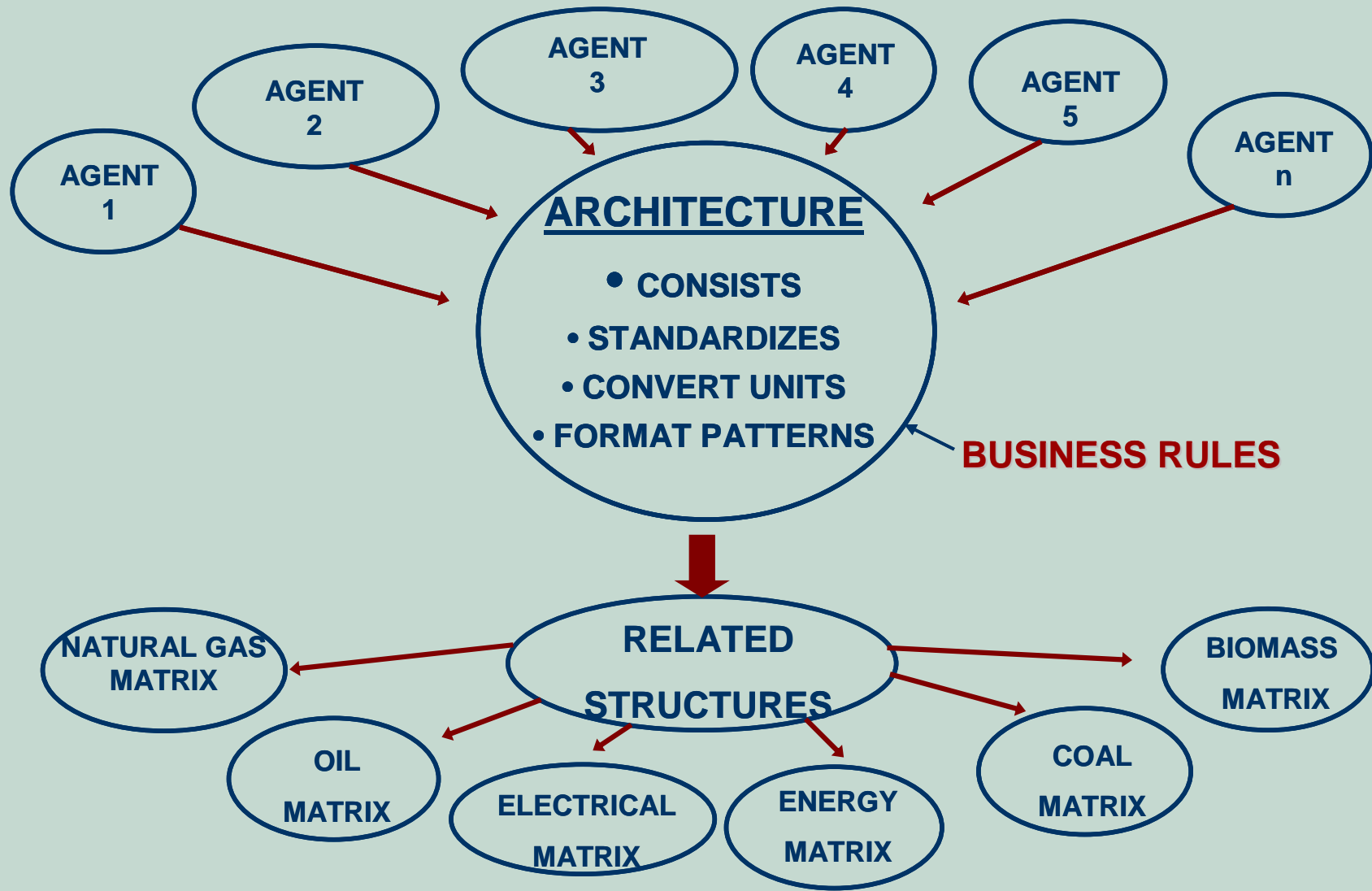
Improving the reliability and quality of the data

For each annual matrix elaboration, it is used about **25 debugger spreadsheets**, in order to do a consistency analysis from the official agents administrative informations and from the self-producer on-line collection. Each one is provided of proper **statistics validation** (business rules), like:

- Percentage variations in relation to the past year;
- Transformations centers pattern efficiencies;
- Statistic adjustments within reasonable limits etc.

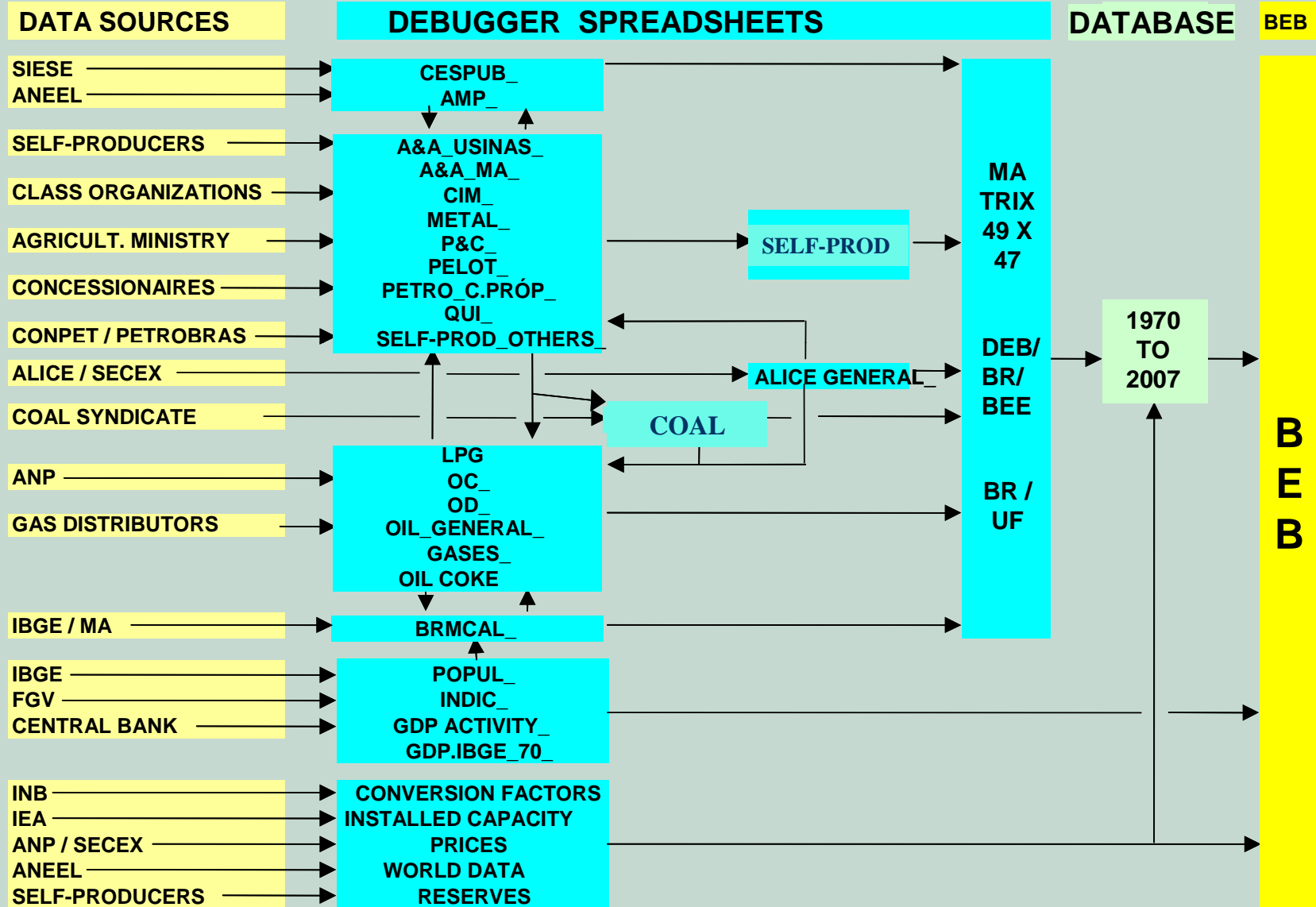


BEB – Data Treatment Flow



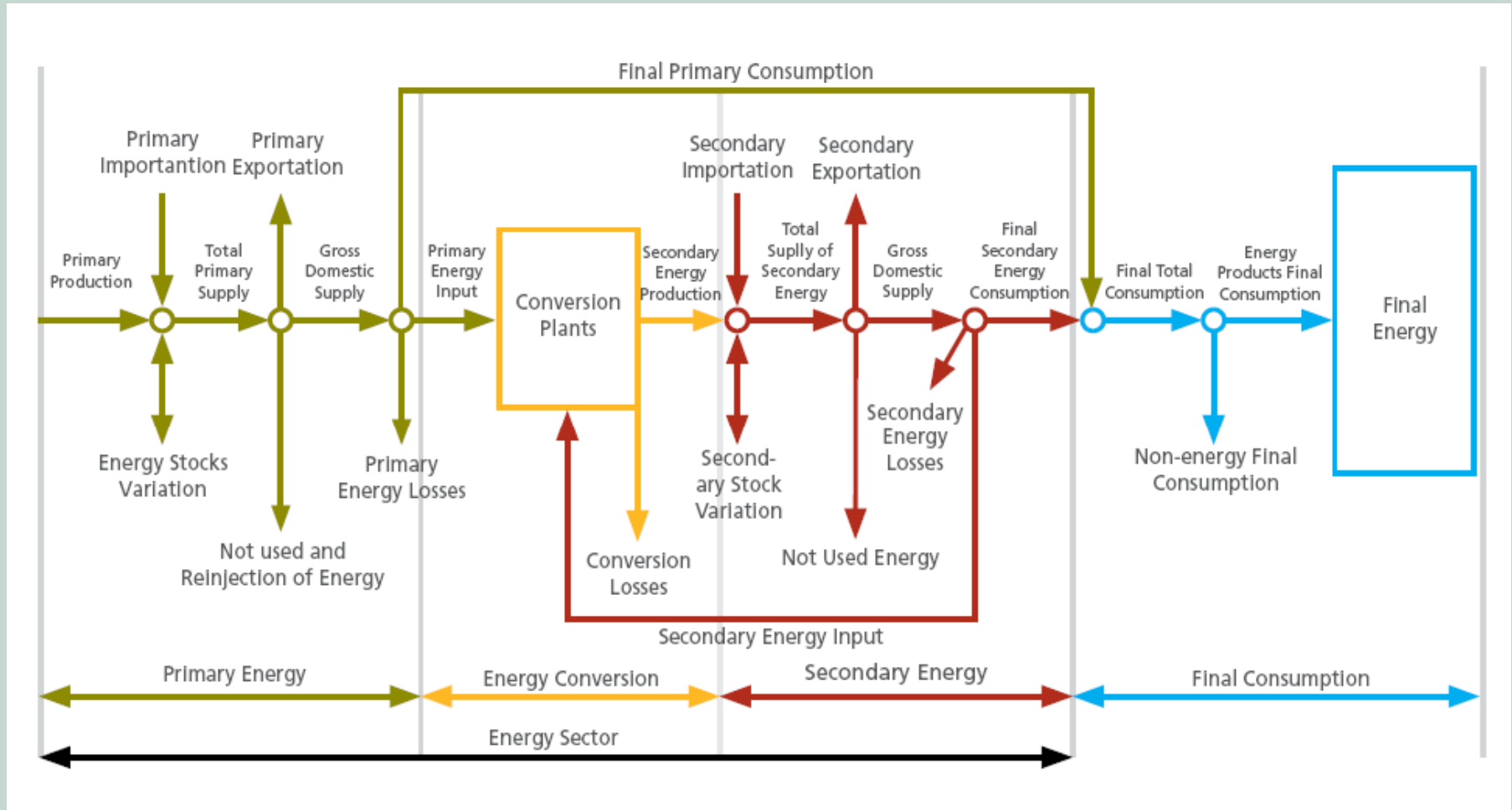


BEB – Data Treatment Flow





Energy Flow in the Brazilian Energy Balance





BEB's Data Structure

BEB, the Brazilian balance, has a historic collection of energy balances, from 1970 to 2007, in the form of Excel spreadsheets with 47 energy flows (rows) by 49 energy products (columns), separated in Primary and Secondary Energy, expressed in **physical units**, and with 52 rows by 47 columns in **basic units** (toe).



BEB's Data (1000 toe)

		24 PRIMARY SOURCES			25 SECONDARY SOURCES			
FLUXO		PETRÓ-CARVÃO ... LEO VAPOR	TOTAL PRIMAR	ÓLEO ELETRI- DIESEL CIDADE	...	TOTAL SECOND.	TOTAL	
7 ACTIV.	PRODUÇÃO	66717	2175	156429	0	0	0	156429
	IMPORTAÇÃO	21544	0	36829	5603	3254	19070	55899
	...							
	OFERTA INTERNA BRUTA	83501	2632	185733	4918	3254	7246	192980
10 TRANSF. CENTERS (12)	TOTAL TRANSFORMAÇÃO	-84194	-2289	-142657	25556	28186	127067	-15590
	REFINARIAS DE PETRÓLEO	-84194	0	-84991	27017	0	84104	-886
	C. ELET. SERV. PÚBLICO	0	-2246	-26195	-1103	25900	19442	-6753
	C. ELET. AUTOPRODUTORAS	0	-43	-3627	-486	2286	894	-2733
	...							
	OUTRAS TRANSFORMAÇÕES	0	0	1	127	0	-55	-54
	PERDAS DISTRIB. ARMAZEN.	0	0	-293	0	-4860	-5190	-5483
24 SECTORS (27 Lines)	CONSUMO FINAL	0	343	43475	30474	26579	129125	172601
	CONSUMO FINAL NÃO ENERG.	0	0	702	0	0	13277	13979
	CONS. FINAL ENERGÉTICO	0	343	42773	30474	26579	115848	158621
	SETOR ENERGÉTICO	0	0	7962	258	961	5572	13534
	...							
	TRANSPORTES - TOTAL	0	0	503	24690	103	47246	47749
	RODOVIÁRIO	0	0	503	23916	0	42493	42996
	...							
	INDUSTRIAL - TOTAL	0	343	25460	496	11931	36147	61607
	CIMENTO	0	10	339	23	374	3022	3361
...								
OUTRAS INDÚSTRIAS	0	67	1352	134	2393	3726	5078	
CONS. NÃO IDENTIFICADO	0	0	0	0	0	0	0	
	AJUSTES ESTATÍSTICOS	693	0	693	0	0	2	695



Consolidated Brazilian Energy Balance

27 Columns

47 Lines

ANO 2000 (10 ³ tep)	ENERGIA PRIMÁRIA									ENERGIA SECUNDÁRIA																TOTAL			
	PETRÓLEO	GÁS NATURAL	CARVÃO VAPOR	CARVÃO METALÚRGICO	URÂNIO U308	ENERGIA HIDRÁULICA	LENHA	PRODUTOS DA CANA	OUTRAS FONTES PRIMÁRIAS	ENERGIA PRIMÁRIA TOTAL	ÓLEO DIESEL	ÓLEO COMBUSTIVEL	GASOLINA	GLP	NAFTA	QUERÓSENE	GÁS DE CIDADE E DE COQUERIA	COQUE DE CARVÃO MINERAL	URÂNIO CONTIDO NO UO2	ELETRICIDADE	CARVÃO VEGETAL	ALCOOL ETÍLICO ANIDRO E HIDRATADO	OUTRAS SECUNDÁRIAS DE PETRÓLEO	PRODUTOS NÃO ENERGÉTICOS DE PETRÓLEO	ALCATRÃO		ENERGIA SECUNDÁRIA TOTAL		
PRODUÇÃO	63.723	13.185	2.603	10	132	26.168	23.054	19.895	4.439	153.208	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	153.208
IMPORTAÇÃO	20.497	1.945	0	9.789	618	0	4	0	0	32.853	4.986	68	47	3.117	2.912	742	0	1.112	0	3.812	7	33	1.940	157	0	0	0	18.932	51.786
VARIAÇÃO DE ESTOQUES	-1.270	0	50	57	1.278	0	0	0	0	114	-225	-235	-175	-109	4	0	0	-50	-222	0	949	-35	20	0	0	0	0	-78	36
OFERTA TOTAL	82.950	15.130	2.653	9.856	2.028	26.168	23.058	19.895	4.439	186.176	4.760	-167	-128	3.008	2.916	742	0	1.062	-222	3.812	7	982	1.905	177	0	0	0	18.854	205.030
EXPORTAÇÃO	-961	0	0	0	0	0	0	0	0	-961	-641	-5.303	-1.579	-6	0	0	0	0	0	-1	-5	-116	-175	-238	0	0	0	-8.741	-9.702
NÃO-APROVEITADA	0	-2.351	0	0	0	0	0	0	0	-2.351	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-14	-2.365
REINJEÇÃO	0	-2.523	0	0	0	0	0	0	0	-2.523	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2.523
OFERTA INTERNA BRUTA	81.989	10.256	2.653	9.856	2.028	26.168	23.058	19.895	4.439	180.340	4.119	-5.470	-1.707	3.002	2.916	64	-14	1.062	-222	3.812	2	866	1.730	-61	0	0	10.099	190.440	
TOTAL TRANSFORMAÇÃO	-81.989	-2.873	-2.310	-7.293	-2.028	-26.168	-9.431	-6.514	-1.439	-140.044	25.143	14.874	15.014	4.747	5.088	3.122	1.355	5.299	222	29.994	4.981	5.590	6.480	4.493	227	126.629	-13.415		
REFINARIAS DE PETRÓLEO	-81.989	0	0	0	0	0	0	0	-690	-82.679	26.188	16.947	14.471	4.252	7.853	3.245	0	0	0	0	4.716	4.493	0	0	0	82.165	513		
PLANTAS DE GAS NATURAL	0	-1.817	0	0	0	0	0	0	606	-1.211	0	0	232	374	151	0	0	0	0	0	0	0	0	0	0	757	453		
USINAS DE GASEIFICAÇÃO	0	-74	0	0	0	0	0	0	0	-74	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	95	21		
COQUERIAS	0	0	0	-7.293	0	0	0	0	0	-7.293	0	0	0	0	0	1.428	5.299	0	0	0	0	0	0	250	6.978	315			
CICLO DO COMB.NUCLEAR	0	0	0	0	-2.028	0	0	0	0	-2.028	0	0	0	0	0	0	0	1.996	0	0	0	0	0	0	0	1.996	-32		
CENTRAIS ELET.SERV.PUB.	0	-311	-2.267	0	0	-25.666	0	0	0	-28.244	-1.151	-1.694	0	0	0	0	0	0	-1.774	27.844	0	0	0	0	0	23.225	-5.019		
CENTRAIS ELET.AUTOPROD.	0	-585	-43	0	0	-502	-147	-735	-1.439	-3.451	-353	-380	0	0	0	0	0	0	2.150	0	0	-322	0	-23	904	-2.547			
CARVOARIAS	0	0	0	0	0	0	-9.284	0	0	-9.284	0	0	0	0	0	0	0	0	0	4.981	0	0	0	0	0	4.981	-4.304		
DESTILARIAS	0	0	0	0	0	0	0	-5.778	0	-5.778	0	0	0	0	0	0	0	0	0	5.590	0	0	0	0	0	5.590	188		
OUTRAS TRANSFORMAÇÕES	0	-86	0	0	0	0	0	0	84	-2	459	0	311	120	-2.915	-123	0	0	0	0	0	2.086	0	0	0	-62	-64		
PERDAS DIST. ARMAZENAGEM	0	-232	0	-74	0	0	0	0	0	-306	0	0	0	-38	0	0	-9	0	0	-5.296	-169	-9	-28	-5	-9	-5.562	-5.868		
CONSUMO FINAL	0	7.115	352	2.489	0	13.627	13.381	3.000	3.000	39.964	29.505	9.500	13.319	7.855	8.102	3.242	1.332	6.506	0	28.509	4.814	6.457	8.182	4.447	219	131.990	171.954		
CONSUMO FINAL NÃO-ENERG.	0	731	0	0	0	0	0	0	0	731	0	0	0	0	8.098	62	0	0	0	0	0	637	172	4.447	142	13.559	14.290		
CONSUMO FINAL ENERGET.	0	6.384	352	2.489	0	13.627	13.381	3.000	3.000	39.233	29.505	9.500	13.319	7.855	4	3.180	1.332	6.506	0	28.509	4.814	5.820	8.010	0	77	118.431	157.664		
SETOR ENERGÉTICO	0	2.066	0	0	0	0	0	5.523	0	7.588	253	1.080	0	57	4	1	318	0	0	901	0	0	2.656	0	0	5.270	12.858		
RESIDENCIAL	0	100	0	0	0	0	6.570	0	0	6.670	0	0	6.325	0	36	60	0	0	0	7.188	409	0	0	0	0	14.018	20.688		
COMERCIAL	0	69	0	0	0	0	75	0	0	144	67	354	0	217	0	18	0	0	0	4.084	63	0	21	0	0	4.968	4.968		
PÚBLICO	0	7	0	0	0	0	0	0	0	7	118	234	0	369	0	3	0	0	0	2.510	0	0	0	0	0	3.235	3.242		
AGROPECUÁRIO	0	0	0	0	0	1.638	0	0	0	1.638	4.452	106	0	16	0	0	0	0	0	1.105	5	0	0	0	0	5.684	7.322		
TRANSPORTES - TOTAL	0	275	0	0	0	0	0	0	0	275	24.090	648	13.319	0	0	3.124	0	0	0	107	0	5.820	0	0	0	47.109	47.385		
RODOVIÁRIO	0	275	0	0	0	0	0	0	0	275	23.410	0	13.261	0	0	0	0	0	0	0	0	5.820	0	0	0	42.491	42.766		
FERROVIÁRIO	0	0	0	0	0	0	0	0	0	0	403	0	0	0	0	0	0	0	0	107	0	0	0	0	0	511			
AÉREO	0	0	0	0	0	0	0	0	0	0	0	0	58	0	0	3.124	0	0	0	0	0	0	0	0	0	3.182			
HIDROVIÁRIO	0	0	0	0	0	0	0	0	0	0	277	648	0	0	0	0	0	0	0	0	0	0	0	0	0	926			
INDUSTRIAL - TOTAL	0	3.867	352	2.489	0	5.344	7.858	3.000	3.000	22.910	524	7.077	0	871	0	19	933	6.506	0	12.614	4.337	0	5.333	0	77	38.290	61.200		
CIMENTO	0	49	7	178	0	22	0	109	0	364	24	510	0	2	0	1	0	1	0	383	233	0	1.845	0	0	2.999	3.363		
FERRO-GUSA E AÇO	0	779	3	1.647	0	0	0	0	0	2.429	30	110	0	113	0	5	932	6.413	0	1.265	3.660	0	251	0	77	12.855	15.285		
FERRO-LIGAS	0	0	0	36	0	60	0	0	0	96	0	12	0	0	0	0	6	0	0	550	430	0	89	0	0	1.086			
MINERAÇÃO E PELOTIZ.	0	142	0	400	0	0	0	0	0	542	158	812	0	20	0	3	0	0	0	639	0	0	138	0	0	1.771	2.312		
NÃO-FER. E OUT.METAL.	0	148	0	158	0	0	0	0	0	306	0	976	0	75	0	0	0	87	0	2.490	6	0	424	0	0	4.059	4.365		
QUÍMICA	0	1.252	74	5	0	74	0	154	0	1.560	83	1.136	0	14	0	2	1	0	0	1.483	0	0	2.139	0	0	4.857	6.417		
ALIMENTOS E BEBIDAS	0	226	49	0	0	1.853	7.834	0	0	9.962	38	1.024	0	64	0	2	0	0	0	1.390	0	0	32	0	0	2.552	12.514		
TEXTIL	0	172	0	0	0	81	0	0	0	252	5	243	0	24	0	0	0	0	0	600	0	0	0	0	0	872	1.124		
PAPEL E CELULOSE	0	273	83	0	0	1.048	24	2.697	0	4.124	31	983	0	24	0	0	0	0	0	1.044	0	0	0	0	0	2.082	6.206		
CERÂMICA	0	260	34	0	0	1.629	0	40	0	1.963	5	468	0	357	0	1	0	0	0	234	0	0	41	0	0	1.105	3.068		
OUTROS	0	567	102	64	0	576	0	0	0	1.310	150	803	0	179	0	5	0	0	0	2.535	8	0	374	0	0	4.052	5.363		
CONSUMO NÃO-IDENTIFICADO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
AJUSTES	0	-35	9	0	0	0	0	0	0	-26	243	96	13	144	98	56	0	145	0	0	0	9	0	20	0	824	798		



Data Collection in Brazil

Even if the objective of the energy accountancy in BEB can be described in a simplified form, the magnitude of the process of data collection, treatment and analysis of country's energy information to build an energy matrix for the base year is extremely complex. The main temporal determinant is the provision of data by the myriad agents and institutions:

- **Official governmental institutions (agents)** of the energy sector in Brazil, who generate the data as most of energy statistics originated from operations in public sector and utilities;
- **Non-commercial energy sources**, which do not have formal accounting instruments or are produced directly by consumers (self-producers);
- Data based on **inquiries, sampling and estimation**

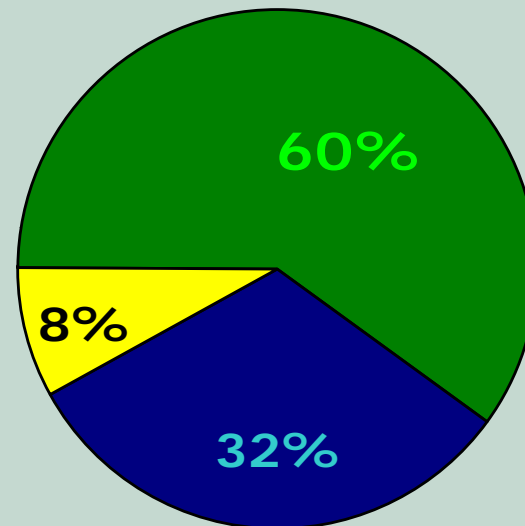


Structure of Data Collection

Inquiries, Sampling
& Estimation



- ✓ Residential and other sectorial firewood
- ✓ Agriculture and livestock diesel
- ✓ Agriculture wastes
- ✓ Small self-producers



Administrative
Data
(95 Agents)

Self-Producers (800 Agents)
&
Class Organizations (10 Agents)



Brazilian Energy Balance Methodology and Particularities

The BEB is according to the international methodologies for the compilation of energy statistics on:

- Primary and Secondary Sources
- Domestic Energy Supply (Total Primary Energy Supply)
- Transformation Sector and Final Consumption.

Particularly, MME follows the manuals of the Latin America Energy Organization of (OLADE), with the exception of some proper Brazilian particularities:

- The internal consumption by Energy Sector takes part of the energy final consumption, because we believe it is an important sector in the Brazilian economy.



BEB's Particularities

- The nuclear fuel cycle is considered as a transformation center.
- The entire natural gas flow is cleared up, like the gross production and the transformations in the natural gas plants into dry natural gas and natural gas liquids (NGL).
- The blast furnace is not considered as transformation center. We only take into account that the blast furnace gas is used in electricity generation and we consider it like a primary recovery. So, there is not coal input and all the coal coke is allocated in the siderurgy final consumption.
- Despite of the differences above mentioned, the high detailing on the Brazilian energy statistics allows the production of energy data perfectly fit in the field of the international criteria.



Useful Energy Balance - BEU

The ***Useful Energy Balance*** is a decennial Ministry of Mines and Energy's publication, composed by a report and several spreadsheets, and conceived with a purpose of amplifying the CONTENT of the energy informations in BEB, and that allows a estimative of energy effectevly used in the main ***Final Uses*** from a conceptualization technically well-structured.

The ***Useful Energy (UE)*** generated by the ***Final Energy i*** (obtained in BEB) in the activity sector ***j***, applied to the ***Final Use k*** is represented as ***UEijk*** and results from the product:

$$UE_{ijk} = FE_{ij} \times p_{jik} \times r_{jik}$$

Where:

p_{jik} = portion of ***Final Energy i*** used in the activity sector ***j*** that is destined to the ***Final Use k***.

r_{jik} = efficiency of the conversion of ***Final Energy i*** in ***Activity Sector j*** for the ***Final Use k***.



BEU's Final Uses

Motor Power: Energy used in stationary motors or in individual or public transport vehicles, freight transport, tractors, agriculture machines etc.

Process Heat: Energy used in boilers and water heaters, or thermal fluid heaters.

Direct Heating: Energy used in ovens, furnaces, radiation, induction heating, conduction and microwaves.

Refrigeration: Energy used in refrigerators, freezers (and other refrigeration equipments) and air conditioner.

Illumination : Energy used in indoor and outdoor illumination.

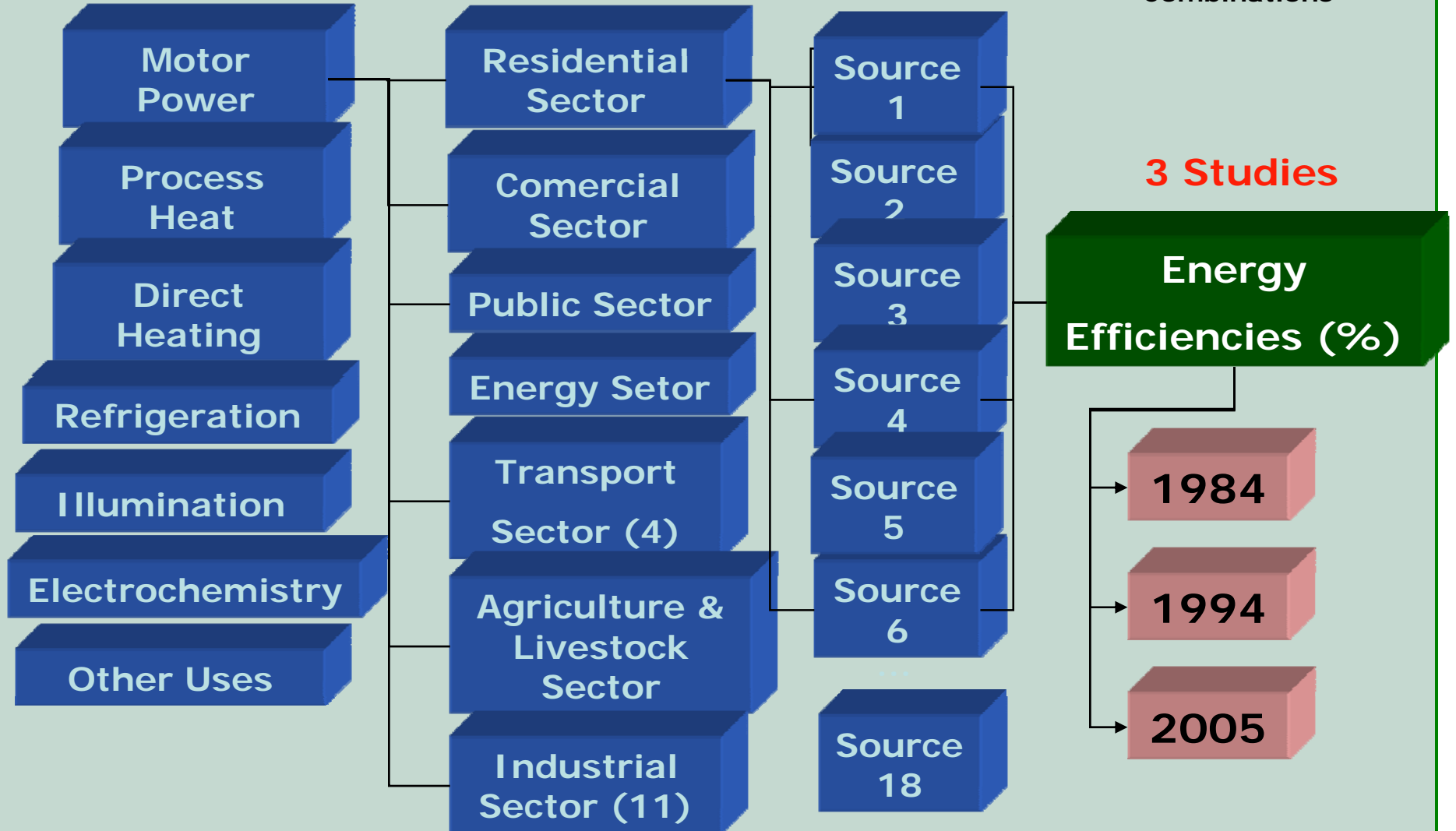
Electrochemistry : Energy used in electrolytic cells, galvanoplasty processes, electrodepositing etc.

Other Uses: Energy used in computers, telecommunications, office machines, xerography and control electronic equipment.



Useful Energy Balance - BEU

7 Final Uses X **19 Subsectors** X **18 Sources** = (2,394 Possible Combinations)





Final Results of BEU

BEU uses a lot of different spreadsheets, makes a number of calculations and finally generates, as final results:

1. A spreadsheet, containing Final Energy, Useful Energy and Efficiencies, by Sectors and Products
2. A spreadsheet, containing Final Energy, Useful Energy and Global Efficiencies, by Sectors and Final Uses
3. A spreadsheet, containing Final and Useful Energy Distribution, by Products and Final Uses
4. A spreadsheet, containing Final and Useful Energy, by Products and Final Uses
5. A complete Report, in MS-Word format.



BEB - Dissemination Policy

The printed version of BEB with the completed and consolidated national energy statistics is traditionally published in the second half of the year following the base year that the data refers to.

However, to anticipate the results, as has occurred in the last few years, EPE and MME try to make the results available beforehand through. Thus, BEB relative documents are divulged as:

- Digital version of the Preliminary Results Report, in the first half of each year;
- Printed and digital versions of the Brazilian Energy Balance and its respective Executive Summary, in the second half of each year.

In the last year it was published about 3,200 issues of BEB in Portuguese, distributed to the Brazilian energy sector agents, self-producers, state governments, academic institutions, research centers, governmental organizations etc.

Besides, BEB is totally accessible by anyone in the globe, on the MME's portal: www.mme.gov.br, menu "Publicações" (Publications).



BEB – Good Practices

Long experience in elaborating energy balances - since 1976.

BEB is a powerfull and reliable tool for private and public sectors planning (good acceptance).

Good cooperation from the self-producers in supplying energy data.

Good data debugging and qualifying tool.

Complete data availability for the BEB's users – as in printed documents as in the Internet.

Good integration and relationship with national and international energy organizations.



BEB – Problems and Challenges

Problem Experienced

Certain difficulty in the energy and economic sectorial conformity (integrated sectors).

Challenges

Improve the powdered consumption estimations of non-administrated energies (lack of resources for the researches).

Implantation of an official, lawful, and integrated energy information system.



Ministério de
Minas e Energia

Thank you!

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¡Gracias!

Merci!



Obrigado!

