Assessment of the current situation and state of the art of energy efficiency in Brazil

Developed by:

prognos

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To:
Agência de Cooperação
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Abbreviations

ABESCO	Associação Brasileira de Empresas de Serviços de Conservação de Energia
ABINEE	Associação Brasileira da Indústria Elétrica e Eletrônica
AL&C	Latin America and the Caribbean
ANEEL	Agencia Nacional de Energia Elétrica
ANP	Agência Nacional do Petróleo, Gás Natural e Biocombustíveis
ANFAVEA	Associação Nacional dos Fabricantes de Veículos Automotores
BEN	Balanço Energético Nacional
BNDES	Banco Nacional de Desenvolvimento Econômico e Social
CHP	Combined Heat and Power Production
DFR	Draft Final Report
EE	Energy efficiency
EEA	European Environmental Agency
EMEEES	Evaluation and Monitoring for the EU Directive on Energy End-Use Efficiency and Energy Services
EPE	Empresa de Pesquisa Energética
ESD	EU Directive on Energy End-Use Efficiency and Energy Services
EU	European Union
EUROSTAT	Statistical Office of the European Commission, Luxembourg
FR	Final Report
GHG	Greenhouse gases
IEA	International Energy Agency
IR	Inception Report
IT	International Team
LBNL	Lawrence Berkeley National Laboratory
MME	Ministry of Mines and Energy
MPE	Métodos de Planejamento Energético
MURE	Mesures d'Utilisation Rationelle de l'Energie
NT	National Team
ODYSSEE	Energy Efficiency Indicators in Europe
OECD	Organisation for Economic Co-operation and Development
OLADE	Organizacio Latinoamericana de Energia
ONS	Operador Nacional do Sistema Elétrico
PROCEL	Programa Nacional de Conservação de Energia
ProFREE	Programa Fontes Renováveis e Eficiência Energética
SIEE	Energy-Economic Information System
ToR	Terms of Reference
UNIFEI	Universidade Federal de Itajuba
UNICAMP	Universidade Estadual de Campinas
UNSNA	United Nations System of National Accounts
WP	Work Package
GDP	Gross Domestic Product
GNP	Gross National Product

1. Necessity of assessing the current situation of energy efficiency accounting in Brazil and management of the project

In fast growing economies the secure provision of energy (electricity, coal, oil, gas, renewables) is of greatest importance to ensure the growing economy. Fast growing countries like Brazil are facing an enormous increase in power plant capacities and other transformation and transmission facilities. Therefore energy saving and the efficient use of energy is of vital interest.

In order to understand the quality and quantities of energy efficiency, and to stimulate the further progress in efficient use of energy, these processes have to be measured. Within this project we will contribute to the understanding of the progress of energy efficiency by sharing with colleagues from Brazil our experience of energy data collection and processing, which we have gained from projects with the Energy Department of the Statistical Office of the European Communities Eurostat in Luxembourg and on several national energy data efficiency accounting systems.

The success of the project depends on efficient and clear project management. The main deliverables are the Inception Report and the Final Report with all results from the different work packages (WPs).

2. Review of international formats of collection and presenting energy efficiency accounting data (IEA, OECD, ODYSSEE, EMEES; EEA, EUROSTAT, OLADE and other national formats)

To understand the methodology of data compilation in energy efficiency accounting systems, the detailed definitions of products, processes, energy and financial indicators need to be compiled.

- First we will start with the “Top-Down-Approach”. Based on data from the national energy balance of Brazil with adjustments on climate etc. we can calculate the changes in energy efficiency within the entire energy sector but also in the transformation sector.
- Second: With a “Bottom-Up-Approach” we can concentrate on technical efficiency of appliances (for example efficiency of thermal power plants, oil refineries, bio-fuel

refineries etc). Concerning the "efficiency" of hydropower we have to understand the implications of the "substitution-method" within the transformation sector.

- Probably a third approach, namely the "Model-Approach" could be used, which could be based on forecast models, when these model will have to be calibrated for periods in the past, we can find the efficiency effects in these model runs for the past years.
- Generally speaking we could consider other methods, which are named as "Expert-Meeting-Approach" or "Delphi-Method" in order to gain a better understanding of the efficiency progress.

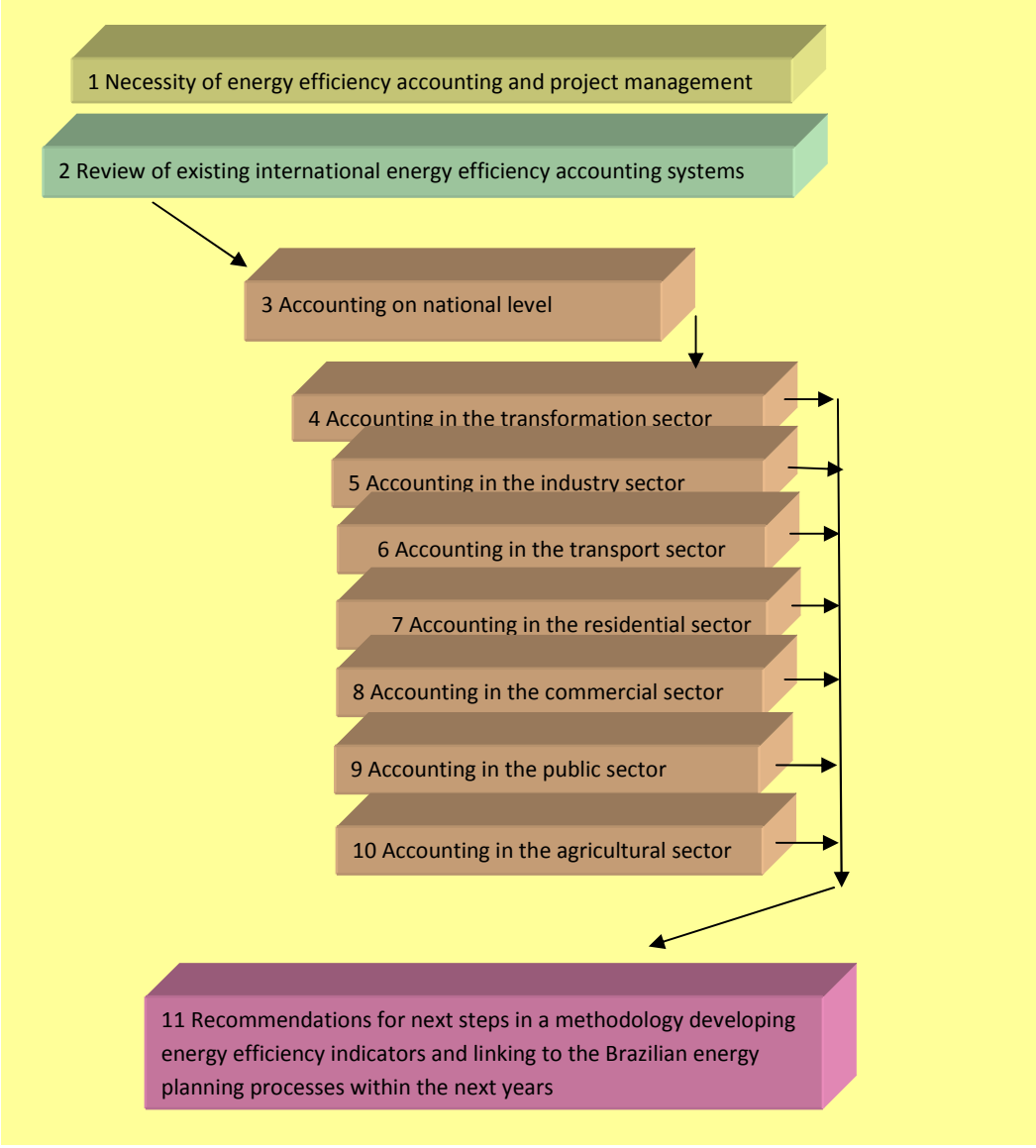

Figure 1: Overview on the work packages in order to assess energy efficiency indicators in Brazil

We have compiled different energy efficiency accounting formats, definitions, questionnaires to industrial energy consumers, and user manuals from available sources on EU, IEA and national level.

On international level some harmonised energy statistics and energy balance reporting system are established to allow for time series analysis and cross-country comparison. Beside these international formats e.g. on OECD, UN, OLADE and EU level, national and regional reporting formats from EU Member States or from Canada exist to complement data reporting according to specific needs, e.g. to evaluate GHG emissions or energy efficiency indicators (Source: EUROSTAT, Yearly Energy Statistics for the Member States, Luxembourg, or International Energy Agency, International Energy Balances, Paris, or OECD: Energy Balances for Developing Countries, Paris and others).

Beside the national energy balances which are usually compiled in periodical intervals, national energy surveys and strategies are elaborated in form of studies and concepts. They often contain more information on energy efficiency and conservation than the mere statistical reports. Recently, climate protection policy and international agreements such as the Kyoto Protocol and the EU Emission Trading Scheme are setting further requirements for accurate energy consumption monitoring in industrial companies and their respective energy savings by increased energy efficiency. Therefore measuring of energy efficiency is getting more important.

First: Within this Working Package we will start with a definition on “energy efficiency” in a technical view. Here we have to differ between the term of “energy savings” and the term “energy efficiency”. From the past we know, that the two terms are not always acting into the same direction, for example the Jevons Paradox shows the positive correlation between increased energy efficiency and increased energy consumption. These effects also have been identified and described as

- JEVONS effect or the Coal Question (this is a paradox identified by William Stanley Jevons that technological progress that increases the energy efficiency with which a resource is used rather increases than decrease the rate of consumption of that resource)
- KHAZZOM-BROOKES postulate (here Daniel Khazzoom and Leonard Brookes argue that any attempts to reduce energy consumption in a country by increasing energy efficiency would finally raise demand for energy in the economy as a whole)
- Thesis by SAUNDERS on increased energy consumption (Harry Saunders argues that any technical improvements in energy efficiency tends to increase energy consumption in two ways, increased energy efficiency makes the use of energy relatively cheaper and therefore encourages increased use of energy; and in parallel increased energy efficiency leads to increased economic growth, which increases energy use for the whole economy.

These three effects clearly show that increased energy efficiency in Brazil will be not always parallel to energy savings or reduction in energy consumption in Brazil. Second: All calculations on measuring increased energy efficiency have to consider a number of side effects:

- Multiplier effects, which have an influence on total energy consumption by increasing the total energy consumption even with increased technical energy efficiency
- Direct and indirect rebound effects, where improved energy efficiency will lead to increased energy consumption due to lower (individual) energy costs and due to lower total social cost for energy, which stimulate the entire economy and then stimulates total energy consumption of the country
- Autonomous market developments, which have an influence on energy consumption independent of technological developments in energy efficiency
- Effects based on increased or decreased energy prices, which can have effects on energy consumption independent of any changes in energy efficiency.

These effects will have to be considered here in Brazil in order to have correct definition and counting of both “improved energy efficiency” and “reduced energy consumption”, which are definitely not synonym.

A comparison has been made on the level of detail, the actuality and the format of presentation of data on national and international level.

Table 1: Comparison of different international systems for accounting "Energy Efficiency Indicators" to be used for Brazil (next pages)

No	Country / region	Indicator system name	Responsible institution	Indicators	No of indicators and regions covered	Comments on data accuracy and data quality, origin of data and updating	Latest year of data used	Source, publication, internet address
1	**European Union**	EU - Useful Energy Balances	Eurostat, Statistical Office of the European Commission	Only on final energy and on useful energy according to sectors and appliances	About 25 different indicators for 9 Member States, latest publication in 1985	Comparatively detailed data, low accucacy, not continued by Eurostat since 1985	1985	Statistical Office of the European Commission: Useful Energy Balances 1985, Luxembourg 1988. Not published on the internet.
2	**European Union**	EU - ODYSSEE - Energy Efficiency Indicators in Europe	Consortium ADEME et al.	Final energy	About 20 different key indicators, additional 40 indicators on request for most of the 27 Member States and Norway / Croatia	Most advanced energy efficiency indicator system, data accuracy on all levels depending on the specific "energy efficiency indicator", updated on annual base.	2006	www.odyssee-indicators.org
3	**OECD countries**	IEA Energy Efficiency Indicators	IEA, International Energy Agency	The International Energy Agency (IEA) collects on national level any data in relation to its energy Balance System for OECD-countries as well for Non-OECD-Countries on final energy and on energy intensity.	About 4 different indicators on the overall energy efficiency of national energy systems.	Energy efficiency indicators are published on national level in a yearly base. Data quality depends exclusively on the data quality of the respective energy balances.	2007	www.iea.org
4	**European Union**	EU - Energy Balance System	Eurostat, Statistical Office of the European Commission	General indicators at macro level	About 10 different energy efficiency indicators	Data quality depends exclusively on the data quality of the respective energy balances, annually updated	2008	www.epp.eurostat.ec.europa.eu
5	**Australia**	Australia - Energy Efficiency Indicators	Department of Environment, Water, Heritage and the Arts	For the moment there are no specific activities in measuring energy efficiency improvements on regional and national level.	Specific interest is given to energy efficient appliances, energy efficient office equipment, phase-out of greenhouse intensive systems, energy efficient lighting and electric motors best practices.	The Department publishes a yearly booklet on the latest development in energy efficiency.	no specific year given	www.environment.gov.au

6	**Canada**	Canada - OEE Energy Efficiency Indicators	Office of Energy Efficiency	Within the analysis five effects on energy consumption have been identified ("Activity Effect", Structure Effect", Service Level Effect", Weather Effect" and "Energy Efficiency Effect"). These effects can clearly mark the input from "efficiency" to the entire final energy consumption	The energy indicator analysis is broken down to all sectors and to a number of end uses (6 end uses).	The Office of Energy Efficiency (OEE) collects all information on energy consumption in Canada on a yearly base.	2006	www.nrcan.gc.ca
7	**California**	California - Energy Efficiency Indicators	LBNL - Lawrence Berkeley National Laboratory	LNBL published a sourcebook, which updated a previous report, with data and information on end-use unit energy consumption (UEC) values of appliances and equipment. There are; historical and current appliance and equipment market shares; appliance and equipment efficiency and sales trends; appliance and equipment efficiency standards; cost vs. efficiency data for appliances and equipment; product lifetime estimates; thermal shell characteristics of buildings; heating and cooling loads etc.	In the residential sector 8 appliances are described, other sectors include a smaller number of appliances.	The Lawrence Berkeley National Laboratory LNBL published a sourcebook, which updated a previous report, with data and information on end-use unit energy consumption (UEC). This report has not been updated.	1990	www.enduse.lbl.gov
8	**USA**	USA - Energy Efficiency Indicators	EIA - Energy Information Agency	The "Energy Information Administration" (EIA) is responsible for national US energy data. The EIA publishes both, an annual and a monthly report on energy data (AER and MER). In these reports so far no data on energy efficiency can be found.	No energy efficiency indicators available	Besides some research activities there are no governmental actiivities on energy efficiency measuring.	no data available	www.eia.doe.gov
9	**Singapore**	E2 Singapore	Singapore Government	Only energy intensity indexed	Only energy intensity as indicator	There are large programmes on supporting energy efficiency measures, but no follow-up of the effects of the measures	2005	www.e2singapore.gov.sg

10	**European Union**	EU - EEA - Energy Reporting System	EEA, European Environmental Agency	General indicators at macro level; the European Environmental Agency publishes data on energy efficiency on macro level.	Here we find statistics for all EU Member States on energy intensity and on energy efficiency of the transformation sector. There are no direct own data collection at EEA.	Data quality depends exclusively on the data quality of the respective energy balances, annually updated		
11	**European Union**	EU - EMEES - Evaluation and Monitoring for the EU Directive on Energy End-Use Efficiency and Energy Services	Consortium led by Wuppertal Institute for Climate, Environment and Energy with 20 additional partners	Various energy efficiency indicators according to sectors and end uses	In general, same number of indicators as in the ODYSSEE model, about 20 key indicators form the data base	The main target is to design methods to evaluate the achievements in energy efficiency in the European Union. Various methods in measuring these effects based on the ODYSSEE project have been developed. A reference system on quality control ("Qualification of Sources" and "Quality Grades") has been established.	2005	www.eea.europa.eu
12	**OLADE**	OLADE - SIEE - Energy-Economic Information System	OLADE - Organizacio Latinoamericana de Energia	Energy intensity for all 26 Member Countries	Only two indicators could be used for efficiency measuring, but for 26 AL&C countries	Data base since 1970, regularly updated on a yearly base using data from the respective Ministries of Energy and validated and checked by the staff of the General-Secretariat	2007	www.olade.org.ec
13	**European Union**	EU - MURE - Mesures d'Utilisation Rationelle de l'Energie	Consortium FhG-ISI, ISIS, Enerdata, Ademe	Backcasting as an ex-post evaluation of energy policy measures	Large number of indicators (energy efficiency coefficients and penetration rates) pending on policy content, technology and sector	Data are calculated for "Reference Case" and "Policy Case" and then compared to "Observed Figures", no regular updates	1990 - 2000	www.mure2.com

We have had a detailed review on the following different systems of energy efficiency measuring in order to understand what could be of interest for the situation in Brazil in order to support their system on energy efficiency measuring with examples for international and national energy statistics and balances reporting systems, including overall national energy balances and sector specific energy efficiency indicators examples for energy country surveys and strategies and comparison of contents and presentation of national energy balances and reports:

- EU - Useful Energy Balances: Eurostat: For the purpose of measuring energy efficiency the system of "Useful Energy Balances" which has been used by EUROSTAT on a 5-year-update-period is a very appropriate tool to measure any success in the field of energy efficiency. These balances include the efficiency rates for all main appliances used in industry, service sector, transport sector and household sector. For example the efficiency rates for motors, engines, boilers and other appliances are in this efficiency accounting scheme. The system has been developed by EUROSTAT itself but also used by other institutions since its publication.
- EU - ODYSSEE - Energy Efficiency Indicators in Europe: ODYSSEE is a project between ADEME, the EIE programme of the European Commission/DGTREN and energy efficiency agencies, or their representative, in the 27 countries in Europe plus Norway and Croatia. About 20 different key indicators with additional 40 indicators on request for most of the 27 Member States and Norway / Croatia have been developed in a Research project. This data base is the most detailed data base available on energy efficiency indicators.
- IEA Energy Efficiency Indicators: The International Energy Agency (IEA) collects on national level any data in relation to its energy Balance System for OECD-countries as well for Non-OECD-Countries. There are about 4 energy efficiency indicators published on national level in a yearly base.
- EU - Energy Balance System: Eurostat, the Statistical Office of the European Union publishes on a yearly base the conventional energy balances, besides these data, about 10 energy efficiency indicators are calculated on the basis of the national energy balance data.
- Australia - Energy Efficiency Indicators: The Department of Environment, Water, Heritage and the Arts is responsible for energy efficiency within the Australian governmental authorities, It publishes a yearly booklet on the latest development in energy efficiency. Specific interest is given to energy efficient appliances, energy efficient office equipment, phase-out of greenhouse intensive systems, energy efficient lighting and electric motors best practices. For the moment there are no specific activities in measuring energy efficiency improvements on regional and national level.
- Canada - Energy Efficiency Indicators: The Office of Energy Efficiency (OEE), a State Government Authority collects all information on energy consumption in Canada. The

energy indicator analysis is broken down to all sectors and to a number of end uses (6 end uses). Within the analysis five effects on energy consumption have been identified ("Activity Effect", Structure Effect", Service Level Effect", Weather Effect" and "Energy Efficiency Effect"). These effects can clearly mark the input from "efficiency" to the entire final energy consumption.

- California - Energy Efficiency Indicators: The Lawrence Berkeley National Laboratory LNBL published a sourcebook, which updated a previous report, with data and information on end-use unit energy consumption (UEC) values of appliances and equipment. There are; historical and current appliance and equipment market shares; appliance and equipment efficiency and sales trends; appliance and equipment efficiency standards; cost vs. efficiency data for appliances and equipment; product lifetime estimates; thermal shell characteristics of buildings; heating and cooling loads etc. This report has not been updated.
- USA - Energy Efficiency Indicators: The "Energy Information Administration" (EIA) is responsible for national US energy data. The EIA publishes both, an annual and a monthly report on energy data (AER and MER). In these reports so far no data on energy efficiency can be found.
- E2 Singapore: There are large programmes at Singapore on supporting energy efficiency measures, but no follow-up of the effects of the measures have been completed. The E2_Singapore programme supports a number of sectors (households, hotels) in order to stimulate the implementation of energy efficiency measures.
- EU - EEA - Energy Reporting System: The European Environmental Agency publishes data on energy efficiency on macro level. Here we find statistics for all EU Member States on energy intensity and on energy efficiency of the transformation sector on a yearly base. There are no direct own data collection at EEA.
- EU - EMEES - Evaluation and Monitoring for the EU Directive on Energy End-Use Efficiency and Energy Services: The project has been carried out by a Consortium led by Wuppertal Institute for Climate, Environment and Energy with 20 additional partners from a large number of Member States of the European Union. The main target is to design methods to evaluate the achievements in energy efficiency in the European Union. Various methods in measuring these effects based on the ODYSSEE project have been developed.
- OLADE - SIEE - Energy-Economic Information System: Since 1970 the Organizacio Latinoamericana de Energia (OLADE) collect data on energy consumption within its 26 Member States. Usually the data come from the respective Ministries of Energy in the Member Countries as basic information and they will be evaluated and checked by the staff of the General-Secretariat at Quito. The latest data available are for 2007, regular updates are on a yearly base.
- EU - MURE - Mesures d'Utilisation Rationelle de l'Energie: This project is a back-casting tool in order to calculate an ex-post evaluation of energy policy measures. Data

are calculated for "Reference Case" and "Policy Case" and then compared to "Observed Figures". This tool requires a large number of indicators (energy efficiency coefficients and penetration rates) pending on policy content, technology and sector. The project has been completed by a consortium consisting of FhG-ISI, ISIS, Enerdata, Ademe. The data are not regularly updated, latest publication is on policy effects for the period 1990 to 2000. Of course we know, that MURE is not an original instrument to calculate energy efficiency indicators but energy efficiency indicators are calculated during the course of evaluating the policy effects.

And we have seen that energy efficiency indicators like

- “kWh used for refrigeration/per 100 l refrigerator volume”
- “litre petrol/100 km distance” or “km/litre petrol”
- “kWh used/Mio USD BIP in the service sector”
- “kWh used/ton of steel produced”
- “kWh used for cooling/m2 gross floor space area”
- “kWh used for hot water preparation/inhabitant”

differ from country to country depending on both the specific energy needs in the country (cooling, heating) and the data availability in the region.

According to our studies, the energy data collection system in Brazil is organized as in other countries and mainly based on the industry statistical system. This system provides energy data of all industrial branches on regional level, which is then aggregated to the national statistic system. In this statistical system energy consumption data from the transport sector are partly collected or calculated via the industrial sector statistics. Energy data from the service sector and from the households are calculated on the basis of research work and estimations of energy consumption figures.

Table 2: Overview of examples of different international indicators of energy efficiency accounting according to sectors (national level, transmission sector, industry sector, residential sector, service sector, useful energy sector)

Sector	Indicator	Unit	Source
National level	Total energy consumption per national product	TOE / USD GDP	General
National level	Total energy consumption per capita	TOE / capita	General
National level	Total final energy consumption per national product	TOE / USD GDP	General
National level	Total final energy consumption per capita	TOE / capita	General
National level	Energy intensity	Toe / 1,000 USD (2000)	OLADE
National level	Industrial energy intensity	Toe / 1,000 USD (2000)	OLADE
National level	Per capita final energy consumption	Toe / inhabitant	OLADE
National level	Per capita residential energy consumption	Toe / inhabitant	OLADE
National level	Per capita electricity residential energy consumption	kWh / inhabitant	OLADE
National level	Electricity consumption per capita	kWh / capita	IEA
National level	Gross inland consumption / GDP	kgoe / 1,000 EUR GDP	Eurostat
National level	Final energy consumption / GDP	kgoe / 1,000 EUR GDP	Eurostat
National level	Final consumption in industry / gross value-added	kgoe / 1,000 EUR GVA	Eurostat
National level	Final consumption in service sector / gross value-added	kgoe / 1,000 EUR GVA	Eurostat
National level	Energy consumption per inhabitant	kgoe / cap.	Eurostat
National level	Gross inland consumption per inhabitant	kgoe / cap.	Eurostat
National level	Final energy consumption / capita	kgoe / cap.	Eurostat
National level	Household consumption / capita	kgoe / cap.	Eurostat
National level	Final electricity consumption / capita	kgoe / cap.	Eurostat
National level	Final energy consumption / Gross inland consumption	in %	Eurostat
National level	Efficiency of thermal power stations	etha	Eurostat
National level	Final energy consumption per unit of GDP	TOE / 1,000 Euro GDP	Odyssee
National level	Total energy consumption per unit of GDP	TOE / 1,000 Euro GDP	Odyssee
National level	Total energy intensity	Index (Basis 1990)	EEA, Copenhagn
Transmission	Energy efficiency of power plants	etha	IEA
Transmission	Energy efficiency of refineries	etha	IEA
Transmission	Efficiency of thermal power stations	etha	Eurostat
Transmission	Transmission losses electricity	in %	General
Transmission	Transmission losses gas	in %	General
Transmission	Energy used and energy lost in % of primary energy consumption (transformation losses, distribution losses)	in %	EEA, Copenhagn
Industry sector	Consumption of manufacturing per unit of value added	Toe / 1,000 Euro GVA	Odyssee
Industry sector	Consumption of manufacturing per unit of value added at constant	Toe / 1,000 Euro GVA	Odyssee
Industry sector	Energy consumption of cement industry per ton	Toe / ton	Odyssee
Industry sector	Energy consumption of steel industry per ton	Toe / ton	Odyssee
Industry sector	Energy consumption of paper industry per ton	Toe / ton	Odyssee
Transport sector	Consumption of air transport	toe / passenger	Odyssee
Transport sector	Consumption of road transport of goods per ton-km	koe / tkm	Odyssee
Transport sector	Energy consumption of road transport per equivalent car	toe / car	Odyssee
Transport sector	Specific consumption of cars	litre / 100 km	Odyssee

Sector	Indicator	Unit	Source
Residential sector	Consumption per dwelling	Toe / dwelling	Odyssee
Residential sector	Consumption per dwelling for lighting & electrical appliances	Toe / dwelling	Odyssee
Residential sector	Consumption per dwelling for space heating	Toe / dwelling	Odyssee
Residential sector	Consumption per dwelling scaled to EU average climate	Toe / dwelling	Odyssee
Service sector	Consumption of service sector per employee	toe / employee	Odyssee
Service sector	Consumption of service sector per unit of value added	kgoe / 1,000 EUR GVA	Odyssee
Service sector	Electricity consumption of services sector per employee	kWh / employee	Odyssee
Useful energy sector	Cement kilns (medium-dry, wet, semi-wet processes)	etha	Eurostat
Useful energy sector	Radiation furnaces	etha	Eurostat
Useful energy sector	Blast fumace	etha	Eurostat
Useful energy sector	Petrol engine	etha	Eurostat
Useful energy sector	Diesel engine	etha	Eurostat
Useful energy sector	Turbo-prop. aircraft jet	etha	Eurostat
Useful energy sector	Gas engine	etha	Eurostat
Useful energy sector	Coal fired industrial fumaces and boilers	etha	Eurostat
Useful energy sector	Coal-fired cooker	etha	Eurostat
Useful energy sector	Coal-fired domestic heating boiler and coal-fired stove	etha	Eurostat
Useful energy sector	Oil-fired industrial fumaces and boilers	etha	Eurostat
Useful energy sector	Oil-fired domestic heating boiler	etha	Eurostat
Useful energy sector	District heating boilers fired wrth residual fueloil	etha	Eurostat
Useful energy sector	Paraffin bumers	etha	Eurostat
Useful energy sector	Gas-fired industrial fumaces and boilers	etha	Eurostat
Useful energy sector	Gas cooker	etha	Eurostat
Useful energy sector	Gas-fired water heater	etha	Eurostat
Useful energy sector	Gas-fired domestic heating boiler	etha	Eurostat
Useful energy sector	LPG cooker	etha	Eurostat
Useful energy sector	Space heating with LPG	etha	Eurostat
Useful energy sector	Electric motors	etha	Eurostat
Useful energy sector	Electric fumaces	etha	Eurostat
Useful energy sector	Electrolysis	etha	Eurostat
Useful energy sector	Electric rail haulage	etha	Eurostat
Useful energy sector	Electric cooker	etha	Eurostat
Useful energy sector	Electric water-heater	etha	Eurostat
Useful energy sector	Electric storage heating	etha	Eurostat
Useful energy sector	Direct electric heating	etha	Eurostat
Useful energy sector	Electric lighting	etha	Eurostat

Energy statistics data reporting and balancing is essential for the monitoring and strategy development in all countries, especially in fast developing economies (such as Brazil). However, the effort for data evaluation and reporting is significant, so that time and financial resources are limiting factors to the level of detail and the length of time for periodical reporting. Furthermore, aspects of data confidentiality in market economies have to be respected in the compilations and publishing of data. Therefore, the national energy monitoring and reporting systems are usually a trade-off between the need for energy data reporting, available financial and human resources, and protection of commercial secrets. Beside the restrictions for data reporting, the methodology used needs to be efficient to produce the required data, and to compile the energy efficiency data with adequate effort.

Here we analyse the examples for energy balances and energy efficiency accounting and reporting systems compiled in the previous WP's with regard to

- Level of detail and actuality
- Reporting obligations of energy consumers and suppliers
- Ability to evaluate efficiency of energy consumption
- Effort made for data reporting and compilation.

As the Brazilian administrative system is better organized then the administrative systems in the neighbouring countries we expect that further relevant and important elements of the international energy data collection and processing system can be included into the Brazilian system. Any proposal for the inclusion of additional data on energy efficiency and respective extended procedures should take into consideration the additional administrative efforts and administration cost. For the addition of energy efficiency data collection, we will define procedures which we consider useful if implemented in Brazil. Based on our experience in other countries, we will especially investigate procedures which are based on the efficient use of already available data and particularly on representative surveys samples, and less on additional energy efficiency data reporting procedures which may be established in all of Brazil's regions.

Having a closer look at the data structure and data quality in Brazil, we find all kind of data sources, be it from the national full census, from commercial census or micro poll, from Delphi procedures and panel queries but also calculations and estimations of energy consumption and energy efficiency data on an individual base (see recommendation 5 in Chapter 11).

3. Energy efficiency indicators in an energy balance accounting system in Brazil on national level

We recommend to use as main energy efficiency indicator GDP (Gross Domestic Product, defined as the "value of all final goods and services produced in a country in one year") instead of GNP (Gross National Product, defined as the "value of all goods and services produced in a country in one year, plus income earned by its citizens abroad, minus income earned by foreigners in the country"), as GDP represents the total economic activity within a country, which influences the energy demand. Therefore total primary energy consumption and total final energy consumption will be compared to GDP. And in parallel both energy data will be related to total population in order to calculate energy consumption per capita, which is also an energy efficiency indicator used on international level. In addition, international statistics quite often show the electricity consumption per capita, but this seems to be more an indicator used for the comparison of living standard than for a comparison of energy efficiency in the electricity sector.

4. Energy efficiency accounting within the transformation sector

Within the transformation sector we recommend to calculate the technical energy efficiency for the main transformation purposes, i.e. for public utility power plants, for oil refineries and for self producers of power. Specific attention has to be given on the calculation of hydro and nuclear power as the technical efficiency is usually replaced by the average energy efficiency in thermal power plants in the respective country. And for the industrial auto-producers a calculation method for combined heat and power processes must be considered.

Besides using the currently available statistical data we do not see any additional request for information in the industry sector except for some specific conversion technologies (CHP, trigeneration).

5. Energy efficiency accounting systems within the industry sector

According to our studies, in Brazil, the data situation in the industry sector, with reference to energy consumption, is better than in other sectors. For the industrial sectors which produce a homogenous product, we recommend preparing specific energy consumption figures. These sectors include the cement, steel, aluminium and paper industry. This procedure could also be replicated for some specific industrial products in some sub-sectors such as bauxite, red ceramics, white ceramics or iron ore. For non-homogenous products we recommend to calculate energy intensity based on gross value added figures for the main industrial sectors, chemical industry and food and beverage industry.

As the industrial sector is by far the largest consumer in Brazil, it has been studied to a larger extent. For the time being we do not see any priority for deeper investigations into this sector. Of course, energy consumption in the industry sector must be carefully monitored and, on a regular base, specific surveys will have to be conducted for some sub-sectors.

6. Energy efficiency accounting systems within the transport sector

Within the transport sector we recommend to use a number of energy efficiency indicators for all transport means (road, rail, air and waterways) and for all transport modes (private transport, public transport) as well for passenger and freight transport. With this procedure we suggest to

calculate different specific energy consumption values as per ton-kilometres or as person-kilometres.

With reference to waterways transport we recommend investigating in transport and energy data linked to inland navigation both for freight as for person transport as the importance of waterway transport, especially in the northern river systems increases. Some data need to be disaggregated as diesel consumption for public transport and for trucks. And we have seen that the database for some transport figures is weak, especially the current estimations on “km per car and year” as well for “average km per litre fuel” is comparatively weak - therefore we recommend to start a procedure for sampling some of these figures in the near future, in collaboration with the respective associations and organisations. Finally, we recommend using models of “transport stocks” (stock of private cars, stock of trucks, etc.) in order to improve the calculation of energy consumption in the transport sector.

7. Energy efficiency accounting systems within the residential sector

The residential sector is with its energy consumption - generally speaking - appropriately monitored due to the national energy saving programmes, but merely for electricity consumption then for all energy carriers.

With reference to energy efficiency indicators we recommend starting with specific energy consumption indicators per capita and per household, which allow also an international comparison.

In the short run we do not see any urgent need for a more detailed survey of electricity consumption in the residential sector - but for rural areas we have only a low understanding of the use of renewable energies like firewood, therefore a survey on this specific energy consumption could be of interest for energy planning. In the medium term regular panel surveys will have to be carried out in order to better follow the energy consumption in this sector. In the long run “stock models” on energy equipment (for examples for refrigerators and other household appliances) should be developed and updated on a regular base. For non-electricity consumption in the household sector a special figure indicating the m2 used for solar heating in the residential sector would allow a deeper understanding of renewables penetrating the Brazilian energy market.

8. Energy efficiency accounting systems within the commercial sector

Energy consumption in the commercial sector is steadily increasing in Brazil. A specific energy efficiency indicator comparing the specific final energy consumption per employee in this sector as time-series would allow us to understand the dynamics of energy consumption in the past. In addition, for an international comparison we have included recommendations specific energy consumption indicators for some sectors like hotels, shopping malls, supermarkets and hospitals.

Energy intensity as indicator would be appropriate for the entire commercial sector and for the financial sub-sector as they are producing non-homogenous products (to be measured as ”gross value added”, which is according to UNSNA the “total net economic output of the respective sector”).

Due to the importance and due to the dynamics of the commercial sector in Brazil we recommend a more detailed survey for some sub-sectors. And in addition to this we see a request for a more detailed analysis for some specific technologies as combined heat and power generation (CHP) and especially trigeneration.

9. Energy efficiency accounting systems within the public sector

In order to understand the energy consumption of the public sector an indicator comparing the final energy used in this sector (see energy balance) per full-time employee would allow time-series comparisons and international comparisons. Other specific indicators of interest are linked to street lighting, water and sewage treatment and schools (this is of specific interest as schools are a standardized system and therefore energy efficiency measures in this sector have usually also a standardized set of technical and organisational measures. As electricity consumption in the public sector has increased rapidly in the past and is expected to increase also in the future we recommend adding specific indicators not linked to overall final energy consumption but to electricity consumption.

As energy consumption in the public sector has been monitored for the national energy saving programmes we do not see any priority for a more detailed survey in this sector in the short run.

Table 3: Recommendations for possible "Energy Efficiency Indicators" in Brazil by sectors (national level, transmission sector, industry sector, transport sector, residential sector, commercial sector, public sector and agriculture sector)

Level / Sector	Energy Efficiency Indicator	Unit	Comments	Line in current energy balance
National level	Total primary energy consumption per national product	toe / 1,000 Reais GDP	energy intensity	8.
National level	Total primary energy consumption per capita	toe / capita	specific energy consumption	8.
National level	Total final energy consumption per national product	toe / 1,000 Reais GDP	energy intensity	11.
National level	Total final energy consumption per capita	toe / capita	specific energy consumption	11.
National level	Electricity consumption per capita	kWh / capita	specific energy consumption	11.
National level	Efficiency of the entire transformation sector (final energy consumption / gross inland consumption)	in %	total efficiency of the transformation sector including internal energy consumption of the transformation sector	11. / 8.
Transformation sector	Energy efficiency of public utility power plants	in %	technical energy efficiency	9.6.
Transformation sector	Energy efficiency of oil refineries	in %	technical energy efficiency, including the internal consumption within the refineries	9.1.
Transformation sector	Energy efficiency of self production power stations	in %	technical energy efficiency	9.7.
Transformation sector	Transmission and distribution losses for electricity	in %	technical energy efficiency, losses divided by total input to the electricity sector	10.
Transformation sector	Transmission and distribution losses for the entire transformation sector	in %	technical energy efficiency	10.
Industry sector	Energy consumption of industry sector per unit of gross value added	toe / 1,000 Reais Gross Value Added	energy intensity	11.2.7.
Industry sector	Energy consumption of cement industry per ton	toe / t cement	specific energy consumption	11.2.7.1
Industry sector	Energy consumption of pig iron and steel industry per ton	toe / t steel	specific energy consumption , this sector could be disaggregated into stages of iron and steel processing	11.2.7.2
Industry sector	Non-ferrous and other metals	toe / 1,000 Reais Gross Value Added	to be disaggregated into industrial subsectors, specific energy consumption can be provided, most important is aluminium industry	11.2.7.3
Industry sector	Energy consumption of aluminium industry per ton	toe / t aluminium	specific energy consumption	Subsector
Industry sector	Mining and pelletization	toe / 1,000 Reais Gross Value Added	to be disaggregated into iron ore and bauxit industry	11.2.7.4
Industry sector	Ferro-alloys industry	toe / 1,000 Reais Gross Value Added	only a few producers within Brazil, no relevant information available	11.2.7.5
Industry sector	Energy consumption of chemical industry per unit of gross value added	toe / 1,000 Reais Gross Value Added	energy intensity, no specific information available on energy consumption in the subsectors	11.2.7.6
Industry sector	Energy consumption of food and beverage industry per unit of gross value added	toe / 1,000 Reais Gross Value Added	energy intensity, in addition to be disaggregated into industrial subsectors	11.2.7.7

Level / Sector	Energy Efficiency Indicator	Unit	Comments	Line in current energy balance
Industry sector	Textile industry	toe / 1,000 Reais Gross Value Added	very diverse sector, low co-operation with the respective associations	11.2.7.8
Industry sector	Energy consumption of paper and pulp industry per ton	toe / t paper	specific energy consumption	11.2.7.9
Industry sector	Ceramic industry	toe / 1,000 Reais Gross Value Added	to be disaggregated into white and red ceramics industry	11.2.7.10
Industry sector	Other industries	toe / 1,000 Reais Gross Value Added	too diverse sector, currently no energy efficiency indicators can be calculated	11.2.7.11
Transport sector - Road transport	Specific energy consumption of cars	km / kgoe	specific energy consumption	11.2.6.1
Transport sector - Road transport	Specific energy consumption of cars	kgoe / Pkm	specific energy consumption	11.2.6.1
Transport sector - Road transport	Energy consumption of road transport of goods per ton-km	kgoe / tkm	specific energy consumption,diesel consumption for buses has to be subtractracted from total diesel consumption in Brazil to be used for road transport of goods	11.2.6.1
Transport sector - Road transport	Energy consumption of road transport per equivalent car	kgoe / car	specific energy consumption	11.2.6.1
Transport sector - Road transport	Specific energy consumption of busses	kgoe / Pkm	specific energy consumption, to be differenciated into city transport and over-land transport, data for specific consumption come from main bus companies to be calculated to national level	11.2.6.1
Transport sector - Rail transport	Energy consumption of rail transport of passengers	kgoe / Pkm	specific energy consumption	11.2.6.2
Transport sector - Rail transport	Energy consumption of rail transport of goods	kgoe / tku	specific energy consumption (net weight cargo transport figures, useful tons per km)	11.2.6.2
Transport sector -Air transport	Energy consumption of air transport of passengers	kgoe / Pkm	specific energy consumption, subtracting the energy consumption for cargo transport from air transport energy consumption gives the figure for energy consumption for air passenger transport	11.2.6.3
Transport sector -Air transport	Energy consumption of air transport of goods	kgoe / tkm	specific energy consumption, the cargo sector must be questionnaired on energy consumption (get some figures for Campinas Airport)	11.2.6.3

Level / Sector	Energy Efficiency Indicator	Unit	Comments	Line in current energy balance
Transport sector - Waterways	Energy consumption of water transport of passengers	kgoe / Pkm	specific energy consumption, currently no statistics for Pkm available	11.2.6.4
Transport sector - Waterways	Energy consumption of water transport of goods	kgoe / tkm	specific energy consumption, currently only data on tons, not on tons-kilometre are available	11.2.6.4
Residential sector	Final energy consumption in the household sector per household	toe / household	specific energy consumption	11.2.2.
Residential sector	Final energy consumption in the household sector per person	toe / capita	specific energy consumption	11.2.2.
Residential sector	Electricity consumption in the household sector per household	toe / household	specific energy consumption	11.2.2.
Residential sector	Electricity consumption in the household sector per person	toe / capita	specific energy consumption	11.2.2.
Residential sector	Heat use in the residential sector per household	toe / household	specific energy consumption, mostly for cooking and water heating	11.2.2.
Residential sector	Solar heating in the residential sector per household	m2 solar collector / capita		11.2.2.
Commercial sector	Final energy consumption in the commercial sector per employee	toe / employee	specific energy consumption	11.2.3.
Commercial sector	Final energy consumption in hotels per hotel room	toe / hotel room	specific energy consumption, better to be calculated with "guest nights"	11.2.3.
Commercial sector	Final energy consumption in hotels per guest	toe / guest	specific energy consumption, better to be calculated with "guest nights"	11.2.3.
Commercial sector	Final energy consumption in shopping malls per employee	toe / employee	specific energy consumption	11.2.3.
Commercial sector	Final energy consumption in shopping malls hotels per m2	toe / m2 gross floor area	specific energy consumption, m2 to be calculated	11.2.3.
Commercial sector	Final energy consumption in supermarkets per employee	toe / employee	specific energy consumption	11.2.3.
Commercial sector	Final energy consumption in hospitals per hospital bed	toe / hospital bed	specific energy consumption, or by patients or by patient nights	11.2.3.
Commercial sector	Final energy consumption in the financial sector per employee	toe / employee	specific energy consumption	11.2.3.
Commercial sector	Final energy consumption in the commercial sector per unit of gross value added in the service sector	toe / 1,000 Reais Gross Value Added	energy intensity	11.2.3.
Commercial sector	Electricity consumption in the commercial sector per employee	toe / employee	specific energy consumption	11.2.3.
Commercial sector	Electricity consumption in the commercial sector per unit of gross value added in the service sector	toe / 1,000 Reais Gross Value Added	energy intensity	11.2.3.

Level / Sector	Energy Efficiency Indicator	Unit	Comments	Line in current energy balance
Public sector	Final energy consumption in the public sector per employee	toe / employee	specific energy consumption	11.2.4.
Public sector	Electricity consumption for street lighting per km of streets lighted	toe / km streets lighted	specific energy consumption	11.2.4.
Public sector	Electricity consumption in the public sector per employee	toe / lighting point	specific energy consumption	11.2.4.
Public sector	Electricity consumption for water and sewage treatment per m3 water supplied	toe / m3 water provided	specific energy consumption	11.2.4.
Public sector	Final energy consumption in schools per pupil	toe / pupil	specific energy consumption	11.2.4.
Public sector	Electricity consumption in the public sector per employee	toe / employee	specific energy consumption	11.2.4.
Agriculture sector	Specific final energy consumption in the agriculture sector per ha agricultural land	toe / ha agricultural land used	specific energy consumption	11.2.5.
Agriculture sector	Specific energy consumption for the production of sugar cane per ton of sugar cane	toe / ton of sugar cane	specific energy consumption	11.2.5.
Agriculture sector	Specific energy consumption for the production of soye beans per ton of soya beans	toe / ton of soya beans	specific energy consumption	11.2.5.
Agriculture sector	Specific energy consumption for the production of corn per ton of corn	toe / ton of corn	specific energy consumption	11.2.5.
Agriculture sector	Specific energy consumption for the production of meat per ton of meat	toe / ton of meat	specific energy consumption	11.2.5.
Other indicators - residential sector	Refrigerators sold with "A" labelling per year compared to all refrigerators sold	in %	same calculation can be made for other electric appliances in the residential sector and partly in commercial and public sector	not in BEN included
Other indicators - transport sector	Specific energy consumption for new cars	km / litre	via the Association of Car Producers, ANFAVEA	not in BEN included
Other indicators - transport sector	Energy efficiency in various transport modes (modal shift)	kgoe / Pkm (kgoe / tkm)	for calculations on modal shift	not in BEN included
Other indicators - industry sector	No of students participating in "Energy Efficiency Courses" per year	Number of participants	allowing a more general indication on penetration of energy efficiency into the Brazilian market	not in BEN included

10. Energy efficiency accounting systems within the agricultural sector

Within the agriculture sector the data situation is currently appropriate. A first indication on energy efficiency in agriculture could be calculated by the “Specific final energy consumption of the sector per ha agricultural land”. For the main agricultural products in Brazil we recommend to measure specific energy consumptions per ton of sugar, soya bean (soybeans, AE) and corn - this would allow a comparison to international indicators. Of specific interest the specific energy consumption for the production of meat could be interesting in the medium term, which

could give an indication on energy consumed between meat and non-meat products which are according to international statistics about 8 to 10 times higher.

A more detailed understanding of the energy consumption within the agriculture sector by carrying out a survey for the main agriculture crops could be of interest for a more detailed analysis. This would allow for a better understanding of energy efficiency according to different agricultural products, planting systems, regions and other parameters. As the Brazilian agricultural sector is highly concentrated, we estimate that a representative survey - compared to other countries - could be conducted with reasonable resources and efforts.

11. Recommendations for next steps in a methodology developing energy efficiency indicators with a focus on energy planning processes

In order to better understand the complex interrelation of energy supply and efficiency of energy consumption, comprehensive data need to be calculated on a regular base (yearly or 5-year-period) and presented in the context of data sheets with easy access for any user. This shall be the basis for evaluation of energy efficiency development, and to compare the real development with national targets and international key energy indicators.

We will not be in the position to complete all recommendations during the first year, therefore we have set all recommendations according to coming phases (Phase 1, Phase 2 and Phase 3):

Recommendation 1 - Developing a set of 55 key energy efficiency indicators: We recommend developing a set of about 55 general energy indicators in order to allow a detailed description of energy efficiency in Brazil. Since not all necessary input data can be fed in and displayed in the single aggregated DIN-A3 sheet, separate supporting Excel worksheets according to the respective sectors will be developed for energy, economic, transport, agriculture and other demand indicators. The table format shall be applicable to reported historical data as well as to target data from energy strategies, and allow for the direct evaluation of the deviations, if any.

Table 4: Recommendations for future activities

No	Topic	Sector	Recommendations	short term	medium term	long term	Institution	Comments
1	**Energy Efficiency Indicators**		Developing a set of 55 key energy efficiency indicators	x			EPE	Phase 1 (priority)
		Industry	Developing the main energy efficiency indicators and a calculation scheme for CHP and trigeneration					Improving the co-operation with manufacturer and trade associations and large energy consumers
		Transport	Developing the main energy efficiency indicators including development of stock models for different types of transport means (cars, trucks, busses)					Improving the co-operation with automobile associations
		Residential	Developing the main energy efficiency indicators including stock models for specific household appliances					Improving the co-operation with consumer associations
		Commercial	Developing the main energy efficiency indicators and a calculation scheme for CHP and trigeneration					Improving the co-operation with manufacturer and trade associations and large energy consumers
		Public	Developing the main energy efficiency indicators					
		Agriculture	Developing the main energy efficiency indicators					Improving the co-operation with agricultural associations and large energy consumers in the agricultural sector
2	**Additional Energy Efficiency Indicators**		Developing a set of about 50 additional supporting energy efficiency indicators for all sectors and appliances		x		EPE	Phase 2 only at a later stage after successful completion of Phase 1
		Industry	Further disaggregation of energy intensive industrial branches					Improving the co-operation with manufacturer and trade associations and large energy consumers
		Transport	Flight: for separation of passenger & freight fuel consumption: review on spec. fuel consumption per tkm is needed					
			Truck & public transport: for separation of fuel consumption - definition of reliable data on specific fuel consumption in public transport (per pkm or per bus-km; incl. occupancy-rates of busses					Improving the co-operation with public transport associations
			Truck & public transport: for separation of fuel consumption - definition of figures for public transport: (1) Best Guess, (2) Expert Estimate, (3) longterm review; developing stock models for busses					Improving the co-operation with public transport associations

No	Topic	Sector	Recommendations	short term	medium term	long term	Institu - tion	Comments
			Truck transport: derive the fuel consumption by substraction of public transport, developing stock model on trucks					Improving the co-operation with automobile associations
			Cars: for fleet average develop stock model; assume average lifetimes; use market data for market average of one specific year					Improving the co-operation with automobile associations
			Water: further research is needed to separate freight / passenger and/or coast / river consumption					
		Residential	Calcualtion of specific energy consumption per equipment by (1) Expert Guess, (2) Estimation, (3) Micro Poll					Improving the co-operation with consumer and trade associations
			Enhancing and improving existing stock models (cp. recommendation in transport sector) by (1) using market data from Ministry of Finance, (2) commercial market data					Improving the co-operation with consumer and trade associations
		Commercial	Super Markets: suitable activity base might be labour statistics; statistic of turnover (sales) - good correlation to surface area of the market					Improving the co-operation with manufacturer and trade associations and large energy consumers
			Hotels: trying to get better data from the syndicate of hotels; possible basis: nr. of guests, nr. of rooms, guest nights = nr. of guests x duration of stay					Improving the co-operation with manufacturer and trade associations and large energy consumers
			Hospitals: suitable basis beds per hospital; better patient days					Improving the co-operation with manufacturer and trade associations and large energy consumers
			Banking Sector: suitable activity base might be labour statistics (nr. of employees)					Improving the co-operation with manufacturer and trade associations and large energy consumers
		Public	Further disaggregation of energy intensive public work					
		Agriculture	Further disaggregation of energy intensive agricultural products					Improving the co-operation with agricultural associations and large energy consumers in the agricultural sector
3	**Comparison with international data**		Comparing all Brazilian indicators with international indicators for countries with similar production and consumption structure.	x	cont.		EPE	All differences between the two indicators will be explained in detail in order to understand the specifics of the Brazilian energy system.

No	Topic	Sector	Recommendations	short term	medium term	long term	Institu- tion	Comments
4	**Surveys**		Adding to the next coming surveys in the of transport sector, commercial sector and in the agricultural sector	x	cont.		EPE	These surveys could be linked to any surveys and censuses or micro-censuses activities, especially for the use of electricity demand
		Transport	Survey on the use of waterways (freight and passenger transport)					Improving the co-operation with automobile associations
		Residential	Development of additional residential data fur rural areas (firewood use etc.)					Improving the co-operation with consumer associations
			Developing own micro poll (even on a panel base)					Improving co-operation with the National Statistical Office
		Commercial	Additional subsector surveys					Improving the co-operation with manufacturer and trade associations and large energy consumers
		Agriculture	Detailed surveys for other crops and their respective energy demand					Improving the co-operation with agricultural associations and large energy consumers in the agricultural sector
5	**Quality control**		Quality control of energy efficiency data, improving the data quality, supporting the sources of data, data handling	x	cont.		EPE	There is a strict need to improve the quality of energy efficiency data, but at least to understand the quality implications of the used data sources; for example three types of "Qualification of Sources" and three types of "Quality Grades"
		Industry	Improving data availability and quality for selected branches					
		Transport	Increasing the data accuracy and data quality					
		Residential Commercial	Increasing the data accuracy and data quality Improving data availability and quality for selected branches					
		Public	Improving data availability and quality for selected branches					
6	**Monito-ring**	Agriculture	Improving data availability and quality for selected branches		x	cont.	EPE	Contracting engineering institutions on measuring energy equipment (as for Stiftung Warentest), for example refrigerators, windows, washing machines, motor cars etc
			Monitoring of energy efficiency and of specific energy consumption of technical devices (status 2010)					

No	Topic	Sector	Recommendations	short term	medium term	long term	Institu- tion	Comments
7	**Effects of energy policy instru-ments**		Evaluation of the effects caused by energy efficiency policies		x	cont.	EPE	Evaluating the effects of energy efficiency policy measures (new standards, PR-campaign, education programme, R&D, grant programmes etc)
8	**Energy efficiency trend**		Calculation of total energy consumption in Brazil with and without energy efficiency increase	x	x	cont.	EPE	1990-2010 with and without energy efficiency measures
9	**National Energy Balance**		Preparation of an updated "Useful Energy Balances" on national level			(x)	EPE	No specific need for regional "Useful Energy Balances"

Recommendation 2 - Developing a set of about 50 additional supporting energy efficiency indicators for all sectors and appliances: There are some additional energy efficiency indicators describing the situation in Brazil in a more detail, therefore we recommend developing additional indicators on a regular base to the current energy statistics.

Recommendation 3 - Comparison of Brazilian energy efficiency indicators with international data: Here we recommend comparing all Brazilian indicators with international indicators for countries with similar production and consumption structure. All differences between the two indicators will be explained in detail in order to understand the specifics of the Brazilian energy system.

Recommendation 4 - Adding to the next coming surveys in the transport sector, residential sector and in the commercial and agriculture sectors: respective questions on energy consumption (kind of equipment, year of production, kW, hours of use per year, etc) - status 2010: We recommend to add to respective economic or any other census surveys a component to measure energy consumption and energy efficiencies of appliances, for example questions on energy consumption (kind of equipment, year of production, kW, hours of use per year, etc).

Recommendation 5 - Quality control of energy efficiency data, improving the data quality, supporting the sources of data, data handling: We recommend to build-up a quality control system for any data linked to energy efficiency indicators. This could lead to a system of “Qualification of Sources” (for example A: Official statistics, national statistical office, Ministries, statistics estimations used as official statistics, data “stamped” by Ministries; B: Surveys / modelling estimates from consulting, research centres, industrial associations; C: Estimations made by the teams here in Brazil) combined with “Quality Grades” (1-Good: low uncertainty, 2-Medium: medium uncertainty, 3-Poor: large uncertainty). This kind of system will have to be established in Brazil for all energy efficiency indicators.

Different levels of data quality				
A	Statistic	Full census	national (official)	direct
B	Statistic	Full census	commercial	direct
C	Statistic	Partial or micro poll		direct
D	Statistic	Panel query		direct
E	Expert	Expert Delphi	multi expert	indirect
F	Engineering Standard	Expert Standard	multi expert	indirect
G	Estimate	Expert	single expert	indirect
H	Guess	(non) Expert	single person	indirect

Table 5: Different levels of data quality

Recommendation 6 - Monitoring of energy efficiency and of specific energy consumption of technical devices (status 2010): Here we recommend monitoring energy efficiency rates for specific technical components (refrigerators, freezers, lamps, pumps, motors and other appliances) and for technical processes (electrolysis, industrial furnaces and other processes) on a regular base (for example on a 5-year-basis).

Recommendation 7 - Evaluation of the effects caused by energy efficiency policies: We recommend to understanding the effects on energy consumption and on energy efficiency based on different energy policy measures in Brazil for the past years. This will be done by a calculation of energy efficiency figures based on current consumption, on state-of-the-art consumption in a baseline trend version and on energy policy implications. The differences between these values represent the effects of energy efficiency policy on national energy consumption in Brazil.

Recommendation 8 - Calculation of total energy consumption in Brazil with and without energy efficiency increase: We recommend measuring energy consumption trends from 1990 to 2010 for both scenarios, with and without energy efficiency measures in the past in order understand the positive effects of increased energy awareness and improved technologies.

Recommendation 9 - Preparation of an updated "Useful Energy Balances" on national level: We recommend developing an updated table format based on the latest version of the useful energy balance table. Whereas most energy balances conclude with the amount of supplied energy to final consumers, a further module on useful energy will be integrated which is indicating the efficiency of final energy consumption, e.g. cooking, heating, cooling and lighting. Even though empirical data are hard to obtain from statistical reporting, special sector surveys can provide indicative data. This module will be the link between economic development and resulting energy demand. It will indicate the efficiency ratios for different sectors and each energy source used. The table could be detailed in the steps of energy supply and use as in the EUROSTAT energy balance (rows), and to the different types of energy sources (solid fuels, petroleum products, gases, electricity etc.) to allow for evaluation of energy cost and cost saved

by energy conservation by specific energy prices. This aggregated data table format shall be applicable to reported real energy data as well as to scenario data from Brazilian energy strategy target data. In this way, comparison of historical and target data will be possible to identify occurring deviations.

Literature

- Eurostat*: EU Energy and Transport in Figures*, Statistical Pocketbook 2005, Luxembourg.
- Eurostat: *Yearly Energy Statistics for the Member States*, Luxembourg.
- International Energy Agency: *International Energy Balances*, Paris.
- Jahn, A. et al.: *Nutzenergiebilanzen Uruguay* - Projektprüfung für die Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH (84 S.), Berlin/Montevideo, 1989.
- Jahn, A. et al.: *Energy Flow Analyses for all Member States of OLADE, Application of the EFLOW System Used by Eurostat to all 26 Latin American Member States of the Organizacion Latinoamericana de Energia - OLADE* (55 pages), Quito 1993.
- Kampet, T./Jahn, A. et al.: *Methodology on Energy Efficiency Measures Impact on National Energy Balance in India*, on behalf of Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH and Ministry of Finance, IGEN Programme Ref. No. 81086046, New Delhi/Eschborn/Berlin (46 p), June 2007.
- Kirchner, A./Hofer, P. et al.: *CO2 Monitoring*, Report on behalf of the BMWi, Berlin, 2004.
- OECD: *Energy Balances for Developing Countries*, Paris.
- Reichmuth, M. et al.: *Analysis of the Renewable Energy Feed-in Act (EEG)*, together with Institut für Energetik und Umwelt, Leipzig & Berlin, 2006.
- Schlesinger, M./Hofer, P. et al.: *Analysis of Energy Consumption*, Report on behalf of the BMWi, Berlin, 2008.
- Seefeldt, F. et al.: *Assessment of the Early Action Savings of Germany within the Framework of EC Directive 2006/32/EC*, on behalf of BMWi, Berlin, 2008.
- Seefeldt, F. et al.: *Contracting (ESCO) Potential for Public Buildings in Germany*, together with dena, National Energy Agency, Berlin, 2007.
- Seefeldt, F. et al.: *Energy Saving & Energy Efficiency Potential with Respect to Actual Price Developments*, Study for the National Energy Efficiency Action Plan, Berlin, 2007.
- Seefeldt, F./Schlomann, B. et al.: *Monitoring System for Energy Savings within the Framework of EC Directive 2006/32/EC*, on behalf of BMWi, Berlin, 2009.
- Volwahsen, A./Bröge, M./Jahn, A. et al.: *Energy Flow Model for the Member States of the European Community* - Report for the Commission of the European Communities, Directorate - General for Energy - DG XVII - (76 p), Berlin, 1986.
- Volwahsen, A./Jahn, A. et al.: Energia para Brasil - Resultados da Utilizacao do Modelo de Fluxo de Energia com Dados do Balanco Energetico Brasileiro 1985, Energy for Brazil - Results of Using the Energy Flow Model with Data from the Brazilian Energy Balance 1985 (19 p), Berlin/Rio de Janeiro, 1987.