

**MINISTRY OF MINES AND ENERGY EXECUTIVE
SECRETARY PROGRAM EXECUTIVE BOARD**

**META PROJECT
Technical Assistance Project to the Energy and Mineral Industries**

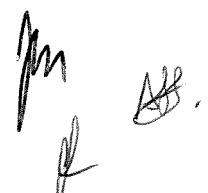
**WORLD BANK
INTERNATIONAL BANK FOR RECONSTRUCTION AND
DEVELOPMENT - IBRD**

Loan: 8095 - BR

Reference Term No. 17

**ANALYSIS OF ENERGY EFFICIENCY IN SELECTED
INDUSTRIAL SEGMENT**

February 2016

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1. CONTEXT

The Energy Research Office - EPE, public company established pursuant to Law No. 10,847 of March 15, 2004 and Decree No. 5,184, of August 16, 2004, under the Ministry of Mines and Energy - MME, is focused on providing services in the area of studies and research aimed to support the planning of the energy industry, such as electricity, oil and natural gas and its derivatives, coal, renewable energy sources and energy efficiency, among others.

The DEA - Board for Economic-Energy and Environmental Studies of the EPE has, among its responsibilities, establish and consolidate statistics on energy use in Brazil and develop energy consumption projections, particularly to the sectors covered in this study, which will be incorporated into different documents of the Brazilian energy planning. In this context, there is the industrial sector, which is primarily responsible for energy consumption in the Country and, in 2011, accounted for approximately 36% of the final Brazilian energy consumption. This sector focuses significant portion of the national demand for electricity and fuels and, associated with this power consumption, there are significant efficiency opportunities in energy use. Thus, it is important to identify both the opportunities of energy efficiency in this sector and possible incentives in the feasibility of utilization of these existing energy efficiency amounts.

Along with the expansion of energy supply in the Country, reduction of energy consumption provided by its efficiency makes up an important element of the portfolio of alternatives in order to meet the growing energy demand of the Country, especially taking into account the prospects for economic growth advocated for years to come. Moreover, energy efficiency measures also contribute to reducing emissions of greenhouse gases, particularly important effect in the current context of great environmental concern worldwide.

Finally, it should be noted that studies on energy efficiency are within the planning process of the energy industry in Brazil, consolidated in the plans such as the Ten Year Plan for Energy Expansion (PDE) and the National Energy Plan (PNE), and direct actions to encourage energy efficiency.

Given the importance of the issue of energy efficiency in the Brazilian industrial sector, the DEA, through the Superintendence of Economic and Energy Studies (SEE), presents this Term of Reference for hiring national research in order to obtain primary data for industrial segments selected in Brazil.

2. JUSTIFICATION

The use of energy efficiency opportunities has, among others, positive impacts such as better use of scarce natural resources, reducing environmental impacts associated with energy use, and in many cases, produces good financial returns. In order to achieve this goal, it is necessary that a range of information on potential efficiency of processes, which involves comparing the usual technologies with more efficient layout, particularly important differences in the industrial sector, the main consumer sector of energy in the country.

In this sense, the theme "energy efficiency" is an integral and inseparable from the studies that EPE and MME have the task to perform, for example, in the medium-term plans (PDE) and long term plans (PNE), and other complementary studies.

During these studies, it was found to be relevant the need of obtaining primary data on how energy is used in the industrial sector, through the most common technologies existing in the country's industrial facilities, as well as data on efficient technology in the energy use. In this sense, it is essential to seek the formation of a critical mass of information on energy efficiency in the Country, which identifies the energy conservation potential, as well as technologies that can provide this efficiency gain, requiring enter into the specification of income, specific consumption of energy, costs and alternative technologies, among others, by industrial segment.

Moreover, the implementation of the proposed study must submit important information in order to create databases of energy efficiency indicators for the industrial segment, the development of potential cost curves of efficiency measures, and the development of the Useful Energy Balance (BEU). The results collected will be decisive subsidies to improve the treatment of energy efficiency and its role in planning of the Brazilian energy sector.

The results of hiring give support to the calibration of parameters of the energy demand projection models used in the preparation of products with PDE and PNE, contributing to improve the quality of the analysis. In some industrial segments, the primary data will also allow improvements in modeling energy use.

3. PURPOSE

The subject matter of this Term of Reference is, by conducting research at the national level, the development of research methodology, as well as the generation of basic data on energy use (electricity, fuel) in selected Brazilian industrial segments. These data will subsidize the estimation by EPE and MME of the efficiency potential of energy use in the industrial segments concerned. The selected industrial segments for this research are:

- Aluminum chain (production of bauxite, alumina and primary and secondary aluminum);
- Paper and cellulose (cellulose production, paper production and recycling of paper);
- Steel industry chain (pelletizing / sintering, pig iron production, steel production through plants integrated to the coal and charcoal, as well as plants that essentially reutilize scrap metal for steel production);
- Ceramic (red ceramic - structural -, white ceramic and glass);
- Food & Beverage (manufacturing and sugar refining, wheat milling and manufacturing of pasta and bakery products, production of oils and fats (grinding grain, bran production, vegetable oils and animal fat), slaughter animals and production of meat and meat products, milk processing and manufacturing of dairy products, production of animal food and feed, beverages - juices, soft drinks and beers - and rice processing (or generally processing of coffee, tea and cereals), Chemical (petrochemicals, gas-chemical, alcohol-chemical, fertilizer and soda-chlorine).

It is emphasized that the obligation of the Contractor covers the development of research methodology, the sample design definition and implementation of the field research for data collection and presentation of results, as specified in these Terms of Reference.

The sampling plan of the national research must be carried through to samples, which sizes are determined in compliance with the criteria formulated in item 6.2.2, and it should be held in order to meet the above items in section 6.1.

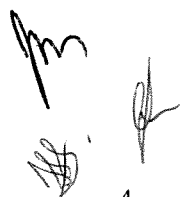
4. SCOPE

The products derived from this work are intended in particular to EPE and MME, contributing to the improvement of planning and for researches within the scope of the industrial sector.

The consultant must interact with other consultants who are addressing issues, within the META Project, which are complementary or which could bring synergy to improve the expected results.

5. PRODUCTS

Below is described the products to be presented as a result of the activities performed, their goals and detailing.



5.1 Research methodology

Purpose: Present the methodology, the sampling design and the activities (working plan) to be developed when carrying out research for each selected segment and sub-segment industrial under the validation commitment on the part of EPE.

Detailing: The product should provide a structured and descriptive methodology, sampling design and the activities to be developed in the operationalization of the research, the training of senior professional staffs (general coordinator), full and junior, the criteria to be adopted in each procedure, work material, and schedule where the research steps are detailed, showing the execution time of each research step.

It should present a product, which will consist of the following:

- Research methodology to be applied;
- Presentation of the questionnaires to be applied in the field research;
- Presentation of seminar of the work plan.

5.2 Database

Purpose: Submit the Database with the codes of the National Classification of Economic Activities - CNAE.

Detailing: The product must also present the Database of group of companies from which will be extracted samples to be researched, which should include information required for the research design.

Among the relevant registration and economic information are:

- Registration in the Corporate Taxpayer Identification Number;
- Corporate name of the establishment, according to the registration with the Corporate Taxpayer
- Identification Number of the Secretariat of the Federal Revenue;
- Full address of the establishment, including telephone and e-mail;
- National Code of Economic Activities - CNAE of the establishment;
- Number of Employees;
- Payroll, among others;
- Geographic coordinates of each industrial facility (latitude and longitude).

5.3 Report: ALUMINIUM chain

Purpose: Submit project reports and spreadsheets containing research data tab in energy consumption technologies (current situation and corresponding to more efficient technologies) for aluminum chain sub-segments.

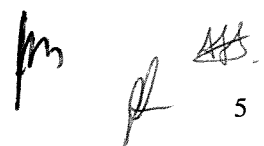
Detailing: The product should include disaggregated aluminum chain according to the following sub-segments: production of bauxite, alumina and primary and secondary aluminum.

The product will be composed of the following items:

- Study report by industrial segment;
- Tabulation of energy consumption data per technology;
- Results presentation seminar.

The minimum itemization of the report to be followed corresponds to those exposed in ATTACHMENT A.

The tabulation of energy consumption data per technology should follow the standard available in ATTACHMENT B. EPE will provided spreadsheet in XLS format, which should be inserted in the data resulting from the research.

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5.4 Report: cellulose and paper

Purpose: Submit project reports and spreadsheets containing research data tab in energy consumption technologies (current situation and corresponding to more efficient technologies) for cellulose and paper sub-segments.

Detailing: The product must include the cellulose and paper disaggregated according to the following sub-segments: production of cellulose, paper production and recycling of paper.

The product will be composed of the following items:

- Study report by industrial segment;
- Tabulation of energy consumption data per technology;
- Results presentation seminar.

The minimum itemization of the report to be followed corresponds to those exposed in ATTACHMENT A.

The tabulation of energy consumption data per technology should follow the standard available in ATTACHMENT B. EPE will provided spreadsheet in XLS format, which should be inserted in the data resulting from the research.

5.5 Report: STEEL INDUSTRY Chain

Purpose: Submit project reports and spreadsheets containing research data tab in energy consumption technologies (current situation and corresponding to more efficient technologies) for steel industry chain sub-segments.

Detailing: The product should include the disaggregated steel industry chain according to the following sub-segments: pelletizing / sintering, pig iron production, steel production through plants integrated to the coal and charcoal, as well as plants that essentially reutilize scrap metal for steel production.

The product will be composed of the following items:

- Study report by industrial segment;
- Tabulation of energy consumption data per technology;
- Results presentation seminar.

The minimum itemization of the report to be followed corresponds to those exposed in ATTACHMENT A.

The tabulation of energy consumption data per technology should follow the standard available in ATTACHMENT B. EPE will provided spreadsheet in XLS format, which should be inserted in the data resulting from the research.

5.6 Report: CERAMIC

Purpose: Submit project reports and spreadsheets containing research data tab in energy consumption technologies (current situation and corresponding to more efficient technologies) for ceramic and glass sub-segments.

Detailing: The product should include the disaggregated ceramic industry according to the following sub-segments: red ceramic (structural), white ceramic and glass.

The product will be composed of the following items:

- Study report by industrial segment;
- Tabulation of energy consumption data per technology;



- Results presentation seminar.

The minimum itemization of the report to be followed corresponds to those exposed in ATTACHMENT A.

The tabulation of energy consumption data per technology should follow the standard available in ATTACHMENT B. EPE will provide spreadsheet in XLS format, which should be inserted in the data resulting from the research.

5.7 Report: food and beverages

Purpose: Submit project reports and spreadsheets containing research data tab in energy consumption technologies (current situation and corresponding to more efficient technologies) for food and beverages sub-segments.

Detailing: The product should include the disaggregated food and beverages industry under the following sub-segments: manufacturing and sugar refining, flour mill and manufacturing of pasta and bakery products, production of oils and fats (grinding grain, bran production, vegetable oils and animal fat), slaughter animals and production of meat and meat products, milk processing and manufacturing of dairy products, production of animal food and feed, beverages - juices, soft drinks and beers - and rice processing (or generally processing of coffee, tea and cereals)

The product will be composed of the following items:

- Study report by industrial segment;
- Tabulation of energy consumption data per technology;
- Results presentation seminar.

The minimum itemization of the report to be followed corresponds to those exposed in ATTACHMENT A.

The tabulation of energy consumption data per technology should follow the standard available in ATTACHMENT B.

EPE will provide spreadsheet in XLS format, which should be inserted in the data resulting from the research

5.8 Report: Chemical

Purpose: Submit project reports and spreadsheets containing research data tab in energy consumption technologies (current situation and corresponding to more efficient technologies) for chemical sub-segments.

Detailing: The product must include the disaggregated chemical industry according to the following sub-segments: petrochemical, gas and chemical, alcohol-chemical, fertilizer and soda-chlorine.

The product will be composed of the following items:

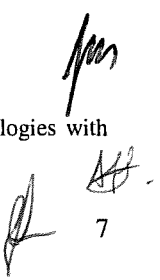
- Study report by industrial segment;
- Tabulation of energy consumption data per technology;
- Results presentation seminar.

The minimum itemization of the report to be followed corresponds to those exposed in ATTACHMENT A.

The tabulation of energy consumption data per technology should follow the standard available in ATTACHMENT B. EPE will provide spreadsheet in XLS format, which should be inserted in the data resulting from the research.

6. ACTIVITIES

The methodology for obtaining data on the main existing technologies in selected industries, in addition to technologies with



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higher potential for energy efficiency, should be developed in order to improve the EPE studies in order to make historical statistics and projections of energy consumption to the Brazilian industrial sector more adherent to reality. With this, one can adjust the energy supply to industrial demand in the Country with the highest degree of accuracy.

It should be noted that the elementary unit (element of the population, which carries the information that you wants to collect) being investigated is the industrial plant, which should be applied the agreed questionnaire. The responding units, i.e., individuals who are classified as qualified informants for the survey should be in charge and responsible for the technical area.

Information may also be obtained from specialized technical literature, and these data should only be used as a supplement to the research along with the industrial units, which should, necessarily, provide most of the information required.

For the development of each product should be carried out specific activities in accordance with the table below:

| Product | Activity |
|--------------------------------------|--|
| Work plan | Preparation of the working plan containing the methodology, the sampling design and the actions to be developed in compliance with the research of each industrial segment and sub-segment selected. In order to collect data, questionnaires should be prepared in order to obtain information on the most common technologies in the selected industrial sub-segments, in addition to more efficient technologies. |
| Face-to-face research | Face-to-face research with the industrial units of each industrial segment selected, by sub-segment. |
| Survey of information - technologies | Survey, in the surveyed plants (with information for georeferencing), information about the main technologies currently used in the Brazilian industries indicated in section 3, by sub-segment, such as the step of the process in which the technology is usually applied, as well as the rates of energy specific consumption (electricity and fuel) and investment costs associated with these technologies. |

| | |
|--|--|
| Survey of information - technological options | Survey, in the sampled industrial units, information about the possible technological options with more efficient use of energy in these industrial segments, by sub-segment, addressing the step of the process where technology is usually applied, the specific energy consumption (electricity and fuel) and the costs associated with its implementation. |
| Survey of the information about the installed capacity and physical production | Survey, for each sampled industrial unit (with information for georeferencing), of information concerning the installed capacity and physical production for the year immediately prior to the beginning of the realization of the sampling research, specifying the end product concerned. |
| Conditions - more efficient technologies | Conditions analysis for insertion of more efficient technologies, involving aspects of technical, economic and financial nature, institutional and market (this connected to the end user decision criteria for its adoption). |
| Data research - specialized technical literature | Survey and research of complementary data for previous items in specialized technical literature |
| Database construction | Group of database, of the group of companies from which the samples will be extracted to be researched, which should include information required for the research design. |
| Consolidation of data by industrial sub-segment | Consolidation of data got in the research in spreadsheet to be sent by EPE in the first month of the agreement. It must be presented a version of the data consolidation spreadsheet for each selected industrial sub-segment, according to item 6.2.3. |

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6.1 Detailing of Variable of Interest

For both the usual technologies in each industry sub-segment selected and more efficient technologies, the following related data should be obtained from variables:

- Industrial segment under analysis;
- Industrial sub-segment under analysis;
- Additional information (only for fertilizer, and where necessary specify the type of product);
- Step of the production process (list of steps of the production process by segment);
- The main existing technologies (list the main consumer technologies for energy by step of the production process);
- Energy used;
- Additional information about the energy (only for cases of coal, other renewable, petroleum coke and other petroleum energy, items and where necessary give further information on the energy source, such as the type and calorific power);
- Installed productive capacity of the plant;
- Physical production of the plant;
- Additional Information: specify the units used for presentation of the installed capacity and physical production, if not for a thousand tons/year;
- Specific energy consumption (electricity, thermal energy and total energy);
- Additional Information: specify the units used for presentation of the specific consumption when they are not GJ/ton, kWh/t, GJ/m³ or kWh/m³, explained above;
- Destination ratio (%), by energy source and end use (process heat, direct heating, etc.);
- Energy efficiency (%), by energy source and end use (process heat, direct heating, etc.);
- Investment needed to implement the technology in question;

Additional Information: specify the exchange rate used, where applicable, products or other units used in unit investment specification;

- Other additional information.

In the case of the most efficient technologies in energy use, in addition to gathering information from the surveyed industrial plants, Contractor must also provide to the EPE / information, for productive stage of the industrial sub-segment, based on bibliographic references with scientific basis. In this case, information will be required regarding: energy possibilities to be used; specific energy consumption (electricity, thermal energy and total energy); and demanded investment to implement the technology in question.

6.1.1 QUESTIONNAIRES FOR INTERVIEWS

For the interviews, Contractor will have to draft questionnaires based on the information identified in the research scope, for the most common technologies in selected industrial sub-segments, in addition to more efficient technologies. These data will allow the extraction of direct primary data and other additional information that will be of great value in order to improve the projection of energy demand by the industrial sector to the horizons of PDE and PNE.

Upon completion of the questionnaire, it should be noted that the secrecy of the research, which should not reveal, under any circumstances, the particulars of the installation and/or units of a particular business group.

The questionnaire to be applied in the research should include the information in section 6.1, in order to fill in the mold of table displayed in ATTACHMENT B.

6.2 Basic Guidelines of the Research

In order to estimate the potential for energy efficiency gains in the Brazilian industrial sector, the sampling plan followed the following guidelines:

- The unit to be analyzed is the industrial plant;
- There will be a first filtering stage where the sampling plan should be defined;
- The units will be selected through a sample, which will be stratified by the industrial segments and sub-segments;
- The variables studied in each industrial unit are exposed in item 6.1;
- The interviews should be face-to-face;
- The interviews will be held with the heads of the technical areas of the Company.



6.2.1 QUESTIONNAIRES FOR INTERVIEWS

This step should be made for the execution of the research of cadastral sources such as federations, associations and trade unions, among other sources that Contractor deems appropriate, in order to enable the preparation of the group of companies.

The group of companies must contain at least the following information:

- Class CNAE 2.0;
- Registration in the Corporate Taxpayer Identification Number;
- Corporate name of the establishment, according to the registration with the Corporate Taxpayer Identification Number of the Secretariat of the Federal Revenue;
- Full address of the establishment, including telephone and e-mail;
- National Code of Economic Activities - CNAE of the establishment;
- Number of Employees;
- Payroll, among others;
- Geographic coordinates of each industrial facility (latitude and longitude).

6.2.2 SAMPLES SIZE

The sample sizes of each industrial sub-segment should be submitted by the Contractor, explaining the significance of each sample within their respective group of Companies. Samples proposals should be subject to validation by EPE/MME prior to execution of field research.

The sampling process must be justified on the basis of statistical theory and its sampling techniques.

6.2.3 SELECTION OF SUB-SEGMENTS WITHIN EACH INDUSTRIAL SEGMENT

Contractor should carry out an analysis of selected industrial segments as in the following exposed breakdown:

- Sub-segments of the aluminum chain: production of bauxite, alumina and primary and secondary aluminum;
- Sub-segments in the cellulose and paper industry: cellulose production, paper production and recycling of paper; Sub-segments of the steel industry chain: pelletizing / sintering, pig iron production, steel production through plants integrated to the coal and charcoal, as well as plants that essentially reutilize scrap metal for steel production;
- Sub-segments of the ceramic industry: red ceramic (structural), white ceramics and glass;
- sub-segments of the food & beverage industry: manufacturing and sugar refining, wheat milling and manufacturing of pasta and bakery products, production of oils and fats (grinding grain, bran production, vegetable oils and animal fat), slaughter animals and production of meat and meat products, milk processing and manufacturing of dairy products, production of animal food and feed, beverages - juices, soft drinks and beers - and rice processing (or generally processing of coffee, tea and cereals). Sub-segments of the chemical industry: petrochemicals, gas-chemical, alcohol-chemical, fertilizer and soda-chlorine;



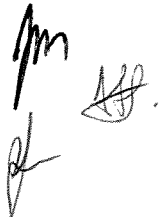
7. PRODUCT PRESENTATION FORMAT

The final products must be delivered in Portuguese language, in the form of reports, on A4 paper, duly numbered and bound, in three hard copies and one electronically (CD or DVD), according to the following format:

- Texts: Microsoft Word®, Office 2007 version or later version;
- Spreadsheets, charts and graphs: Microsoft Excel®, Office 2007 version or later version;
- Presentations: Microsoft PowerPoint®, Office 2007 version or later version;
- Database: Microsoft Access®, Office 2007 version or later version;
- Images: JPG, GIF or BMP.

All documents have indicators of the number, date and nature of the issuance, and their submission should be properly recorded.

EPE/MME will provide the spreadsheet template, in .XLS extension, for use of the performing research, according to the tables presented in ATTACHMENT B.

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8. SCHEDULE AND TERMS OF SERVICE

The deadline for implementation of the services is 12 (twelve) calendar months, from the issuance of the formal authorization for the commencement of activities.

Among the milestones of the presentations at a technical report, there will be follow-up meetings of the work in progress. The location of these meetings will be defined by EPE/MME.

The term limits for presentation and delivery of products resulting from contracted activities should comply with the following schedule, with reference to the authorization date for commencement of activities:

| Expected Product | | | Deadline |
|------------------|----------|---|---|
| Type | Quantity | Description | |
| Report | 1 | Product 01 - Research Methodology: Project report, detailing the methodology and questionnaires to be applied to the Companies (Report 1) | 30 days after signature of the agreement |
| Seminar | 1 | Product 01 - Research Methodology: Seminar about the project, detailing the methodology and questionnaires to be applied to the Companies (Seminar 1) | 30 days after signature of the agreement |
| Report | 1 | Product 02 - Database: Database delivery (Report 1) | 60 days after signature of the agreement |
| Report | 1 | Product 03 - Aluminium Chain: Project report (Report 1) | 90 days after signature of the agreement |
| Report | 1 | Product 03 - Aluminium Chain: Tabulated research data (Report 2) | 90 days after signature of the agreement |
| Seminar | 1 | Product 03 - Aluminium Chain: Technical seminar (Seminar 1) | 90 days after signature of the agreement |
| Report | 1 | Product 04 - Cellulose and Paper: Project report (Report 1) | 120 days after signature of the agreement |

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| Report | 1 | Product 04 - Cellulose and Paper: Tabulated research data (Report 2) | 120 days after signature of the agreement |
| Seminar | 1 | Product 04 - Cellulose and Paper: Technical seminar (Seminar 1) | 120 days after signature of the agreement |
| Meeting | 1 | Follow-up meeting of the work (Meeting 1) | 150 days after signature of the agreement |
| Report | 1 | Product 05 - Steel Industry Chain: Project report (Report 1) | 180 days after signature of the agreement |
| Report | 1 | Product 05 - Steel Industry Chain: Tabulated research data (Report 2) | 180 days after signature of the agreement |
| Seminar | 1 | Product 05 - Steel Industry Chain: Technical seminar (Seminar 1) | 180 days after signature of the agreement |
| Meeting | 1 | Follow-up meeting of the work (Meeting 2) | 210 days after signature of the agreement |
| Report | 1 | Product 06 - Ceramics: Project report (Report 1) | 240 days after signature of the agreement |
| Report | 1 | Product 06 - Ceramics: Tabulated research data (Report 2) | 240 days after signature of the agreement |
| Seminar | 1 | Product 06 - Ceramics: Technical seminar (Seminar 1) | 240 days after signature of the agreement |

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| Meeting | 1 | Follow-up meeting of the work (Meeting 3) | 270 days after signature of the agreement |
| Report | 1 | Product 07 - Food & Beverage: Project report (Report 1) | 300 days after signature of the agreement |
| Report | 1 | Product 07 - Food & Beverage: Tabulated research data (Report 2) | 300 days after signature of the agreement |
| Seminar | 1 | Product 07 - Food & Beverage: Technical seminar (Seminar 1) | 300 days after signature of the agreement |
| Meeting | 1 | Follow-up meeting of the work (Meeting 4) | 330 days after signature of the agreement |
| Report | 1 | Product 08 - Chemical: Project report (Report 4) | 360 days after signature of the agreement |
| Report | 1 | Product 08 - Chemical: Tabulated research data (Report 2) | 360 days after signature of the agreement |
| Seminar | 1 | Product 08 - Chemical: Technical seminar (Seminar 1) | 360 days after signature of the agreement |

For purposes of facilitating understanding of the content of the work by the EPE technicians, the Contractor must send the products contracted 7 (seven) days prior to the dates of their respective technical seminars, even if such products are still in preliminary nature.

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9. QUALIFICATION

9.1 PROFILE

A senior consultant will have as primary attribution the overall coordination of the project. It must allocate the consultants in order to optimize their working hours, while maintaining a standard structure and quality of reports and databases through guidance to the group of junior consultants and statistician.

For each industrial segment under analysis, described in section 3, a consultant should be hired with specific experience proven in these respective segments. The minimum composition and qualifications of the main staff are described below, which aggregates the total hours worked in teams of all industries under analysis.

| Technical Staff | Qualification | Activities |
|--|---|--|
| Project Coordinator (Senior Consultant) | <ul style="list-style-type: none"> - Degree in Engineering; ■ Experience in sectorial studies in the industry | <ul style="list-style-type: none"> - Its activities are geared towards coordination of all the products referred to in the consultancy. Professional responsible for coordinating the work, dialogue with the staff of MME and the META project and responsible for technical, financial and legal of the consultancy with the services to be performed. |
| Consultants (one for each industrial segment researched) | <ul style="list-style-type: none"> - Degree in engineering / economics; - Experience in sectorial studies in the industry | <ul style="list-style-type: none"> - Its activities will be focused on all products referred to in the consultancy, according to their specialty, following even field research. |
| Junior Consultants | Degree in engineering / economics | <ul style="list-style-type: none"> - Preparation of reports and spreadsheet / database - Field research |
| Statistician | Degree in statistics | <ul style="list-style-type: none"> - Critical and processing of data obtained through field research |

9.2 SELECTION

The consulting firm should be selected by the Special Committee of Selection, through evaluation from the interested applicants, using the criteria of the "guidelines for selection and employment of consultants by the borrowers of the World Bank".

10. IMPLEMENTATION STRATEGY

The field research works should follow the scope presented in item 6. The required indicators listed in item 6.1 will be organized in the form of spreadsheet, as set out in ATTACHMENT B.

11. SUPERVISION

11.1 COORDINATION

After authorization of services, the EPE's and Contractor's representatives will be formally designated for the purposes of technical coordination and centralization of communication throughout the development of the study.

From time to time and according to schedule defined in agreement with the representatives will be held follow-up meetings of the activities. Either Party may request the meeting, which should result in record as the deliberations or providences to be taken by the Parties.

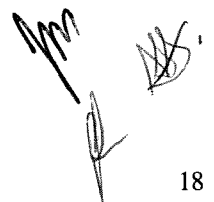
In order to share the experiences gained over the consulting, after approval of the products listed in item 5 technical seminars will be held, where the consulting firm shall presented the relevant aspects of the work.

The seminars will be held in the central office premises of EPE or in a place designated by it. The costs of site availability for realization of these seminars shall be borne by EPE.

The presentations used in the technical seminars will be made available to EPE.

11.2 QUALIFICATION

In order to share the experiences gained over the consulting, after approval of the products listed in section 5 technical seminars will be held, where the consulting firm shall presented the relevant aspects of the work.



The seminars will be held in the central office premises of EPE or in a place designated by it. The costs of site availability for realization of these seminars shall be borne by EPE.

The presentations used in the technical seminars will be made available to EPE.

12. ELEMENTS AVAILABLE

Doubts about this Terms of Reference should be forwarded via fax or email, and its responses should be provided simultaneously to all candidates.

EPE should arrange, whenever necessary, the appropriate physical environment to enable work meetings scheduled between the Parties, with location in the EPE office - RJ.

13. CLASSIFICATION OF EXPENSES

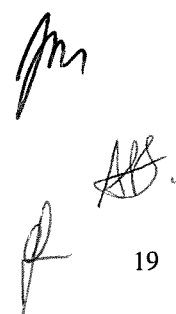
Expenses incurred on the hiring of consulting services that treats this Terms of Reference fall into the Work Program No. 10.32.101.25.572.2119.13E4.0001.

14. LEGAL PROHIBITION

Hiring is forbidden, on any account, of active employees of the Federal, State, Federal District or Municipal Public Administration, direct or indirect, as well as employees of its subsidiaries and controlled companies, within the international technical cooperation projects. Clause 7 of Decree No. 5151 of 07.22.2004.

15. CONFIDENTIALITY

The Contractor should ensure the confidentiality of the information collected on behalf of EPE or provided by it, and will assume the obligation of not disclosing any information resulting from work to third parties nor facilitate, in any way, such disclosure and not use the associated documentation with the works for purposes not approved in writing by the Empresa de Pesquisa Energética - EPE.

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16. PROPERTY OF THE STUDIES

All results from the studies, including primary databases, database containing collected answers and product documents, should be the exclusive property of EPE and MME, and should be formulated, presented and disclosed strictly in their names.

The intellectual rights, as the authorship of the studies are maintained, according to Brazilian law.

17. LOCATION OF THE PROVISION OF SERVICES

The expected seminars in section 0 should be held in the central office premises of EPE or in a place designated by it in city of Rio de Janeiro.

Other services should be developed on the premises of the Contractor and the locations selected for data collection at the national level, and in accordance with the methodology of Planning and Selection of the Sample, described in item 6.2, which will be validated in the analysis of the product 5.1 (Work Plan).

Technical in Charge:

Name: ARNALDO DOS SANTOS JUNIOR

Position: ENERGY RESEARCH ANALYST

Signature: 

Technical in Charge:

Name: JEFERSON BORGHETTI SOARES

Position: SUPERINTENDENT OF ECONOMIC AND ENERGY STUDIES

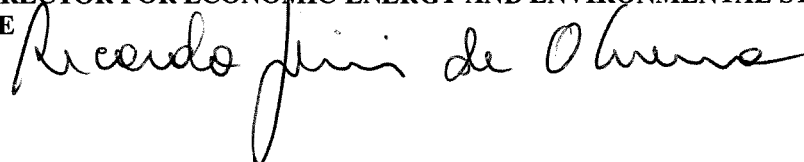
Signature: 

Approval

Name: RICARDO GORINI DE OLIVEIRA

Position: DIRECTOR FOR ECONOMIC-ENERGY AND ENVIRONMENTAL STUDIES

Agency: EPE

Signature: 



ATTACHMENT A STRUCTURE OF REPORTS FOR SELECTED INDUSTRIAL SEGMENTS

A. 1 STRUCTURE OF THE REPORT

1- Introduction

2- Description of the main production processes of the industrial segment

- a. Main production processes of the sub-segment 1**
- b. Main production processes of the sub-segment 2**
- c. Main production processes of the sub-segment 3**
- d. Main production processes of the sub-segment ... N**

(N = number of sub-segments of that is function of the covered industrial segment, disaggregated as specified in this notice)

Scope: present a brief description of the main production processes in the industry sub-segments indicated in the notice. Indicate the degree of participation of the processes in the Brazilian industrial facilities by sub-segment. Indicate the parameters (indicators) that will be quantified from analysis of the current Brazilian reality.

3- Description of the methodology used in the study

a. Selection of the research sample

Scope: characterizing the sample consulted within the group of companies, justifying the sampling plan used, as well as describes the preparation process of the queries;

b. Selection of the steps of the production process

Scope: justify and explain the breakdown to be adopted for the stages of the production process of the sub-segment, for purposes of energy consumption indicators research

c. Data calculation

Scope: explain the criteria used for calculation of raw data received from the Companies that make up the industrial sub-segment addressed.

4- Indicators of energy consumption by sub-segment

a. Sub-segment 1



- i. **Current situation**
- ii. **More efficient technologies**
- b. **Sub-segment 2**
- i. **Current situation**
- ii. **More efficient technologies**
- c. **Sub-segment 3**
- i. **Current situation**
- ii. **More efficient technologies**
- d. **Sub-segment ... N**
- i. **Current situation**
- ii. **More efficient technologies**

(N = number of sub-segments of that is function of the covered industrial segment, disaggregated as specified in this notice)

Scope: Present energy consumption indicators (electricity and fuel) by stage of process and by industrial sub-segment, addressing the technologies currently in use and the alternatives for more efficient use of energy for this sub-segment. Presenting investment costs associated with adoption of the technologies currently in use and new technologies with more efficient use of energy.

5. Conditions analysis for insertion of efficient energy technologies by sub-segment

- a. **Sub-segment 1**
 - i. **Technical conditions**
 - ii. **Economic and Financial conditions**
 - iii. **Other conditions**
- b. **Sub-segment 2**
 - i. **Technical conditions**
 - ii. **Economic and Financial conditions**

- iii. **Other conditions**
- c. **Sub-segment 3**
 - i. **Technical conditions**
 - ii. **Economic and Financial conditions**
 - iii. **Other conditions**
- d. **Sub-segment ... N**
 - i. **Technical conditions**
 - ii. **Economic and Financial conditions**
 - iii. **Other conditions**

(N = number of sub-segments of that is function of the covered industrial segment, disaggregated as specified in this notice)

Scope: present analysis of technical, economic, financial factors and others to be identified that influence the adoption of more efficient technologies for use of energy, by the Companies that comprise the studied industrial segment. Other factors influencing the decision to be analyzed include aspects not covered above, and include, for example, asymmetric information, among other aspects. The contract executor should include other factors and that aspect should include research to be held by the Companies in the segment.

6- **References used**

Scope: present a list of Companies consulted and specialized technical publications used to prepare the product.

7- **Attachments**

- a. **Structure of the questionnaire used in the research**
- b. **Relationship of answered questionnaires**

Scope: presentation of the data structure with answers from the queried Companies for analysis of energy consumption indicators in the industry. List of persons contacted in the Companies and their respective telephone numbers and electronic addresses (e-mails).

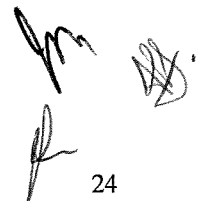
The report shall necessarily contain the questionnaires answered with the identification of the queried companies in each industrial segment. **The questionnaire shall be discussed with the technical team of EPE assigned to technical monitoring of the project.** The information provided by the companies during the research process will necessarily have confidential treatment, restricting the circulation to the EPE staff and the Company performing the services listed in this notice.

Spreadsheets containing research data tab on energy use technologies must be submitted in Microsoft Excel® format, Office 2007 version, covering information on physical production, specific consumption of energy by energy sector, stage of the production process for each industrial segment, addressing both qualitative and quantitative aspects, as well as investments associated to the technologies.

Regarding the content specification, the information of energy consumption technologies must follow the following guidelines:

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- The energy consumption rates should refer to the main technologies used in each selected industrial segment, identifying the stage of the process where they fall;
- On the sources of primary research data:
 - i. The results presented should result from the combination of research both in specialized technical publications as of consultations and surveys with Companies and associations in each industrial segment;
 - ii. The final indicators should result **mainly** from information obtained directly from the Companies mentioned;
 - iii. **It will be up to the Company that wins the Bid the responsibility to identify and carry out contacts with companies and trade associations for conducting research and surveys with them, not fitting to EPE the responsibility in these contacts in whatever stage of this process;**
 - iv. **Sources for information obtained from specialized technical publications should be significantly more comprehensive and up to date than the Useful Energy Balance (BEU), which will not be accepted as the sole or primary source of information for this study. If there is the use of the BEU as the only or the main source of information for the study, the products are considered previously rejected by the technical team of EPE, not fitting payment for products to the COMPANY, until they submit products revised according to other sources of information. It should be noted that the main source of information must necessarily be obtained from field research, as stated in this notice.**
- The specific energy consumption rates (electricity and fuel) should be made in technology currently used in each industrial segment as well as to the most effective technology applicable to each case. These rates can be expressed in GJ/t product (fuel) and kWh/t product (electricity). The type of fuel used should be specified as well as their amounts, in case of technology with possibility of using more than one fuel;



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- Typical investment costs **updated** and associated with the adoption of each technology. It is possible the presentation of a range of values and more likely values should be indicated;
- Technical, economic and financial aspects, institutional and market (linked to the end user) that influence the adoption of more efficient technologies of energy in each of the segments and sub-segments defined above.

It is attached to this notice, in ATTACHMENT B, the specification of the data tab spreadsheet with the information to be included in the delivery of products.

The term "fuel" as used herein includes both commercial sources (e.g., oil and reforestation wood) and non-commercial (e.g., native wood and waste from biomass). A complete listing of commercial and non-commercial sources matches the one adopted in the publications of the National Energy Balance, available at: <https://ben.epe.gov.br>.

The term "final use" includes the following uses: direct heating, process heat, driving force, cooling, lighting and other uses, as defined by the Useful Energy Balance (BEU).

All the calculation memory adopted for indicators estimates should be made available to the technical staff of EPE/MME, for reproducibility purposes of the calculations, but also to continue the work of this kind in the studies developed by EPE.



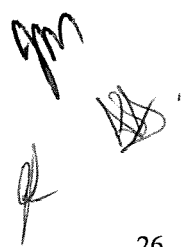
**ATTACHMENT B STANDARD OF THE TAB OF TECHNOLOGICAL DATA FOR SELECTED
INDUSTRIAL SUB-SEGMENT**

A.2. GENERAL GUIDELINES:

A.2.1. FOR THE "TECHNOLOGIES - PRESENT SITUATION" TAB:

For this tab, information must be entered to reflect the current reality of the Brazilian industrial sector, which is presented breakdown in segments in the notice. In order to fill-in the table, follow these guidelines:

- 1- In the "segment" field, choose between the options presented in the list.
- 2- In the "sub-segment" field, choose between the options presented in the list.
- 3- In the "additional information" field, detail the sub-segments where requested "specify".
- 4- In the "step of the production process" field, insert the key steps of the main production process of each industrial segment.
- 5- In the "existing key technologies" field, complete with information on key technologies currently employed by stage of the production process. For example, if this technology is a mill, a compressor, a furnace, etc.
- 6- In the "used energy" field, specify whether it is electricity or fuel. Specify the energy available in the list by clicking in the cell. Use one line for each energy.
- 7- In the "additional information" field, fill in information about energy, which further specification was requested in the previous field. Specify the energy and the average calorific value (kcal/kg)
- 8- In the "physical production" field, report for the year 2010, production capacity, production and type of product generated by production plant. When the unit is different from tons/year, it should be informed.
- 9- In the "specific consumption" field, report the consumption of energy by production plant. When the unit is non-tons or cubic meter, it should be informed.
- 10- In the "energy efficiency" field, inform the energy performance for each source, as in %. Inform the end-use concerned. When necessary, add additional information.



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11- In the "allocation coefficient" field, inform the % of allocation of each source for end use. When necessary, add additional information.

12- In the "demanded investment" field, inform the investment cost estimated by technology, given in R\$ or US\$/production unit. Inform the adopted unit and the exchange rate used when informing the cost in dollars.

A.2. FOR "ALTERNATIVE TECHNOLOGY" TAB:

This tab, for each step of the production process and technology identified on the "Current technologies-situation," the most efficient technology corresponding to that application should be identified, so that it is possible to estimate the relative energy savings by adopting it. Regarding the content to be filled in the fields, it should be carried out as the one adopted for the "alternative technologies" tab.

A.3 SUGGESTED FORMAT FOR CONSOLIDATION OF THE INFORMATION COLLECTED

A.3.1 TECHNOLOGIES: CURRENT SITUATION:

| | |
|-------------------------------|--|
| INDUSTRIAL SEGMENT: | |
| SUB-SEGMENT: | |
| ADDITIONAL INFORMATION | |

| STEP OF THE PRODUCTION PROCESS | MAIN EXISTING TECHNOLOGIES | ENERGY USED | ADDITIONAL INFORMATION OF ENERGY |
|---|--|--------------------|---|
| LIST STEPS OF THE PRODUCTION PROCESS BY SEGMENT | LIST THE MAIN CONSUMER TECHNOLOGIES FOR ENERGY BY STEP OF THE PRODUCTION PROCESS | | |

| PHYSICAL PRODUCTION | | | |
|----------------------------|-------------------|-------------|-------------------------------|
| CAPACITY | PRODUCTION | UNIT | ADDITIONAL INFORMATION |
| | | | |

| SPECIFIC CONSUMPTION | | |
|-----------------------------|-------------|-------------------------------|
| QUANTITY | UNIT | ADDITIONAL INFORMATION |
| | | |

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| ENERGY EFFICIENCY | | |
|-------------------|-----------|------------------------|
| YIELD | FINAL USE | ADDITIONAL INFORMATION |

| DESTINATION COEFFICIENT | | |
|-------------------------|-----------|------------------------|
| COEFFICIENT | FINAL USE | ADDITIONAL INFORMATION |

| DEMANDED INVESTMENT | | |
|---------------------|------|------------------------|
| QUANTITY | UNIT | ADDITIONAL INFORMATION |

A.3.2 ALTERNATIVE TECHNOLOGY

| | |
|------------------------|--|
| INDUSTRIAL SEGMENT: | |
| SUB-SEGMENT: | |
| ADDITIONAL INFORMATION | |

| STEP OF THE PRODUCTION PROCESS | MAIN EXISTING TECHNOLOGIES | ENERGY USED | ADDITIONAL INFORMATION OF ENERGY |
|---|--|-------------|----------------------------------|
| LIST STEPS OF THE PRODUCTION PROCESS BY SEGMENT | LIST THE MAIN CONSUMER TECHNOLOGIES FOR ENERGY BY STEP OF THE PRODUCTION PROCESS | | |

| PHYSICAL PRODUCTION | | | |
|---------------------|------------|------|------------------------|
| CAPACITY | PRODUCTION | UNIT | ADDITIONAL INFORMATION |

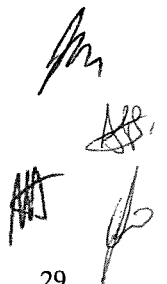
| SPECIFIC CONSUMPTION | | |
|----------------------|------|------------------------|
| QUANTITY | UNIT | ADDITIONAL INFORMATION |

| ENERGY EFFICIENCY | | |
|-------------------|-----------|------------------------|
| YIELD | FINAL USE | ADDITIONAL INFORMATION |

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| DESTINATION COEFFICIENT | | |
|-------------------------|-----------|------------------------|
| COEFFICIENT | FINAL USE | ADDITIONAL INFORMATION |

| DEMANDED INVESTMENT | | |
|---------------------|------|------------------------|
| QUANTITY | UNIT | ADDITIONAL INFORMATION |



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ATTACHMENT C PHYSICAL AND FINANCIAL SCHEDULE

| Physical and financial schedule | | | | | | | | | | | | |
|---|----------------------|-----------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Product | Calendar Days | | | | | | | | | | | |
| | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 |
| Follow-up meetings | | | | | 0% | | 0% | | 0% | | 0% | |
| Product 1 - Presentation of the Work Plan (Project report, Methodology, Questionnaires and Technical Seminar) | 0% | | | | | | | | | | | |
| Product 2 - Database presentation | | 10% | | | | | | | | | | |
| Product 3 - Aluminum chain (Project report, tabulated data of research and Technical Seminar) | | | 15% | | | | | | | | | |
| Product 4 - Cellulose and Paper (Project Report, Tabulated data of research and Technical Seminar) | | | | 15% | | | | | | | | |
| Product 5 - Steel industry chain (Project report, tabulated data of research and Technical Seminar) | | | | | | 15% | | | | | | |
| Product 6 - Ceramic and Glass (Project Report, Tabulated data of research and Technical Seminar) | | | | | | | | 15% | | | | |
| Product 7 - Food and Beverages (Project Report, Tabulated data of research and Technical Seminar) | | | | | | | | | | 15% | | |
| Product 8 - Chemical (Project report, tabulated data of research and Technical Seminar) | | | | | | | | | | | | 15% |
| Total | 100% | | | | | | | | | | | |