

# **ENERGY MANAGEMENT MANUAL**



**Organization, Procedures and Worksheets**

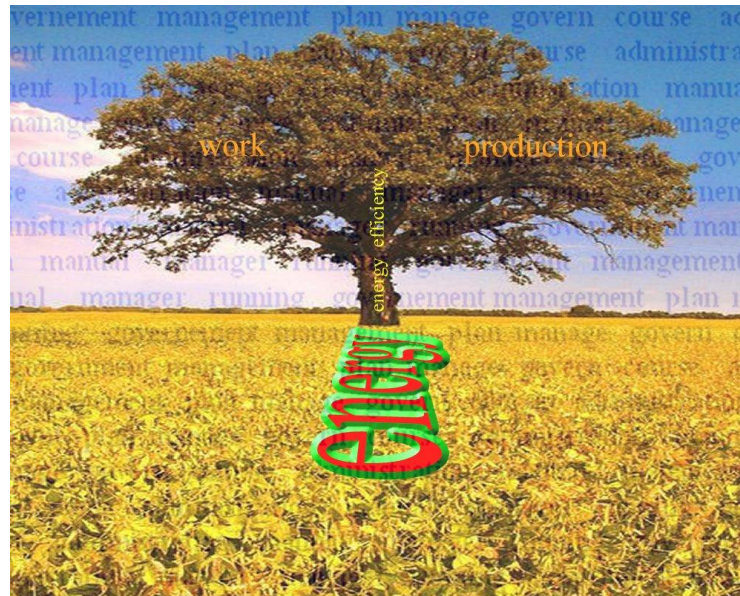
**( to use with energy matrix )**

**application standards: ISO 50001, ISO 50002,  
ISO 50003, ISO 50004, ISO 50006, ISO 50015**

**Artequim.com**

**4 th. edition**

# ENERGY MANAGEMENT MANUAL



Author: Artequim.com

4<sup>th</sup> edition



June, 2014  
Santiago of Chile

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## Foreword to the 4<sup>a</sup> edition

In the continuous study of the management of the energy, we have been able to appreciate as the energy aspect goes returning to their natural bed of evaluation in a vision integrated with the environmental aspects. The use of the energy ones has direct relationship with the sustainability of the Industry, Business and Institution.

In this edition we have purified some procedures and in the references we can find the support texts that help to understand the growth of the integral management of the energy.

The normative aspect through laws, ordinances, regulations, ordinances, etc, is present approaches in this version and that they help to have a more integral look of the energy topic.

We have also incorporated a practical procedure of implementation of a System of Administration of Energy using like references the norms ISO 50001, 50002, 50003, 50004, 50006 and 50015, applicable to all Organization.

A very important topic continues being the election of the (or those) indicator(s) of the energy performance that will allow us to value the Energy Efficiency or rather they will help us to know more to the management of the energy.

The world use of the standard ISO 50001 and complementary norms have impelled to many Industries, Business and Institutions to look for a tool that made more accessible this norms in their practical application and this Manual has been good as guide to establish the work route.

For Artequim.com it is a duty continuing progressing in the studies that drive toward the excellence of the management of the energy womb and for that reason we have gone publishing new versions when the material that serves for: to expose a new focus of procedures, registrations, to index, to show new development areas, to present new norms, protocols, specifications, time lapsed from the last version; to deserve changes.

Once again we hope the Energy Management Manual, serve to those responsible for the management of the energy matrix in the Industries, Business and Institutions.

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## Preface

### What is Energy ?

**Energy:** substance or system that it possesses properties to carry out work, and can be used in facilities, equipments, machines, which allow to carry out processes of transport, well-being, conversion of materials and inputs; and give a sense to value chain to obtain goods, or services that correspond to the pattern of the users' business in the different scopes.

To see annex 8.3.1

### What is the Energy Management ?

By means of this brief text we seek to give an answer guidance to this query, presenting a solution by means of a Manual of organization of the procedures and registrations that are involved in all process of energy management, for any type of Industry, Business, Institution, and even our Home. To negotiate, it means to manage with rational sense, and in many cases with appropriate analytic tools for one taking of guessed right decisions, that which will promote in this environment, the energy efficiency (%) and the saving (\$).

To count or to Negotiate the Energy, there is the dilemma there:

- To count kiloWatt / month, m3 / month, liters / month, etc., just as it indicates it the verb it is alone to count.
- We can also define the " productive units of the business / energy units"; in this case the quotient is known as energy specific ( calculates historical or standard supposition ).

In both cases the analysis units give us partial information about the use of the energy, and we are in front of calculations and concepts of productivity ( of the Industrial Engineering ), it lacks the evaluation of the Energy Efficiency characteristic of the Engineering: Electric, Mechanics, Chemistry and Civil of the processes, machines, teams, facilities. Historical data that would indicate us a certain tendency, can exist but like it has happened in the human being many environments what felt true for a lot of time, it was a false concept that deviated to complete generations in their evaluations, negotiations, points of view, etc., examples are many. In many informations it is commented on her, they take measures to improve", among others: light bulb is changed, heat exchanged is changed, change of fuels, I redraw of circuits, change of electric tariffication, installation of catalysts, change of insulations, reengineering of processes, installation of molecular computers, change of devices and tools, etc, and it is supposed that the historical data will guide us in the taking of decisions to improve; but the management concepts and energy administration are left it stops later, solutions have been given for the tip of the iceberg."

The Energy Management helps to all the environments in the handling with knowledge, of the technical - economic variables that conform the study of the use of the Energy Matrix.

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## What is the Energy Efficiency ?

- a) It is the relationship among the real consumption versus the theoretical consumption of the energy ones. The error of this fact varies between 20 and 40%.

The energy consumption refers to the Energy Matrix: electricity, water, lpg gas, natural gas, coal, firewood, biomass, eolic, solar, photovoltaic, hydraulics, compressed air, vacuum, cold, hydrogen, petroleum, nuclear, thermal fluids, etc. is measured in units physique - chemical, according to the SI, English System, etc.

This alone variable considers the consumptions of the energy.

- b) It is the relationship among the specify index real versus the specify index theoretical. The error of this fact oscillates between 5 and 20%.

It is generally measured in [production units / unit energy].

The alone indexes consider the relationship of productivity versus the energy consumptions.

But the energy efficiency this related with environmental parameters, construction, human, mechanics, thermodynamic, of materials, electric, chemical, productivity, localization, classification, of transfer, geographical; therefore the answer to the question takes us to outline a model a not very more complicated one what the previous ones, in such a way of having represented all the aspects that influence in her.

- c) it is the solution to the algorithm (\*) that measures the performance with which you/they are carried out the energy consumptions (energy womb). The error of this fact fluctuates between -1 and 1%.

It is measured in %.

The mathematical expression of the Energy Efficiency is:

$$\begin{aligned}
 (*) \quad EE = (\eta_r / \eta_t) * 100 = f \{ [ (\partial(S_i) / \partial t (\partial q_i) - \partial S_i / \partial q_i), m c \partial T_i / \partial q_i, \\
 VI \sqrt{3} \cos(\varphi) * t, ( \text{fis. unit}_r / \text{fis. unit}_t ), kA(\partial T_i / \partial t_i) / x, \\
 hA \partial T_i / \partial t_i, (2\pi h\nu^3) / c^2 (1 / \int \exp^{h\nu/kT-1} \partial T_i / \partial t_i), \\
 [ \partial(\epsilon_0 E^2 + \beta^2 / \mu_0) / \partial t + \partial E_c / \partial t ], SpI_r / SpI_t, \\
 ( \partial(H_i - pV) / \partial t_i ), T \partial S / \partial t - p \partial V / \partial t, T^2 \partial(G/T) / \partial T, \\
 [ \partial(x,y) / \partial q_i - \partial(x,y) / \partial T_i ], |Hu|_{ij}, [ \nabla_{\alpha,\beta} ] \}
 \end{aligned}$$

you take notices that the terms S and G, relate the exergy of the energy with their energy efficiency.

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## **ENERGY MANAGEMENT MANUAL**

This Energy Management Manual allows to manage Energy with standardization and efficiency criterions to manage all the components of the matrix of energy at any scope: Industries, Business and Institution.

<b>Chapter</b>	<b>N°</b>	<b>Description</b>
		<b>Index</b>
<b>1.</b>		<b>Introduction</b>
	1.1	Purpose
	1.2	Industry, Business, Institution Presentation
	1.3	Administration of the Energy Management Manual
<b>2.</b>		<b>Strategic Concept</b>
	2.1	Vision and Mission of the Industry, Business and Institution
	2.2	Energy Management: Policy and Objectives
	2.3	Revision Legal Aspects and others
	2.4	Indicators of Energy Efficiency Management
	2.5	Extent and application
	2.6	Commitment of Management
<b>3.</b>		<b>Organization and Responsibilities</b>
	3.1	Organization chart and Responsibilities
	3.2	Executive Committee to Energy Management
	3.3	Management Representative to Energy Management
	3.4	Energy Management Secretary
	3.5	Internal Communications
<b>4.</b>		<b>Planning of Energy Management Plan</b>
	4.1	Energy Planning
	4.2	General Structure
	4.3	Process and Interaction in the Energy Management Plan
	4.4	Control of Documents and worksheets ( records )
	4.5	Inspection of Manual and Energy Management Plan
	4.6	Management of the Human Resources
	4.7	Management of Physical Resources
<b>5.</b>		<b>Energy</b>
	5.1	Purchasing
	5.2	Utilization
	5.3	Measurement and Testing
<b>6.</b>		<b>Continuous improvement</b>
	6.1	Internal Audits
	6.2	Control of non conforming uses
	6.3	Correctives and Preventives Actions
	6.4	Monitoring and measurements : Revision of Indicators
	6.5	Verification, Validation, Certification and Communication
	6.6	Data Analysis and Continuous Improvement

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**7. Procedures and Worksheets**

- 7.1 Elaboration and Control of the Documentation
- 7.2 Control and Maintenance of the energy worksheets
- 7.3 Internal Audits
- 7.4 Human Resources Management
- 7.5 Correctives Actions
- 7.6 Preventives Actions
- 7.7 Physical assets Management
- 7.8 Revision of Legal Aspects and others
- 7.9 Management of Purchases of Energy
- 7.10 Control of Use of Energy no - approval
- 7.11 Energy Efficiency Assessment
- 7.12 Verification, Validation, Certification y Communication
- 7.13 Identification and Control of no - approval
- 7.14 Control and Energy Measurement
- 7.15 Management Inspection

**8. Attached**

- 8.1 Glosary
- 8.2 Tools
- 8.3 Correspondence of technical data with the Energy Management Manual
  - 8.3.1 Energy Types
  - 8.3.2 Schedule of square Electrical charge
  - 8.3.3 Budgets worksheets for the EMP
  - 8.3.4 Training of the Personnel on Climatic Change
  - 8.3.5 Diagram of evaluation of energy management
  - 8.3.6 Energy Management Plan ( EMP )

**9. As implementing a Energy management System based on ISO 50001 and other related standard**

- 9.1 General characteristics of the standard ISO 50001 and their relationship with this Manual
- 9.2 Implementing the standard ISO 50001

**10. Bibliography and References**

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## 1. INTRODUCTION

### 1.1 Purpose

This Manual describes the Energy management Plan of an Industry, Business or Institutions; that they consume diverse energy. In this the organization of the Plan is described, for the Efficient Use of the Energy.

Standard references. The Energy management Plan ( EMP, to see annexed 8.3.6 ) here presented, it is designed to establish an effective, efficient and economic system, based on the requirements similar of standard ISO 9001:2008 and ISO 14001, to this date we have the ISO 50001<sup>3</sup>, we revise them and we conclude that this Manual is completely applicable, it is even it with the complementary norms ISO 50002<sup>4</sup>, ISO 50003<sup>5</sup>, ISO 50004<sup>6</sup>, ISO 50006<sup>7</sup>, ISO 50015<sup>8</sup> (at the moment in study), together with the practical experience of Artequim.com, they allow to conclude the complete applicability of this Manual.

As complement we have examined those standard ISO 17021<sup>9</sup>, ISO 19011<sup>10</sup>.

For the purposes of this Energy management Manual, the definitions and terminology of the international standard ISO 9001:2008 are applied, besides the technical concepts characteristic of the Energy.

The definitions....

### 2.3 Revision of Legal Aspects and others

The different laws, ordinances, regulations, ordinances, instructive, etc, they can end up affecting the energy management in their different environments. It is important the periodic revision to avoid the no-approval in the purchase, use, waste, etc, of energy. The EMS will gather the pertinent information and will inform the EMR, to the EMC and these will revise the obtained results and the percentage of...

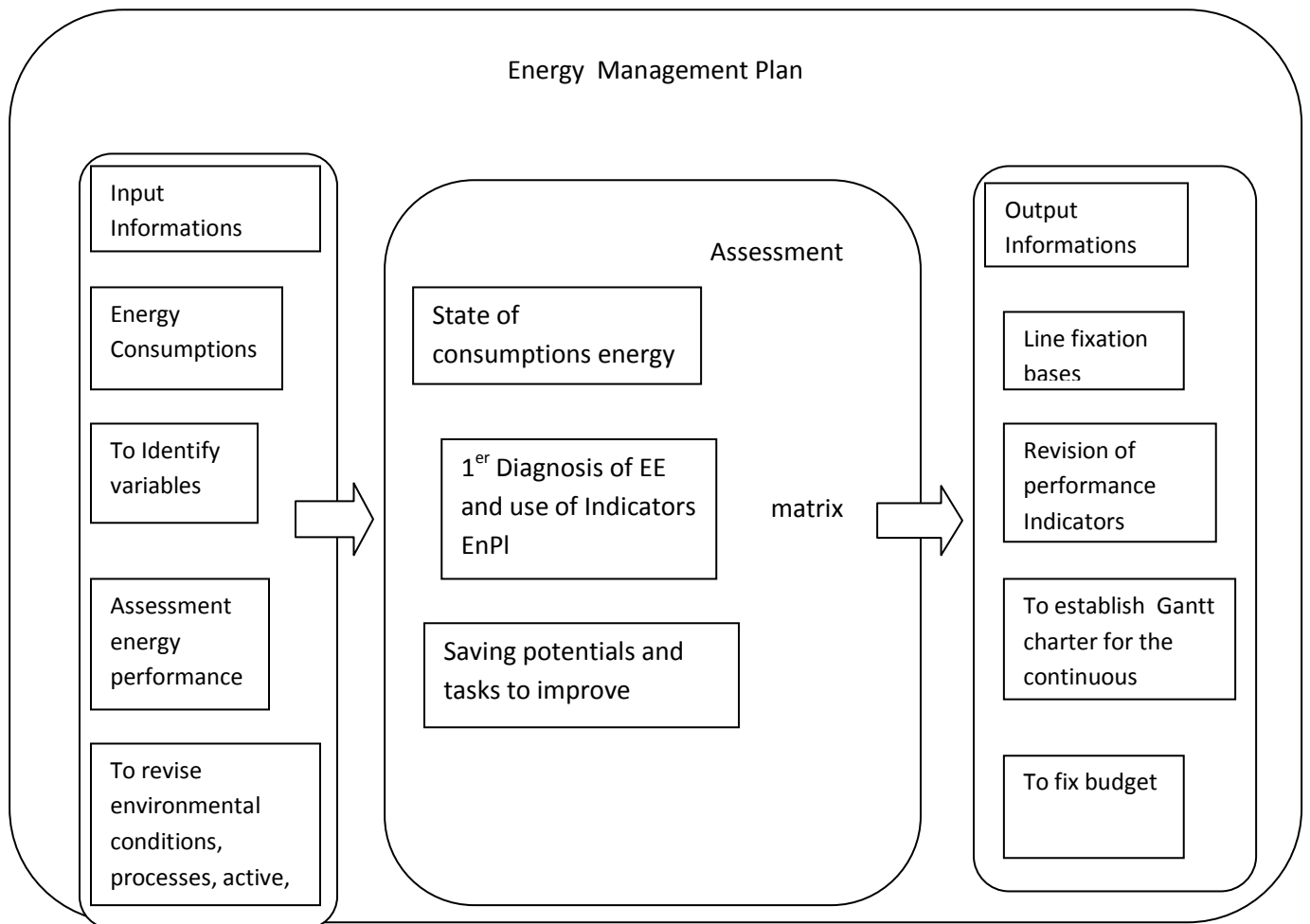
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#### 4. PLANNING OF THE ENERGY MANAGEMENT PLAN

##### 4.1 Energy planning

The energy Planning allows to elaborate a Plan of development of the implementation of a Energy Management System.



**PPE-02:** Control and Maintenance of worksheets of Energy Management.

The internal audits of energy management assure that the necessary worksheets are being generated, used and conserved, according to that settled down

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## 4.5 Revision of Manual and Energy management Plan

The EMC of the Industry, Business or Institution revises the Energy Management Manual and the EMP, at least once a year, in order to assure its adaptation and effectiveness. The revision procedure assures that all the information is gathered and presented to allow that the Management carries out an appropriate evaluation, including the necessities of change of the Plan and/or of the Politics of Energy Management, its objectives and goals; keeping in mind the results of the audits, conditions of change and the commitment of the Industry, Business or Institution for the continuous improvement. The revisions for the Administration are registered.

**Information for the Revision.** The inputs for the Revision for Administration to include the opportunities of improvement related with the results of the internal audits, the users' feedback, the acting of the key processes, reports of no-approval of the energy efficiency, state of correctives and preventives actions, work resultants previous of Administration Revisions and changes that can affect to the Energy Management Plan.

**Results of the revision.** The results of the Revision for the Administration are registered in terms of actions and responsibilities for:

- The execution of the improvements of the Energy Management Plan.
- The execution of the improvements of....

## 7. PROCEDURES AND WORKSHEETS

- 7.1 PPE – 01 Elaboration and Control of Documentation
  - a. RPE01 - 00 New Document
  - b. RPE01 - 01 Responsibility Matrix on documents
  - c. RPE01 - 02 Matrix of controlled Documents
  - d. RPE01 - 03 Control of delivery Documents
- 7.2 PPE – 02 Energy worksheet Control and maintenance
  - a. RPE02 – 01 Worksheet Energy Management Plan Schedule
- 7.3 PPE – 03 Internal Audits
  - a. RPE03 – 01 Audit Annual to Energy Management Plan
  - b. RPE03 – 02 Program and List of Audit Verification
  - c. RPE03 – 03 Summary of mitting
- 7.4 PPE – 04 **Human Resources Management: qualifying, coaching and training**
  - a. RPE04 – 01 Evaluation of Personal Performance in Energy Scope
  - b. RPE04 – 02 Annual Training Plan in Energy Subject
- 7.5 PPE – 05 Correctives Actions
  - a. RPE05 – 01 No-approval worksheet, Correctives and Preventives Actions
  - b. RPE05 – 02 No-approval Open / Closed summary
- 7.6 PPE – 06 Preventives Acions
  - a. RPE06 – 01 No-approval worksheet, Correctives and Preventives Actions
  - b. RPE06 – 02 No-approval Open / Closed summary
- 7.7 PPE – 07 Physical resources Management
  - a. RPE07 – 01 Control of Informations for Physical Resources Management
  - b. RPE07 – 02 Worksheet Plan of continuous improvement
- 7.8 PPE – 08 Revision of Legal Aspects and others
  - RPE08 – 01 Summary schedule of....

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- Code** : **PPE – 01.v04**
- Name** : **Elaboration and Control of Documentation**
- Objetives** : To establish the work methods to generate, to modify, to revise, to approve, to maintain, to control and to eliminate the essential documents settled down in the Energy Management Plan of the Industry, Business or Institution.
- Extent** : This Procedure embraces all the essential considered documents for the Energy Management Plan, such as Energy Manual, Procedures or Work Instructions, applicable to all the areas of the organization. However, it is not included in this reach it with respect to the Worksheets, because this settles down in the procedure **PPE - 02**. The documents of external origin are controlled and they distribute according to they establish it the Procedures **PPE-07, PPE-08, PPE-09, PPE-11** and **PPE-12**; using the Controlled Documents Matrix worksheet **RPE01-02**.
- References** : Ref. 1: **EMM** Energy Management Manual  
 Ref. 2: **PPE-02** Energy worksheet Control and maintenance  
 Ref. 3: **PPE-09** Energy procurement Management  
 Ref. 4: **PPE-10** Control and use of no-approval Energy  
 Ref. 5: **PPE-12** Verification, Validation, Certification and Communication  
 Ref. 6: **PPE-14** Control and Energy measurement  
 Ref. 7: **PPE-15** Administration Revision: Data Analysis and improvement
- Definitions** : EMP: Energy Management Plan  
 PPE: Procedure of Energy Management Plan  
 RPE: Record or worksheet of Energy Procedure  
 EMC: Energy Management Committee

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According to the norm ISO 50006 <sup>7</sup>, different methodologies that give origin to diverse Indicators of the yield exist (performance ) Energy ( EnPIs ). we have this way:

EnPIs types	Considered Variables	Unit	Tools to use	Application in	Results that are obtained
Energy consumption quantity, well-known as <b>Consumptions Index</b>	Energy Consumptions	m3, kWh, gal, GJ, kCal, BTU, ft3, etc.	Calculus schedule	Industry, Business, Institutions	<ul style="list-style-type: none"> <li>Quantity of consumed energy and variations.</li> </ul>
Energy Ratio consumed with regard to some variable, well-known as <b>Specific Index</b> .	Energy Consumptions, productivity.	m3/ton, kWh/box, gal/km, GJ/HH, kCal/kg, BTU/per, ft3/ht, liters/m2, etc.	Calculus schedule	Industry, Business, Institutions	<ul style="list-style-type: none"> <li>Quantity of energy consumed by variable and variations.</li> </ul>
Energy Ratio consumed with concerning to the expense, well-known as <b>Index of Intensity</b> .	Energy Consumptions, expenses	m3/\$, kWh/\$, gal/\$, GJ/\$, kCal/\$, BTU/\$, ft3/\$, etc.	Calculus schedule	Industry, Business, Institutions	<ul style="list-style-type: none"> <li>Quantity of energy consumed with regard to the expense (\$).</li> </ul>
Statistical model, without own name, that allows to quantify previous indexes	Energy Consumptions, productivity, expenses.	m3/ton, kWh/box, gal/km, GJ/HH, kCal/kg, BTU/per, ft3/ht, etc.	Statistical programm of regression, variance, deviation, etc.	Industry, Business, Institutions	<ul style="list-style-type: none"> <li>Quantity of energy consumed by variable and variations.</li> </ul>
Advanced algorithm of engineering, well-known as <b>Energy Efficiency Index</b> .	Energy Consumptions, productivity, expenses ( \$), environmental, construction, mechanical, human, geographical, thermodynamic, assets, localization, materials, chemical, electric, regulations.	%	Energy matrix management Software	Industry, Business, Institutions	<ul style="list-style-type: none"> <li>Energy Efficiency.</li> <li>Savings Potential.</li> <li>Invesment for improvement</li> <li>NAV, RIT, Depreciation.</li> <li>Abatement curves.</li> </ul>

To see 2.4, of Manual.

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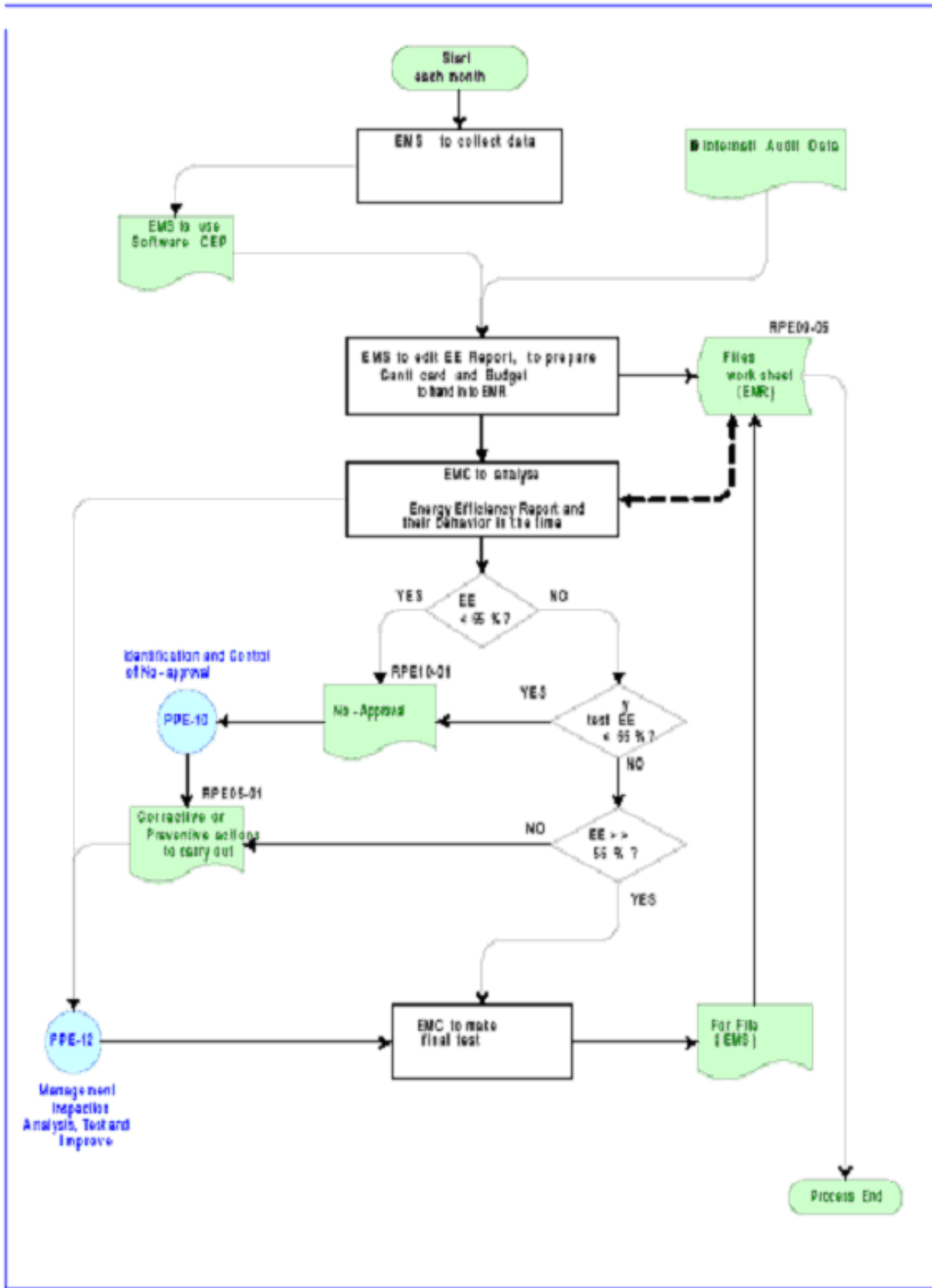
Diverse methodologies exist for monitoring and to report the performance energy, we have this way:

Mhethodology	Work Variables	Error possibility in the delivery of the final result of Energy Efficiency	Time of answer for the evaluation
	n°	%	días
Graph of present state and goal	2	20 a 40	90
Indicator of tendencies and important variables	3	15 a 20	90
Diagram X - Y	2	20 a 40	90
Graph of accumulative variances	2	10 a 20	75
Multidimensional graphic with benchmarking	Up to 50	1 a 2,5	7

To see ISO 50006<sup>7</sup>

The Industry, Business or Institution, it should select the indicator type and methodology that it represents their processes of business and that helps in more significant form to their manage of the Energy matrix

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## 9. As implementing a Energy management System based on ISO 50001 and other related standard

### 9.1 General characteristics of the standard ISO 50001 and their relationship with this Manual

The structure of practical application of standard indicates according to its index in the point 4:

Action	4.1	General Aspect	To see in N° of Manual	Chapter Manual
	4.2	Responsibilities of Manager	2.5	PPE 15
	4.2.1	The Administration		
	4.2.2	Representative of the Management	3.3	
	4.3	Energy Policy	2.2	
To Plan	4.4	Energy Planing	4.1	
	4.4.1	Generalities		
	4.4.2	Legal Aspect and others	2.3	PPE 08
	4.4.3	Energy Revision	4.4	
	4.4.4	Energy Baselines		
	4.4.5	Energy performance Index	2.4	PPE 11
	4.4.6	Objectives, energy goals and action Plans	4.2	PPE 15
To Do	4.5	Implementation and operation		
	4.5.1	Generalities		
	4.5.2	Human Resources Management	4.5	PPE 04
	4.5.3	Communication	3.5	PPE 12
	4.5.4	Documentation	4.3	PPE 01
	4.5.5	Operational control	4.6, 5.3	PPE 7, PPE 14
	4.5.6	Design	6.	PPE 12, PPE 15
	4.5.7	Energy purchase, products, teams and services	5.1	PPE 09
To Verify	4.6	Verification	6.5	PPE 12
	4.6.1	Monitoring, mensuration and analysis	6.4	PPE 14, PPE 11
	4.6.2	Evaluation of observance, legal aspects and others		PPE 08
	4.6.3	Internal Audit	6.1	PPE 03
	4.6.4	No – approval, correctives & preventives actions	6.2, 6.3	PPE 13, PPE 05, PPE 06
	4.6.5	Worksheets Control	4.3	PPE 02
To Act	4.7	Administration Revision	6.6	PPE 15
	4.7.1	Generalities		
	4.7.2	Input information for revision of Administration	6.6	PPE 15
	4.7.3	Result of Administration revisión	6.6	PPE 15

Table 9.1 Index of ISO 50001, chap 4.

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## 10 Bibliography and References

- 1 : Energy Management Manual, ISBN 978-956-8819-02-6
- 2 : GEI and Carbon footprint management Manual, ISBN 978-956-8819-03-3
- 3 : Standard ISO 50001, Energy Management Systems
- 4 : Standard ISO 50002, Energy Audits
- 5 : Standard ISO 50003, Requirements for bodies providing audit and certification of energy management systems
- 6 : Standard ISO 50004, Guide for the implementation, maintenance and improvement of an energy management
- 7 : Standard ISO 50006, Measuring energy performance using energy baselines and Energy performance indicator
- 8 : Standard ISO 50015, Measurement and verification of Organizational energy performance
- 9 : Standard ISO 17021, Conformity assessment
- 10 : Standard ISO 19011, Guide for auditing management systems
- 11 : We consider the hydric resource like an energy one abler of carrying out work. To see Water footprint Manual, ISBN 978-956-8819-04-0
- 12 : In many companies, industrial or other residuals are used to extract their heating potential (whose value is generally smaller to 3.000 kcal / kg), the industrial residuals or others have the advantage of the \$/ kg; whose value is very low or third pay for its elimination (previous authorization of the Sanitary and/or Environmental Authority).
- 13 : Standard ISO 17741, General technical rules for measurement, calculation and verification of energy savings of Project
- 14 : Standard ISO 17742, Energy Efficiency and savings calculation for Countries, Regions and Cities
- 15 : Standard ISO 17743, Definition of a methodological framework applicable to calculation and reporting on energy savings
- 16 : Standard EN 16612, Energy Efficiency and savings Calculation
- 17 : Used as half of conversion in diverse processes which require of energy.
- 18 : Standard PAS 55, Asset Management
- 19 : Standard EN 16646, Maintenance within physical assets management
- 20 : Standard ISO 55000, Asset Management, overview
- 21 : Standard ISO 18617, Sustainable Purchasing
- 22 : As preparing a Carbon footprint Report, DPI 210332
- 23 : Standard ISO 14040, Life cycle assessment – principles and structure
- 24 : Standard ISO 14044, Life cycle assessment – requirements and guidelines
- 25 : G4, Global Reporting Initiative, used to inform the Sustainability of the Industry, Business or Institution, very used by the High Administration of Industries, Business and Institutions.
- 26 : Clasp implementing energy efficiency label, System of standard and labeled, it guides for Appliances, equipments and illumination
- 27 : Example of Gantt form of development of projects of energy management.

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