



RENIECYT - LATINDEX - Research Gate - DULCINEA - CLASE - Sudoc - HISPANA - SHERPA UNIVERSIA - E-Revistas - Google Scholar DOI - REBID - Mendeley -
 DIALNET - ROAD - ORCID

Title: Power factor correction for the efficient use of electrical energy, a success case at
 Universidad Tecnológica Emiliano Zapata del Estado de Morelos

Authors: Oscar-SALINAS, María-DÍAZ, Jessica-PUIG, Alejandro-CABALLERO

Editorial label ECORFAN: 607-8324
 BCIE Control Number: 2016-01
 BCIE Classification (2016): 221116-0101

Pages: 22
 RNA: 03-2010-032610115700-14

ECORFAN-México, S.C.

244 – 2 Itzopan Street
 La Florida, Ecatepec Municipality
 Mexico State, 55120 Zipcode
 Phone: +52 1 55 6159 2296
 Skype: ecorfan-mexico.s.c.
 E-mail: contacto@ecorfan.org
 Facebook: ECORFAN-México S. C.
 Twitter: @EcorfanC

www.ecorfan.org

Holdings

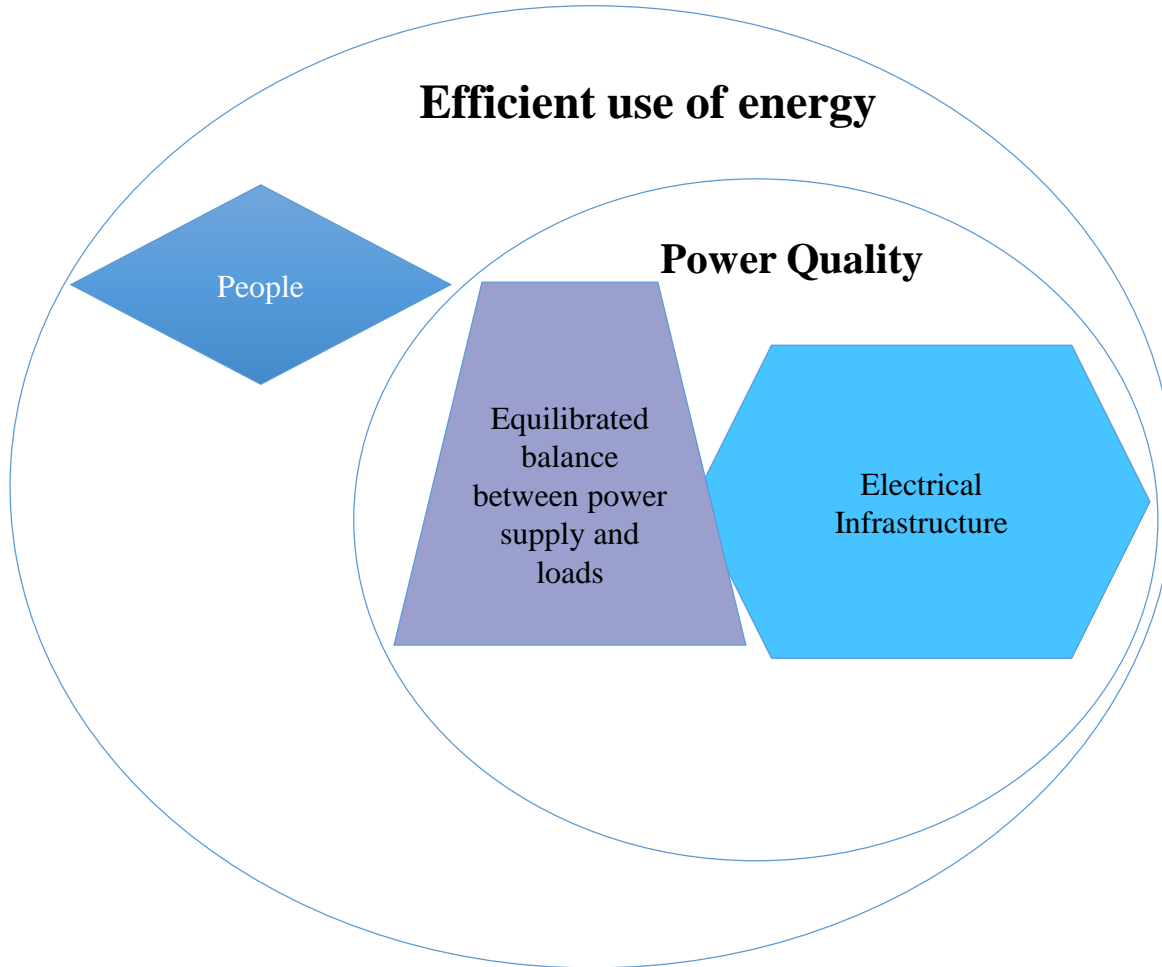
Bolivia	Honduras	China	Nicaragua
Cameroon	Guatemala	France	Republic of the Congo
El Salvador	Colombia	Ecuador	Dominica
Peru	Spain	Cuba	Haití
Argentina	Paraguay	Costa Rica	Venezuela
Czech Republic			



ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

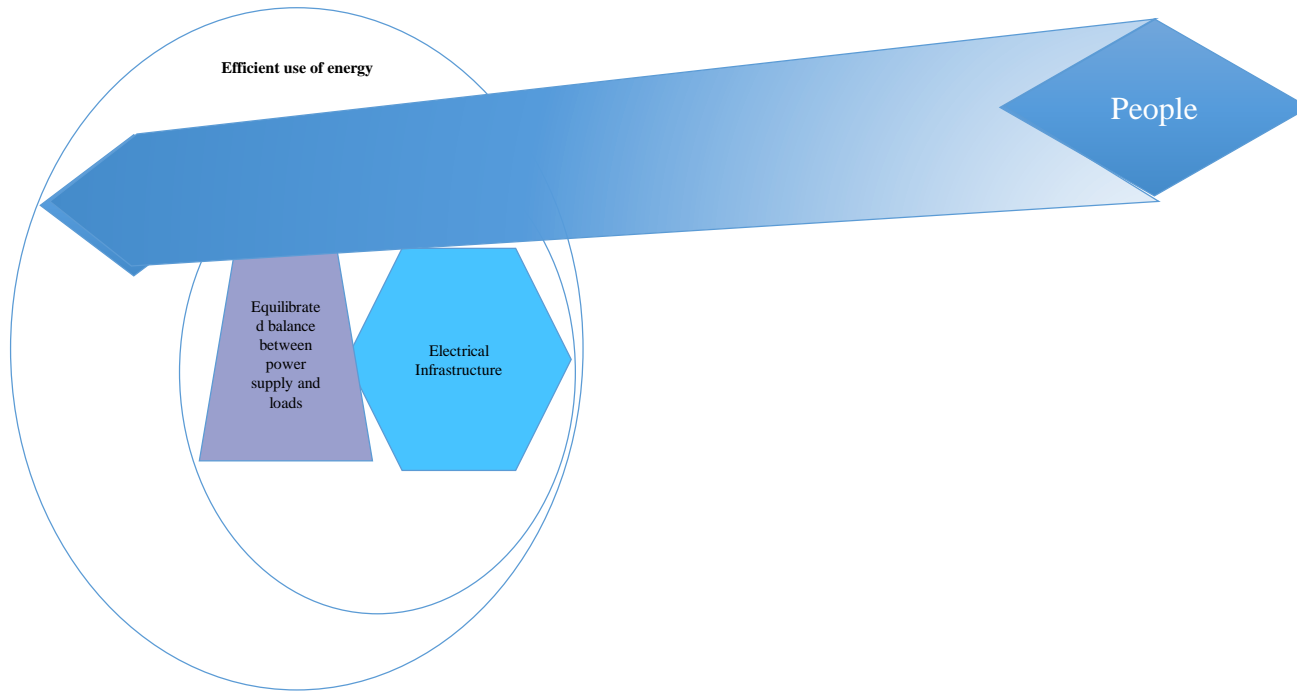
Introduction

Efficient Use of Energy



Introduction

Efficient Use of Energy



Change some habits:

- **Design strategies based on marketing techniques**
- **Information technologies.**

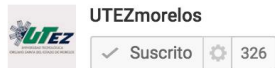


ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

Introduction



Ahorro en energía eléctrica en la UTEZ



152 visualizaciones



¿Sabías que?



53 visualizaciones



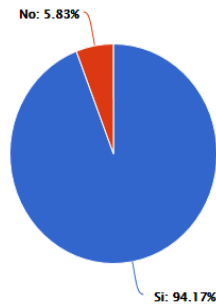


ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

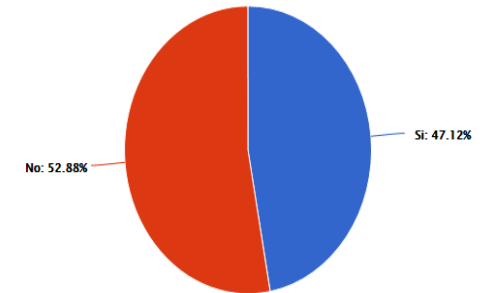
Introduction

Survey about culture of sustainability

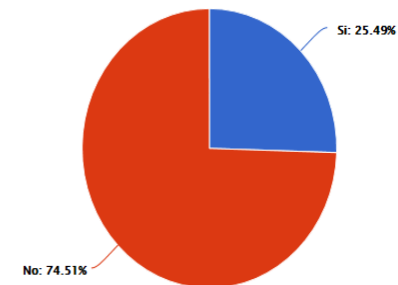
1 ¿Sabes qué es sustentabilidad?



2 Te han informado que hay un programa de sustentabilidad en tu campus



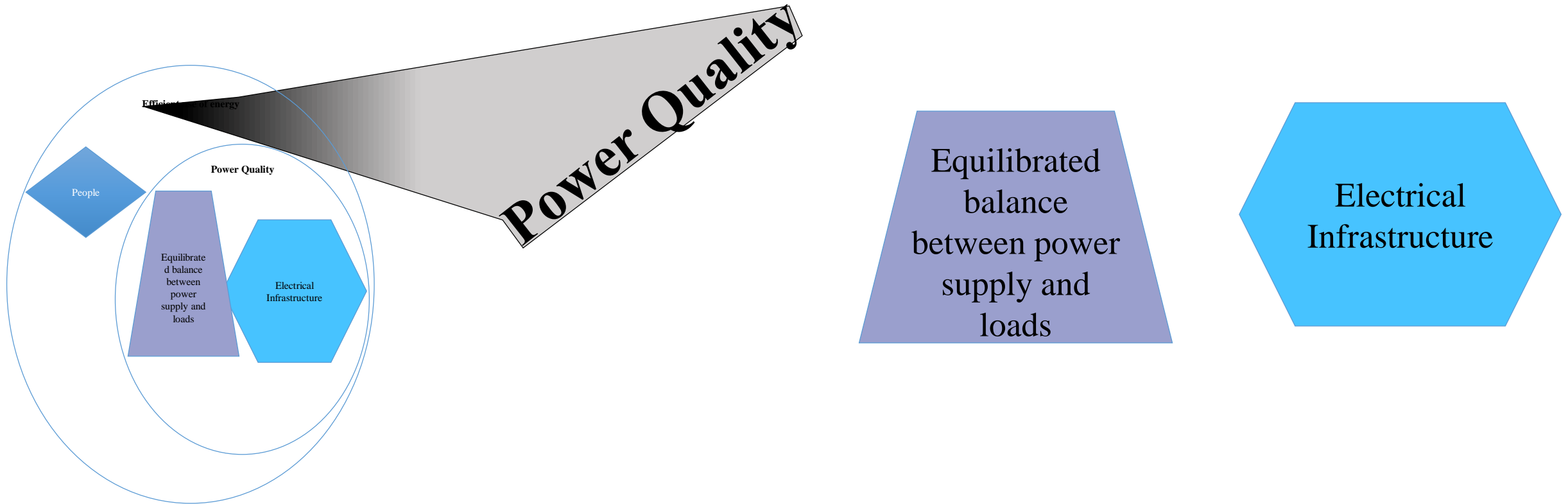
6 Conoces el Programa de ahorro de energía que tiene la UTEZ





ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

Introduction





ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

Methodology



Ruta	Periodo	No. Medidor			
82DG31G062000065	30 ABR 15 A 31 MAY 15	8EY178			
Función	No. Medidor	Lectura actual	Lectura anterior	Diferencia	Totales

kWh base					16,560
kWh intermedia					64,560
kWh punta					3,600
Mes	Días de mes	Consumo prom. diario	Energía kWh	Precios \$/kWh	Importe \$
kW base					101
kW intermedia					322
kW punta					197

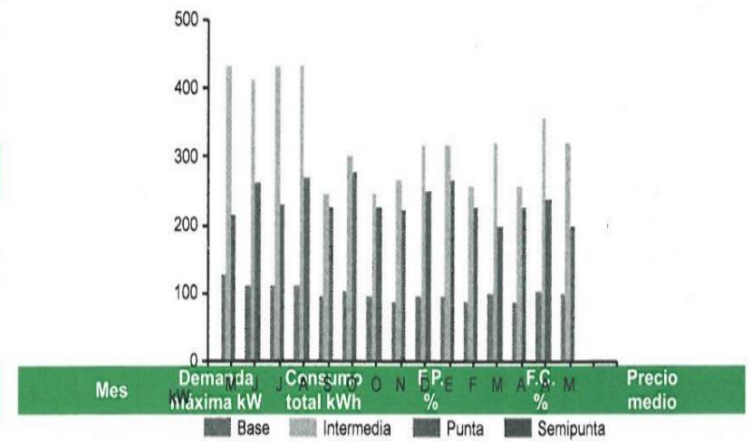
Mes	Factor de proporción	Demanda máxima kW	Precios \$/kWh	Importe \$	Factor de potencia
					9.120
Factor de potencia %					99.43

Energía en base kWh	16,560	0.71160
Energía en intermedia kWh	64,560	0.85530
Energía en punta kWh	3,600	1.81020
Demanda facturable kW	235	187.41000

Avisos importantes

- Corte a partir de 13 JUN 15.
- Nos transformamos para servirte mejor.
- Servicio a Clientes Teléfono 071.

Tarifa	Carga conectada kW	Demanda contratada kW	Multiplicador
HM	556	556 Datos históricos	240



Mes	Demanda máxima kW	Consumo total kWh	O.N.F.P. %	F.M.A.F.C. %	Precio medio
MAY 14	324	110,400	99.10	31	1.7520
JUN 14	281	96,000	99.17	32	1.7539
JUL 14	273	97,920	99.47	33	1.7440
AGO 14	280	105,120	99.38	33	1.7602
SEP 14	306	108,960	99.22	37	1.7645
OCT 14	292	86,400	99.26	33	1.7006
OCT 14	318	20,160	99.43	32	1.8509
NOV 14	285	81,360	99.66	37	1.8938
DIC 14	231	56,160	99.91	31	1.9669
ENE 15	235	66,720	99.77	34	1.8197
FEB 15	271	73,920	99.67	35	1.7819
MAR 15	280	85,200	99.62	36	1.6248
ABR 15	234	6,480	99.73	26	1.8441
ABR 15	274	70,800	99.34	32	1.4954
MAY 15	235	84,720	99.43	35	1.3543

Estado de cuenta



ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

Methodology



Power Factor
KWh
KVARh

Ruta	Periodo	No. Medidor			
82DG31G062000065	30 ABR 15 A 31 MAY 15	8EY178			
Función	No. Medidor	Lectura actual	Lectura anterior	Diferencia	Totales

kWh base	16,560				
kWh intermedia	64,560				
kWh punta	3,600				
Mes	Días de mes	Consumo prom. diario	Energía kWh	Precios \$/kWh	Importe \$
kW base	101				
kW intermedia	322				
kW punta	197				

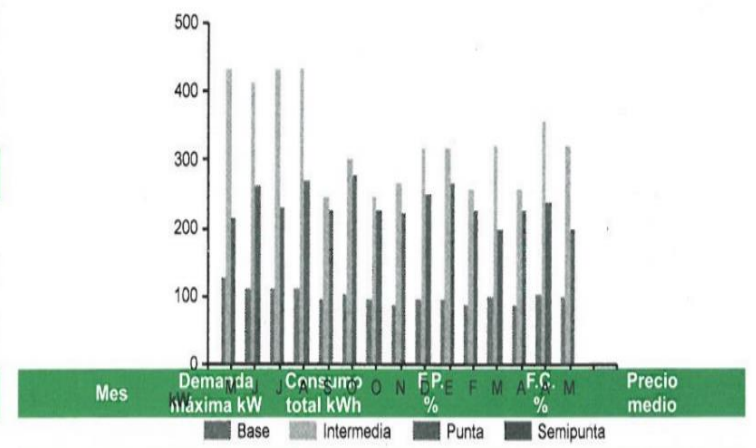
Mes	Factor de proporción	Demanda máxima kW	Precios \$/kWh	Importe \$	Factor de potencia
					9.120
Factor de potencia %	99.43				

Energía en base kWh	16,560	0.71160
Energía en intermedia kWh	64,560	0.85530
Energía en punta kWh	3,600	1.81020
Demanda facturable kW	235	187.41000

Avisos Importantes

- Corte a partir de 13 JUN 15.
- Nos transformamos para servirte mejor.
- Servicio a Clientes Teléfono 071.

Tarifa	Carga conectada kW	Demanda contratada kW	Multiplicador
HM	556	Datos históricos	240



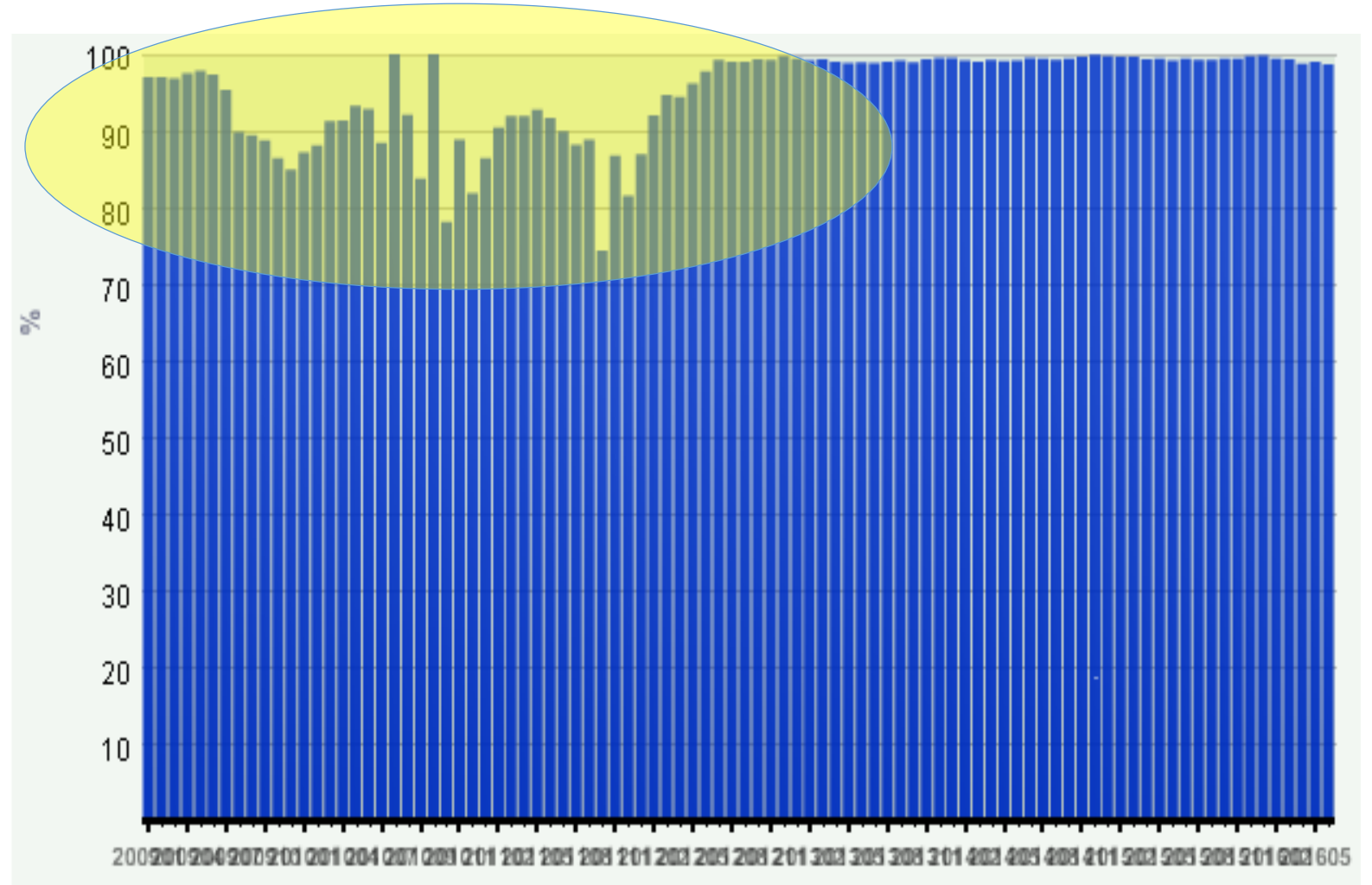
Mes	Demanda máxima kW	Consumo total kWh	O.N.F.P. %	F.M.A.F.C. %	Precio medio
MAY 14	324	110,400	99.10	31	1.7520
JUN 14	281	96,000	99.17	32	1.7539
JUL 14	273	97,920	99.47	33	1.7440
AGO 14	280	105,120	99.38	33	1.7602
SEP 14	306	108,960	99.22	37	1.7645
OCT 14	292	86,400	99.26	33	1.7006
OCT 14	318	20,160	99.43	32	1.8509
NOV 14	285	81,360	99.66	37	1.8938
DIC 14	231	56,160	99.91	31	1.9669
ENE 15	235	66,720	99.77	34	1.8197
FEB 15	271	73,920	99.67	35	1.7819
MAR 15	280	85,200	99.62	36	1.6248
ABR 15	234	6,480	99.73	26	1.8441
ABR 15	274	70,800	99.34	32	1.4954
MAY 15	235	84,720	99.43	35	1.3543

Estado de cuenta



ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

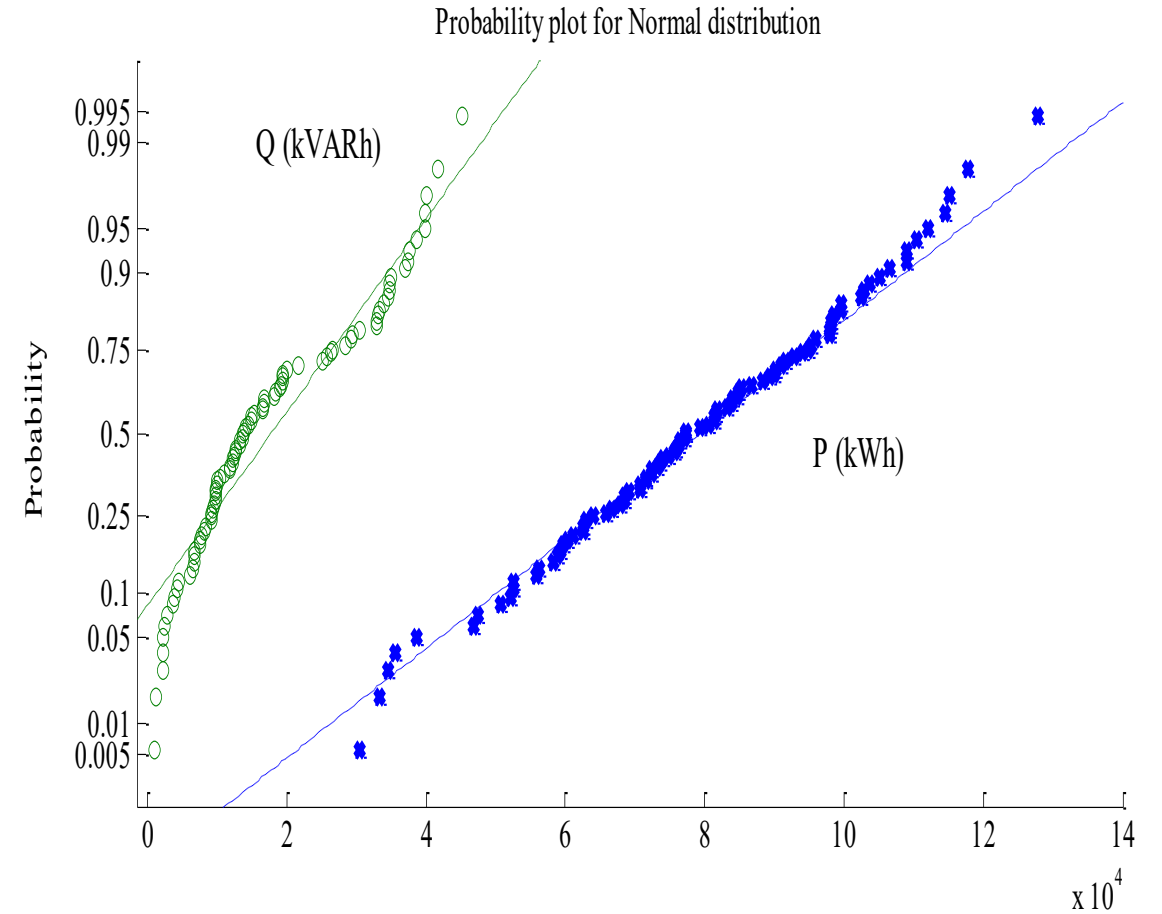
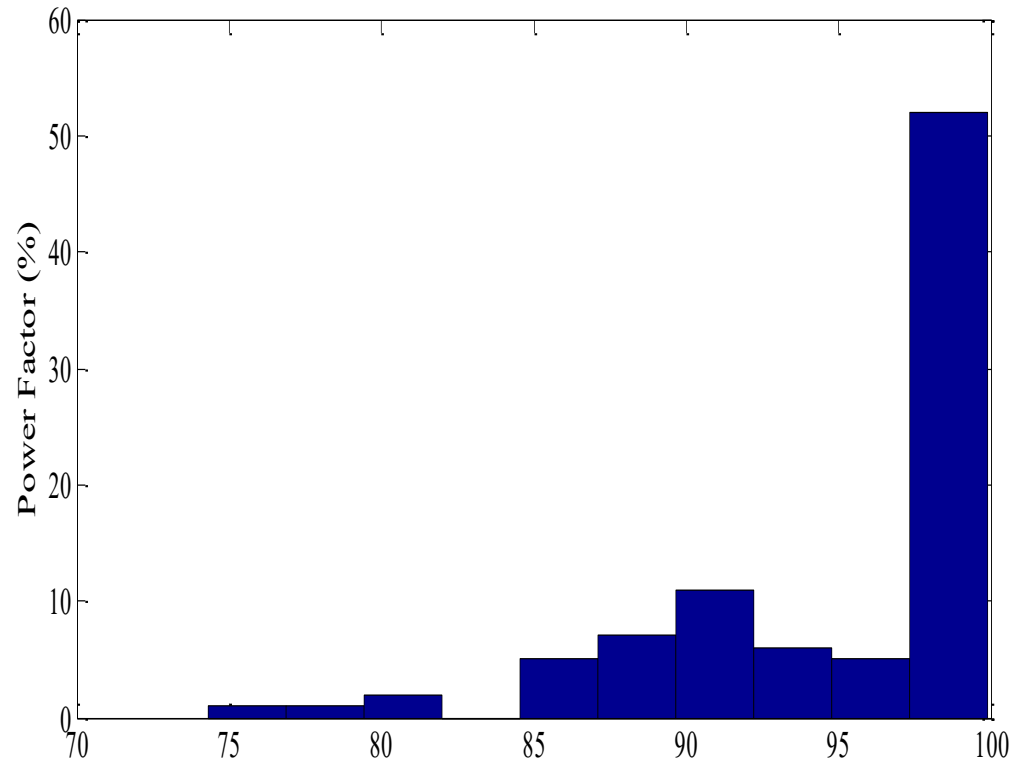
Methodology





ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

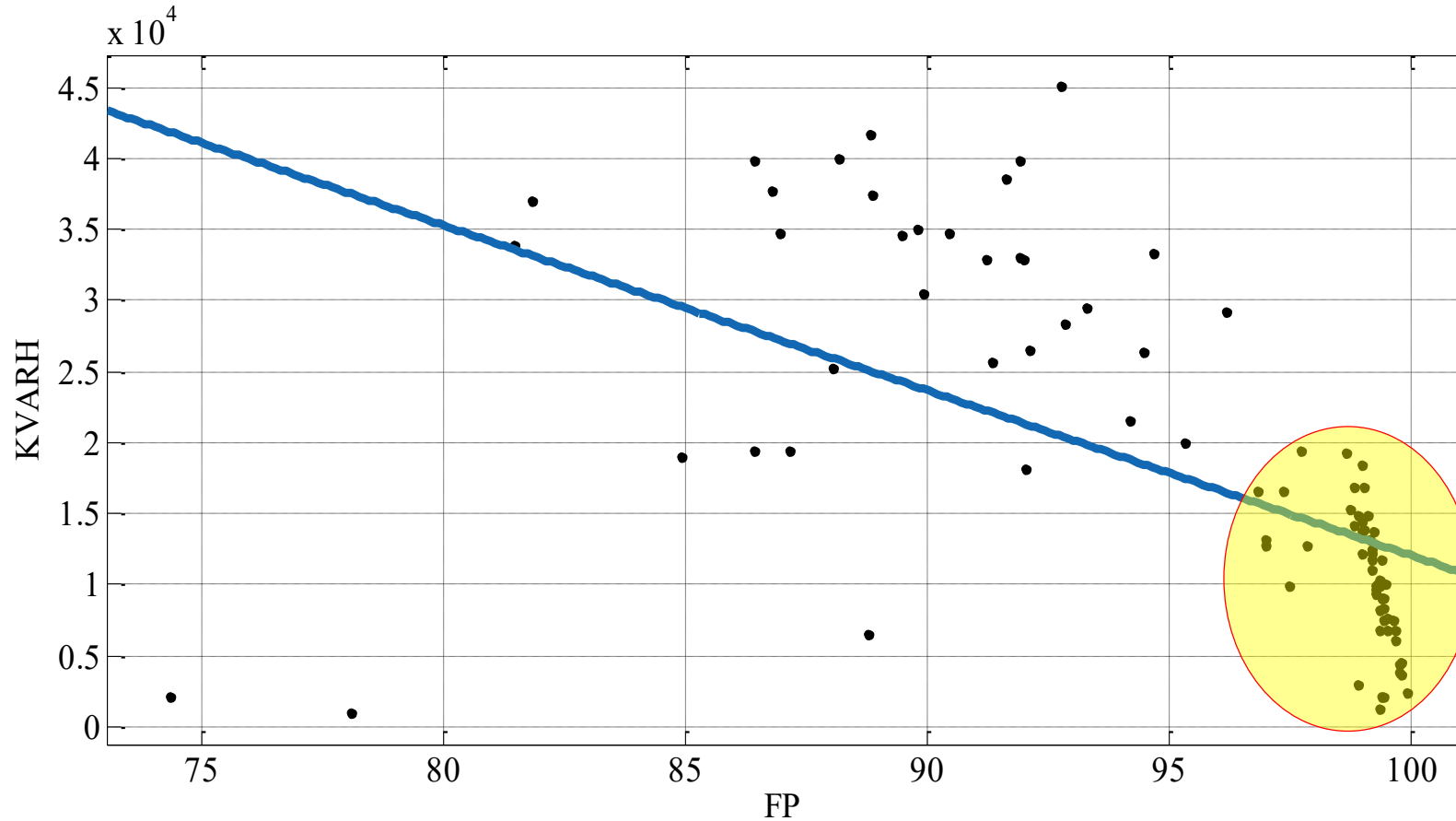
Methodology





ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

Methodology

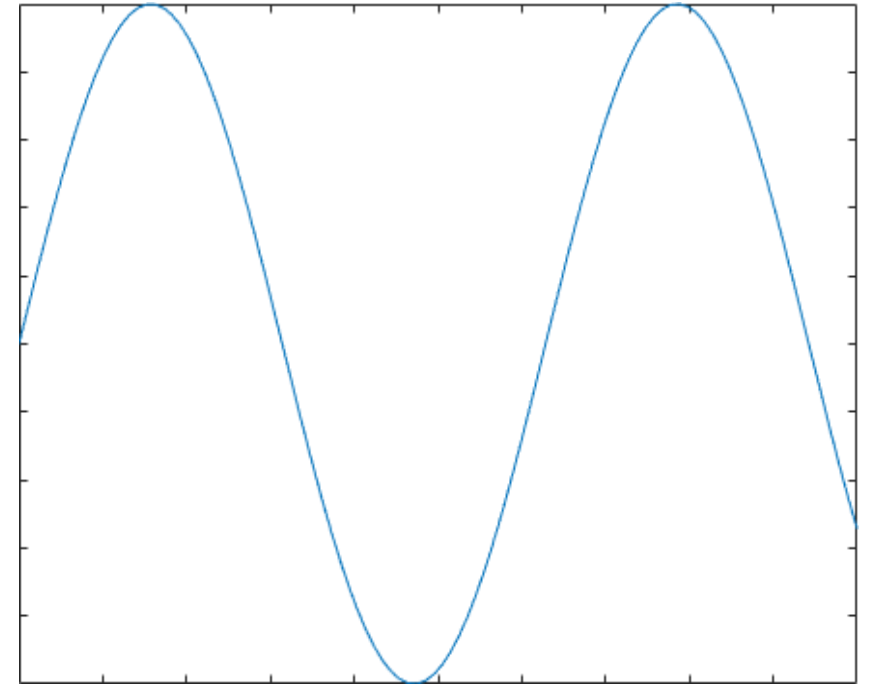
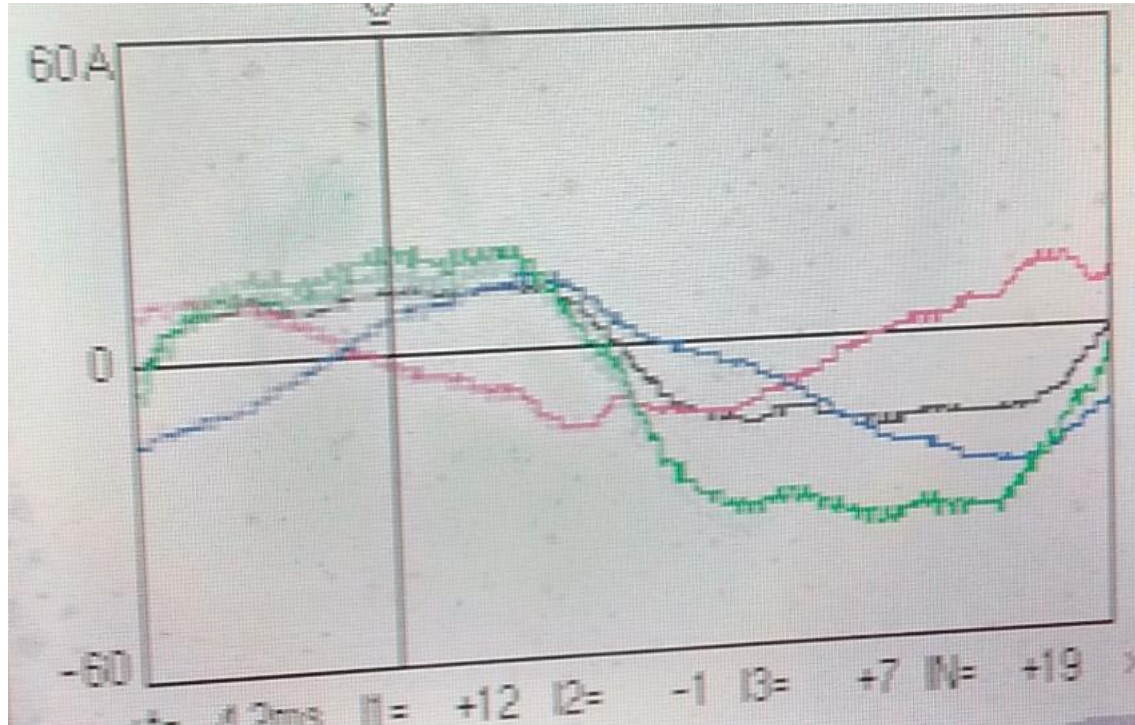


r-squared value
0.3029.



ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

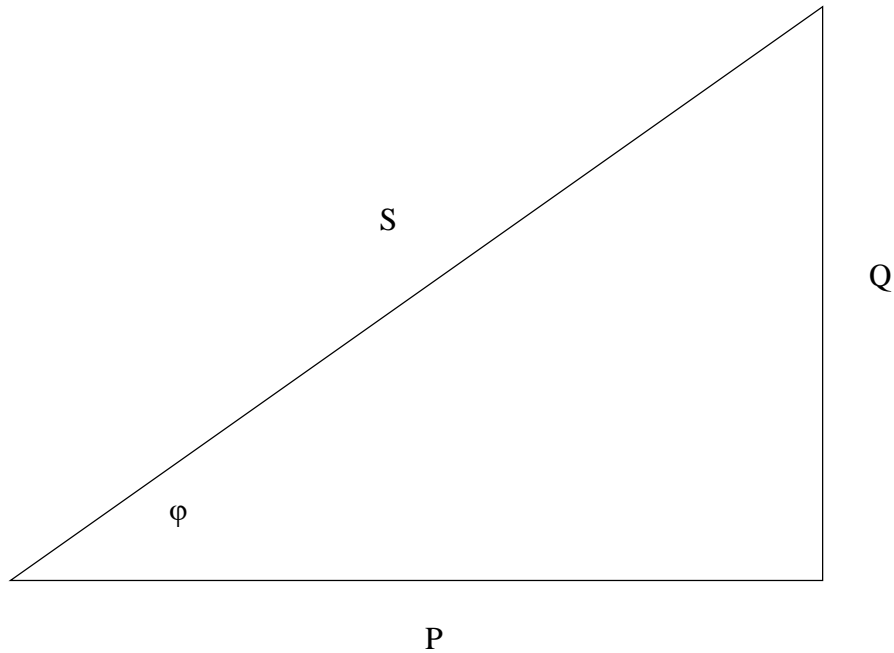
Methodology





ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

Methodology



Power

Active, P

Reactive, Q

Apparent, S

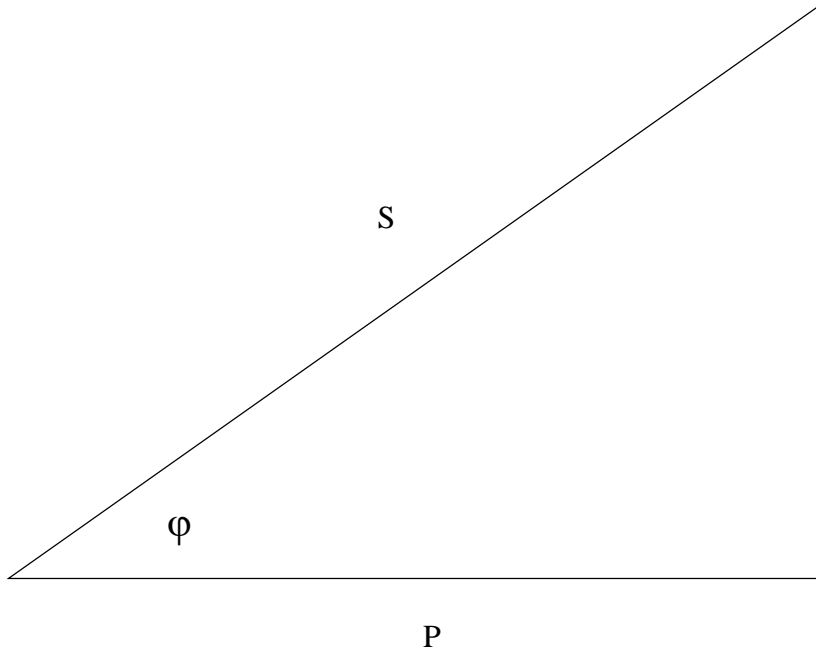
Distortion



ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

Methodology

$$p(t) = P \cos[1 - \cos(2\omega t)] + Q \sin(2\omega t)$$



$$P = VI \cos(\varphi)$$

$$Q = VI \sin(\varphi)$$

The one used to be transformed into different types of energy.

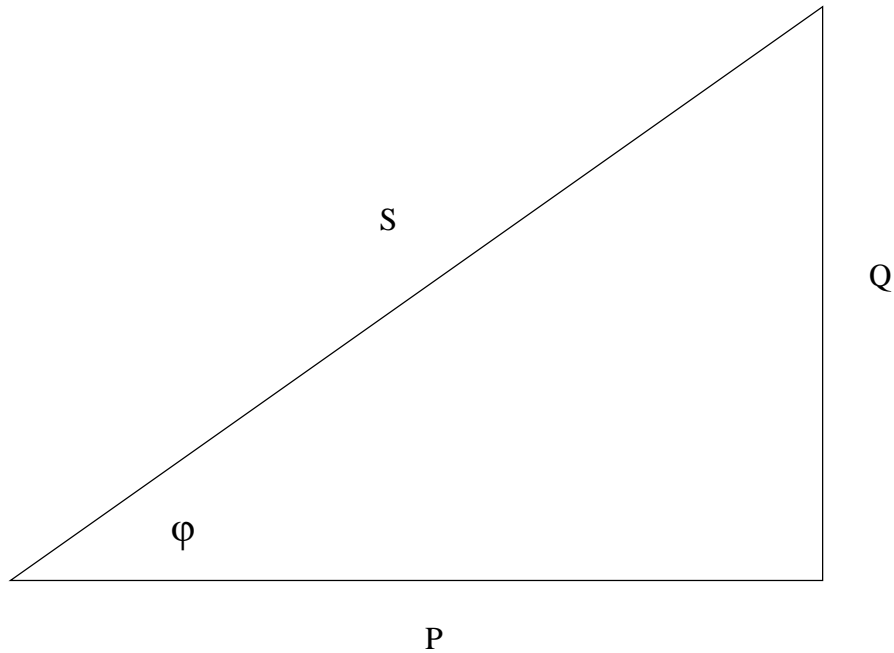
Effect of inductive and, or capacitive behavior.



ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

Methodology

PF is defined as the coefficient of active power suminstred to the load (P), and the apparent power (S).



$$PF = \frac{P}{S} = \frac{V_0 I_0 + \sum_1^n V_n I_n \cos \varphi_n}{\sqrt{\sum_1^n V_n^2} \sqrt{\sum_1^n I_n^2}}$$

$$PF = \frac{P}{S} = \cos (\varphi)$$



Methodology

Corrective actions:

- **Maintenance of ground systems.**
- **Substations corrective maintenance (humidity, corrosion, wiring, and so on)**

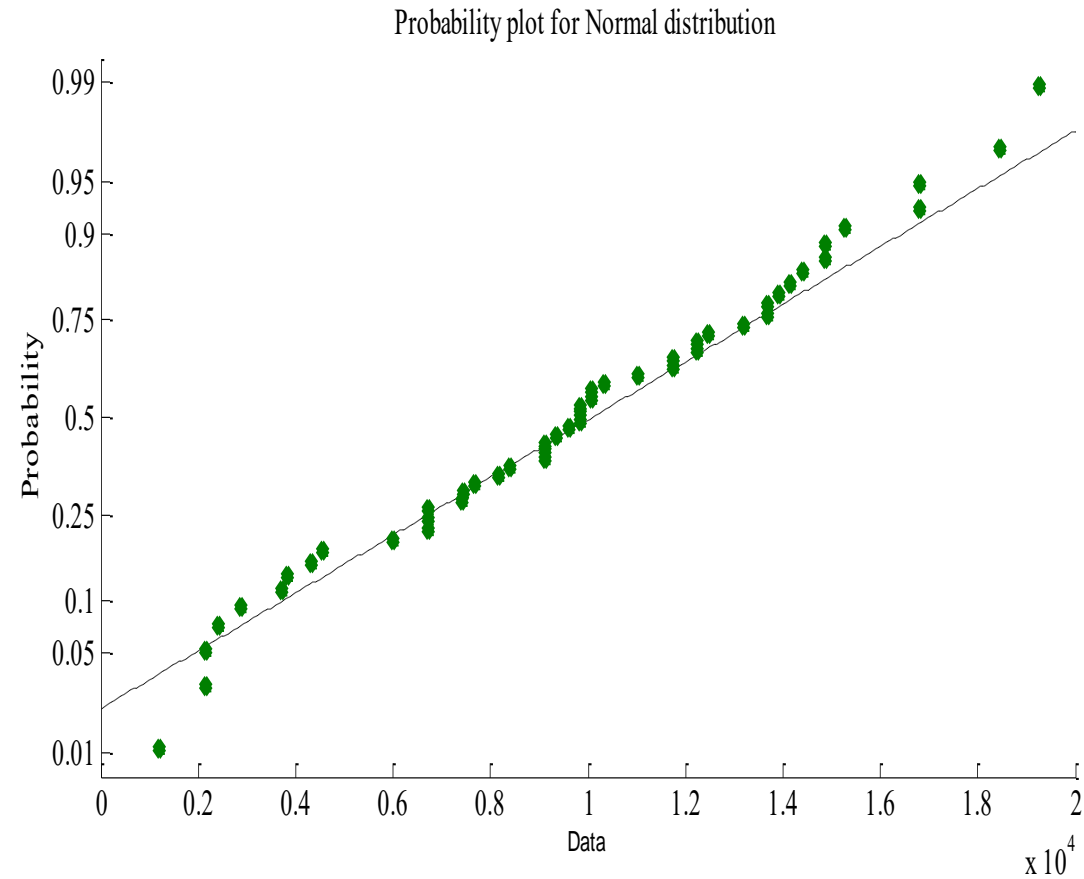
Methodology





ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

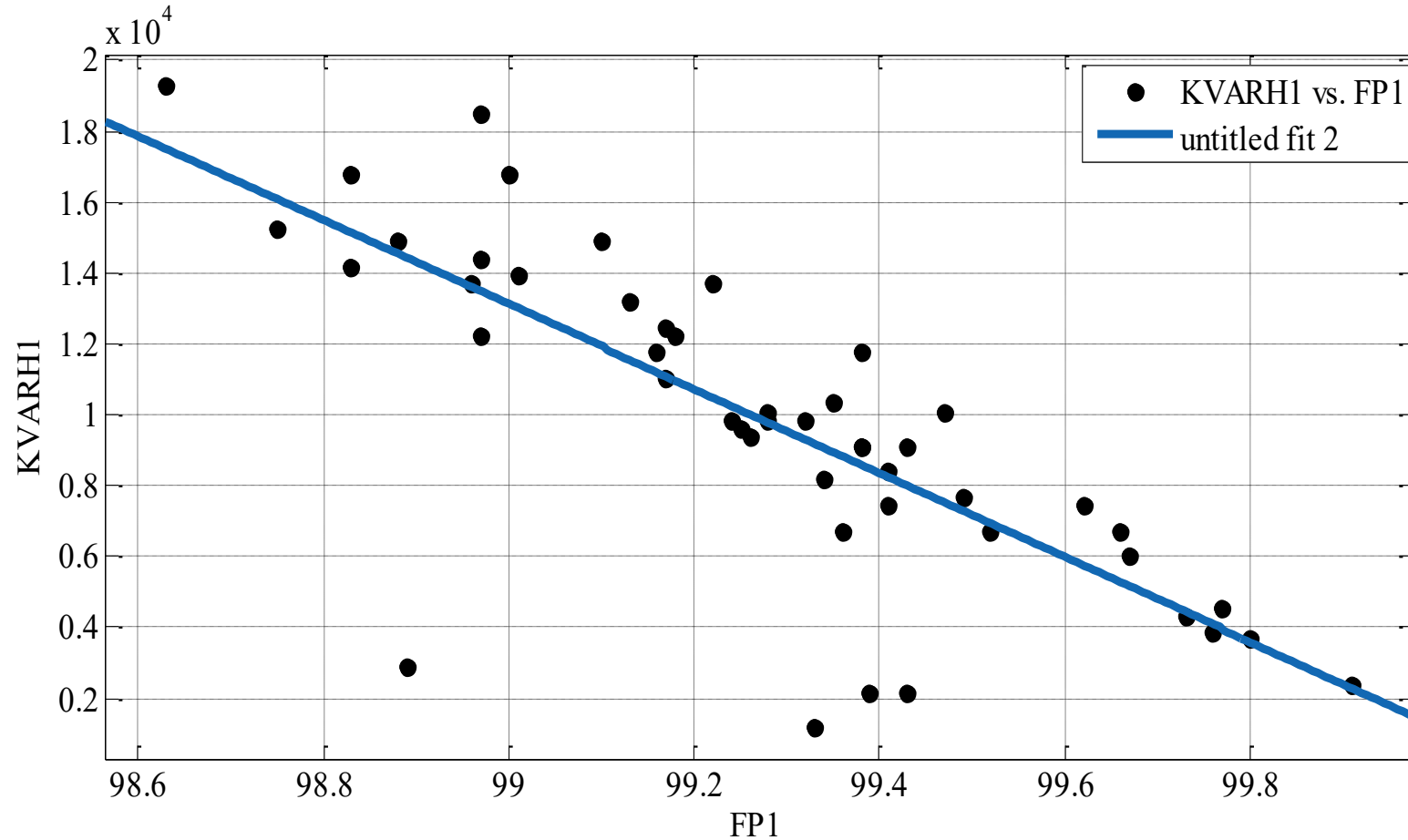
Results





ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

Results

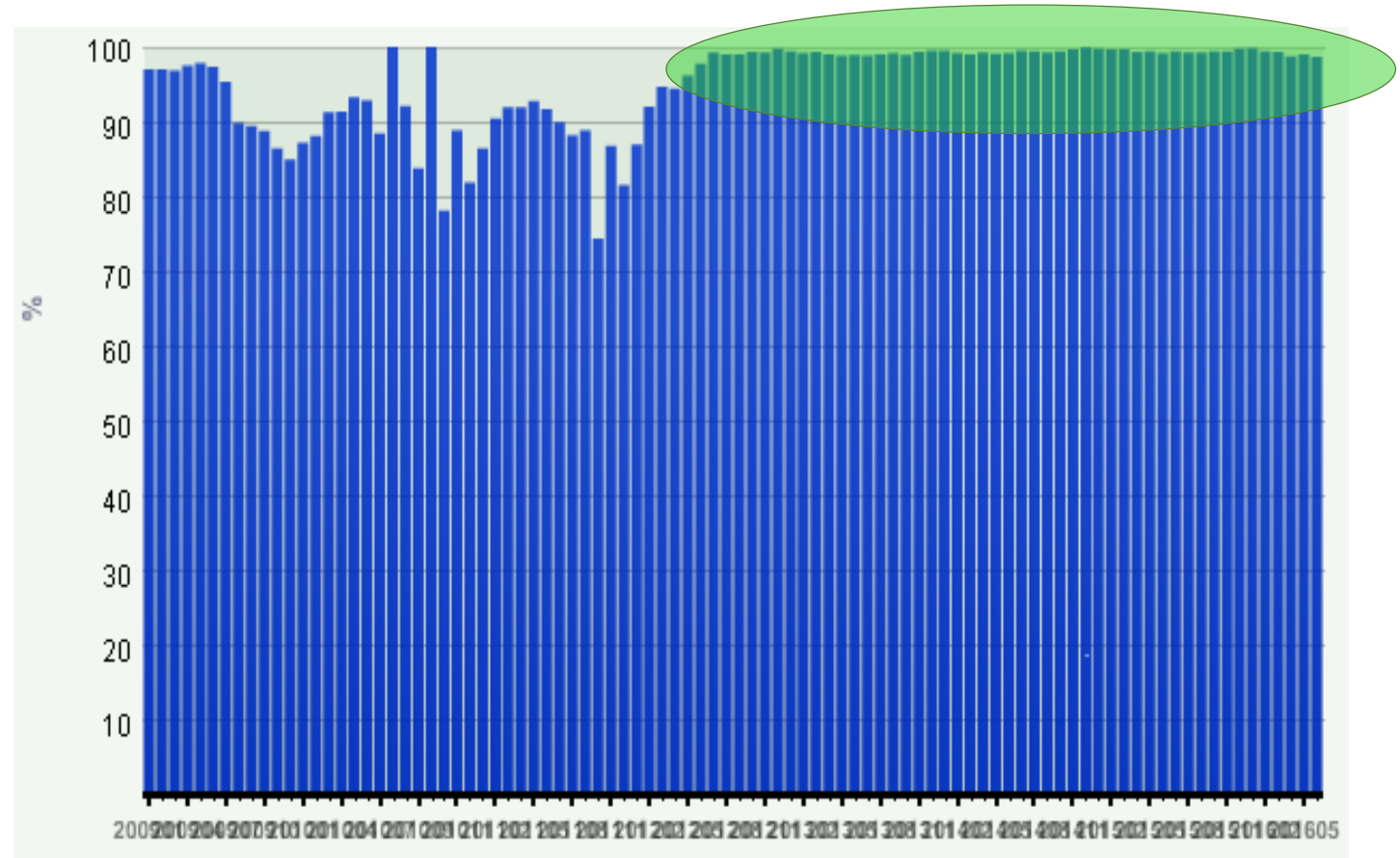
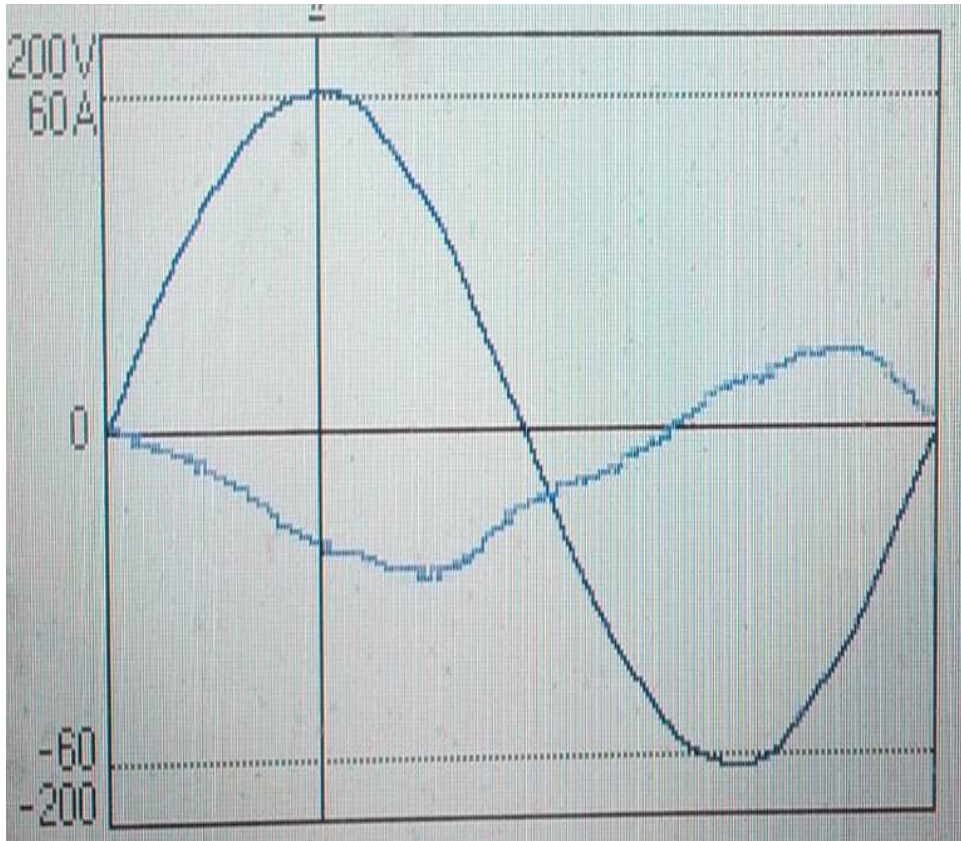


r-squared value
0.3029.



ECORFAN® 7th International Congress Scientific, Technological and Innovative Crowdsourcing

Results





Conclusions

Pay attention to the electrical parameters that are available on receipt of payment sent by the Federal Electricity Commission (CFE), it is an important starting point for an analysis to understand primary concepts of power quality, both in the process of delivery by CFE and consumption on campus.

Keep the power factor below 0.95, guaranteed to have a economical bonus by the federal electricity company (CFE), but does not guarantee a low level of reactive power, which in principle represent power quality.

Sometimes simple actions affect significant progress in achieving the objectives: schedule preventive maintenance of electrical installations, review of control systems for switching on and off of lamps, program requisitions improvement or repair of control systems on and off of the lights or air conditioners.

Acknowledgements

Management personnel administration and finance for the support with financial support requisitions for maintenance.

Department staff infrastructure, support for scheduling and tracking preventive and corrective maintenance.

References

Burgan, M. (2009). *Nikola Tesla, physicist, inventor, electrical engineering* (First ed.). (C. P. Books, Ed.) Minneapolis, Minnesota, USA: Signature Lives.

Cáceres, R. (March de 2008). Factor de utilización de la potencia. *IEEE Latin America Transactions*, 6(1), 66-73.

CONUEE. (12 de Mayo de 2012). *Comisión Nacional para el Uso Eficiente de la Energía*. Recuperado el 10 de Enero de 2014, de Secretaría de Energía.

Del Pilar, M., Salinas, O., Velázquez, E., & Adan, E. (Diciembre de 2015). Diseño y elaboración de material didáctico multimedia como apoyo el aprendizaje de habilidades matemáticas por y para estudiantes de ingeniería en T.I. *Revista de Docencia e Investigación Educativa*, 119-126.

Electricidad, C. F. (12 de January de 2010). *CFEctiva Empresarial*. Recuperado el 05 de February de 2014, de CFEctiva Empresarial : http://cfectiva.cfe.gob.mx/cfectiva/bibliotecas/datos_grales.php

Fink, D., & Beaty, W. (2013). *Standard Handbook for Electrical Engineers*. New York: Mc Graw-Hill.

Hernández, R., Fernández, C., & Baptista, P. (2006). *Metodología de la investigación*. México: Mc Graw Hill.

Magnago, F., Reineri, C., & Santiago, L. (2011). Power Quality Measurement Under Non-Sinusoidal Condition. En Z. Ahmed, M. Canteli, & B. Ramesh, *Power Quality Monitoring, Analysis and Enhancement* (págs. 37-60). Croatia: Intech.

Masoso, Q., & L.J, G. (February de 2010). A monitoring study of 5 office buildings by Masoso et al. revealed that more energy was being used out-of-hours (56%) than during working hours (44%), largely due to occupants leaving lighting and equipment on at the end of the day . *Energy and buildings*, 42(2), 173-177.

Menezes, A., Cripps, A., Buswell, R., & J. Wright, D. B. (2014). Estimating the energy consumption and power demand of small power equipment in office buildings. *Energy and Buildings*, 75, 199-209.

Situations, I. W. (Enero de 1996). Practical definitions for Power in Nonsinusoidal Waveforms an Unbalanced loads: a discussion . *IEEE Transactions on Power Delivery* , 11(1), 79-101.

Smithsonian. (30 de January de 2015). Smithsonian.com. Recuperado el 30 de January de 2015, de [www.smithsonianmag.com](http://www.smithsonianmag.com/history/edison-vs-westinghouse-a-shocking-rivalry-102146036/?no-ist): <http://www.smithsonianmag.com/history/edison-vs-westinghouse-a-shocking-rivalry-102146036/?no-ist>

Standards, I. (01 de January de 1995). *IEEE Standards Association*. Recuperado el 12 de January de 2014, de IEEE Standards Association: <https://standards.ieee.org/findstds/standard/739-1995.html>

UTEZ. (09 de Junio de 2015). *Universidad Tecnológica Emiliano Zapata del Estado de Morelos*. Recuperado el 10 de Junio de 2015, de Canal de youtube de la UTEZ.

UTEZ. (20 de August de 2015). *Universidad Tecnológica Emiliano Zapata del Estado de Morelos*. Recuperado el 21 de August de 2015, de UTEZ_USEE: <http://www.utez.edu.mx/USEE/>

UTEZ, D. (09 de Junio de 2015). *Universidad Tecnológica Emiliano Zapata del Estado de Morelos*. Recuperado el 10 de Junio de 2015, de Canal de youtube de la UTEZ: <https://www.youtube.com/watch?v=qO5r0at2v8o>



ECORFAN®

© ECORFAN-Mexico, S.C.

No part of this document covered by the Federal Copyright Law may be reproduced, transmitted or used in any form or medium, whether graphic, electronic or mechanical, including but not limited to the following: Citations in articles and comments Bibliographical, compilation of radio or electronic journalistic data. For the effects of articles 13, 162,163 fraction I, 164 fraction I, 168, 169,209 fraction III and other relative of the Federal Law of Copyright. Violations: Be forced to prosecute under Mexican copyright law. The use of general descriptive names, registered names, trademarks, in this publication do not imply, uniformly in the absence of a specific statement, that such names are exempt from the relevant protector in laws and regulations of Mexico and therefore free for General use of the international scientific community. BCIE is part of the media of ECORFAN-Mexico, S.C., E: 94-443.F: 008- (www.ecorfan.org/ booklets)