



Renewable Energy Research Activities in Mexico

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Out line

- Scientometrics
- Analysis of renewable energy topics
- Analysis of energy category in WoS
- Comments



Method of analysis

- Scientometrics
- Citation Mining
- Bibliometrics and Text Mining
- Analyzing abstracts
- Use of entropy to find **relevant words**
- To find topics and expertise areas



Background



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Technological Forecasting & Social Change 72 (2005) 798–814

**Technological
Forecasting and
Social Change**

The structure and infrastructure of Mexico's science and technology[☆]

Ronald N. Kostoff^{a,*}, J. Antonio del Río^b, Héctor D. Cortés^b, Charles Smith^c,
Andrew Smith^d, Caroline Wagner^e, Loet Leydesdorff^e, George Karypis^f,
Guido Malpohl^g, Rene Tshiteya^h

We found in Web of Science Database that one of the strengths of Mexican Science and Technology is the area of Thin Films



Thin Films

Table 1
Most prolific Mexican thin film authors

Author name	Institution	# Papers
Zelaya-Angel O	IPN	79
Nair PK	UNAM	78
Falcony C	CINVESTAV	71
Sebastian PJ	UNAM	70
Gonzalez-Hernandez J	CINVESTAV, IPN	66
Nair MTS	UNAM	55
Ramirez-Bon R	UNIV SONORA	47
Pena JL	CTR INVEST CIENTIFICA	43
Ortiz A	UNAM	42
Castro-Rodriguez R	CINVESTAV, IPN	40
Jergel M	CINVESTAV, IPN	37
Contreras-Puente G	CINVESTAV, IPN	37
Asomoza R	CINVESTAV, IPN	36
Jimenez-Sandoval S	CINVESTAV, IPN	35
Espinoza-Beltran FJ	CINVESTAV, IPN	35
Andrade E	UNAM	34
Alonso JC	UNAM	32
Haro-Poniatowski E	UAM-I	31

Prolific Authors and their Institutions and we know that they are related with solar cells



Journals

Table 2
Most prolific journals—Mexican thin film research

Journal	# Papers
Thin Solid Films	147
Revista Mexicana de Fisica	80
Journal of Applied Physics	66
Solar Energy Materials and Solar Cells	62
Physical Review B	48
Applied Surface Science	46
Applied Physics Letters	36
Semiconductor Science and Technology	35
Journal of Vacuum Science and Technology A-Vacuum Surfaces and Films	34
Modern Physics Letters B	34
Solid State Communications	33
Journal of the Electrochemical Society	32
Materials Letters	27
Journal of Physics and Chemistry of Solids	25
Journal of Physics D-Applied Physics	23

Related with thin films : Solar Energy



Look for RE research activities in S&T

- We use WoS database
- First we use the intuitive approach
- Looking for authors, institutions and
- **Themes or relevant topics**

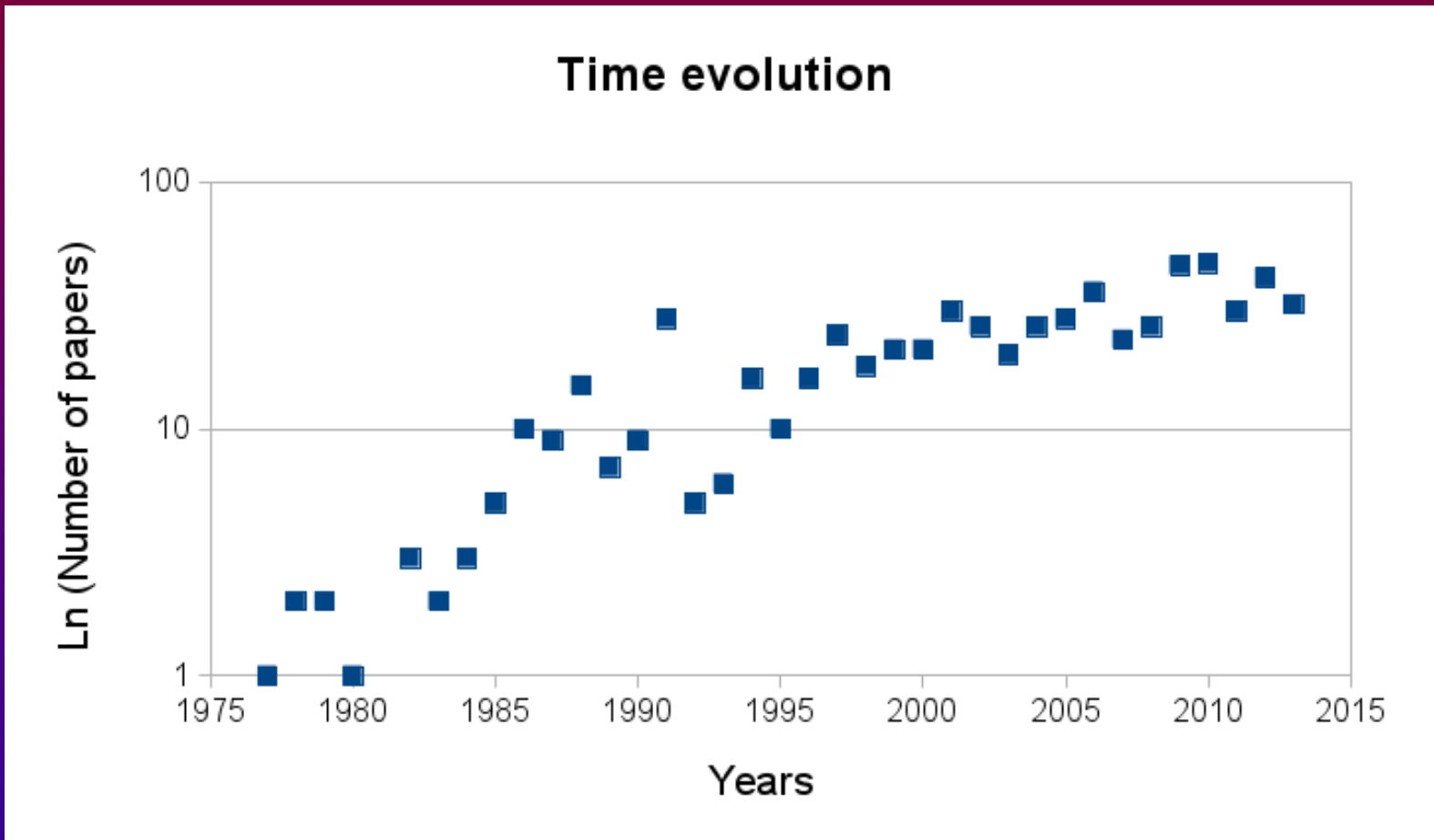


RE activities

- CU=**MEXICO** AND TS=("SOLAR ENERGY" OR "WIND ENERGY" OR GEOTHERM* OR "EOLIC ENERGY" OR "MARINE ENERGY" OR "OCEANIC ENERGY")
- Timespan=All years. Databases=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH.
- **Results: 645**



Time evolution



It seems we reach the saturation production in RE themes.

We need to invest in this area



Document type

Document type	Number
ARTICLE	435
PROCEEDINGS PAPER	106
ARTICLE; PROCEEDINGS PAPER	51
MEETING ABSTRACT	21
EDITORIAL MATERIAL	19
REVIEW	9
CORRECTION	1
LETTER	1
NOTE	1
SOFTWARE REVIEW	1

Table: Type of document according to Web of Science database



Prolific authors

Authors	Papers
SANTOYO, E	36
VERMA, MP	25
VERMA, SP	25
PROLLEDESMA, RM	20
BIRKLE, P	18
GARCIA, A	18
ARELLANO, VM	17
BARRAGAN, RM	17
JARAMILLO, OA	15
NIEVA, D	15
GONZALEZPARTIDA, E	14
PORTUGAL, E	14
TORRESALVARADO, IS	14
GARCIAGUTIERREZ, A	13
MATHEW, X	13

- Authors with more than 13 papers in this set
- These authors are different from thin films, although we know that Mexico has a strength in this topic related with Solar Energy



Country

- Total is 645
- Less than 10% of the papers are doing in collaboration with USA.
- No presence of Latina America

Country	Papers
MEXICO	542
USA	53
SPAIN	28
FRANCE	19
ITALY	16
GERMANY	15
ENGLAND	6
RUSSIA	6
AUSTRALIA	5
CANADA	5
SWEDEN	5



Country collaboration and Language

Country group	Papers
MEXICO	400
MEXICO:USA	36
MEXICO:SPAIN	17
FRANCE:MEXICO	12
GERMANY:MEXICO	9
ITALY:MEXICO	9
CANADA:MEXICO	3
EL SALVADOR	3
BRAZIL:MEXICO:RUSSIA	2
CANADA:MEXICO:USA	2
ENGLAND:MEXICO	2
ENGLAND:MEXICO:SCOTLAND	2
GERMANY:MEXICO:USA	2
INDIA:MEXICO	2
MEXICO:RUSSIA	2
MEXICO:SPAIN:VENEZUELA	2
MEXICO:UKRAINE	2

- Mexican RE research community is independent

Language	Papers
ENGLISH	612
SPANISH	32
RUSSIAN	1

- Language indicates that most of the paper are in international journals



Institutions and collaborations

Institution collaborations	Papers
UNAM	83
IIE	49
COMIS FED ELECT	17
CINVESTAV	14
CICESE	10
UNIV AUTONOMA BAJA CALIFORNIA	10
COMIS FED ELECT:IIE	8
UAEM:UNAM	6
IPN	5
UAEM	5
GEOTERMIA	4
UNIV AUTONOMA METROPOLITANA IZTAPALAPA	4

- Leading organization in these topics are clearly related with the topic of RE



Journals

Journal	Number of papers
GEO THERMICS	45
HEAT RECOV SYST CHP	32
J VOLCANOL GEOTH RES	32
GEO TH RES T	29
SOL ENERG MAT SOL C	18
APPL THERM ENG	16
ING HIDRAUL MEX	16
ABSTR PAP AM CHEM S	14
ENERG CONVERS MANAGE	13
RENEW ENERG	13
REV MEX CIENC GEOL	12
SOL ENERGY	12
INT GEOL REV	10

Journals with more than 10 papers



Relevant phrases

One word	Two Words
CALDERA	CARBONIC SPECIES
ANN	THERMAL CONDUCTIVITY
CDS	POWER CONVERSION
CDTE	ABSORPTION HEAT
GRAVITY	PHOTO FENTON
RESISTIVITY	LAGUNA SALADA
PRIMAVERA	FRESH WATER
WIND	PRIMAVERA CALDERA
FENTON	SOLUTE GEOTHERMOMETERS
CHIPILAPA	GAS VOID
CPGF	CARBON STEELS
MANTLE	HYDROGEN PEROXIDE
CARBONIC	TRANS MEXICAN
REFRIGERATION	CONCENTRATED SOLAR

Also important **Los azufres, Cerro Prieto**



First results

- There is a bias to geothermal
- Clearly there are research on the RE area where keywords are not in abstracts
- We need another approach

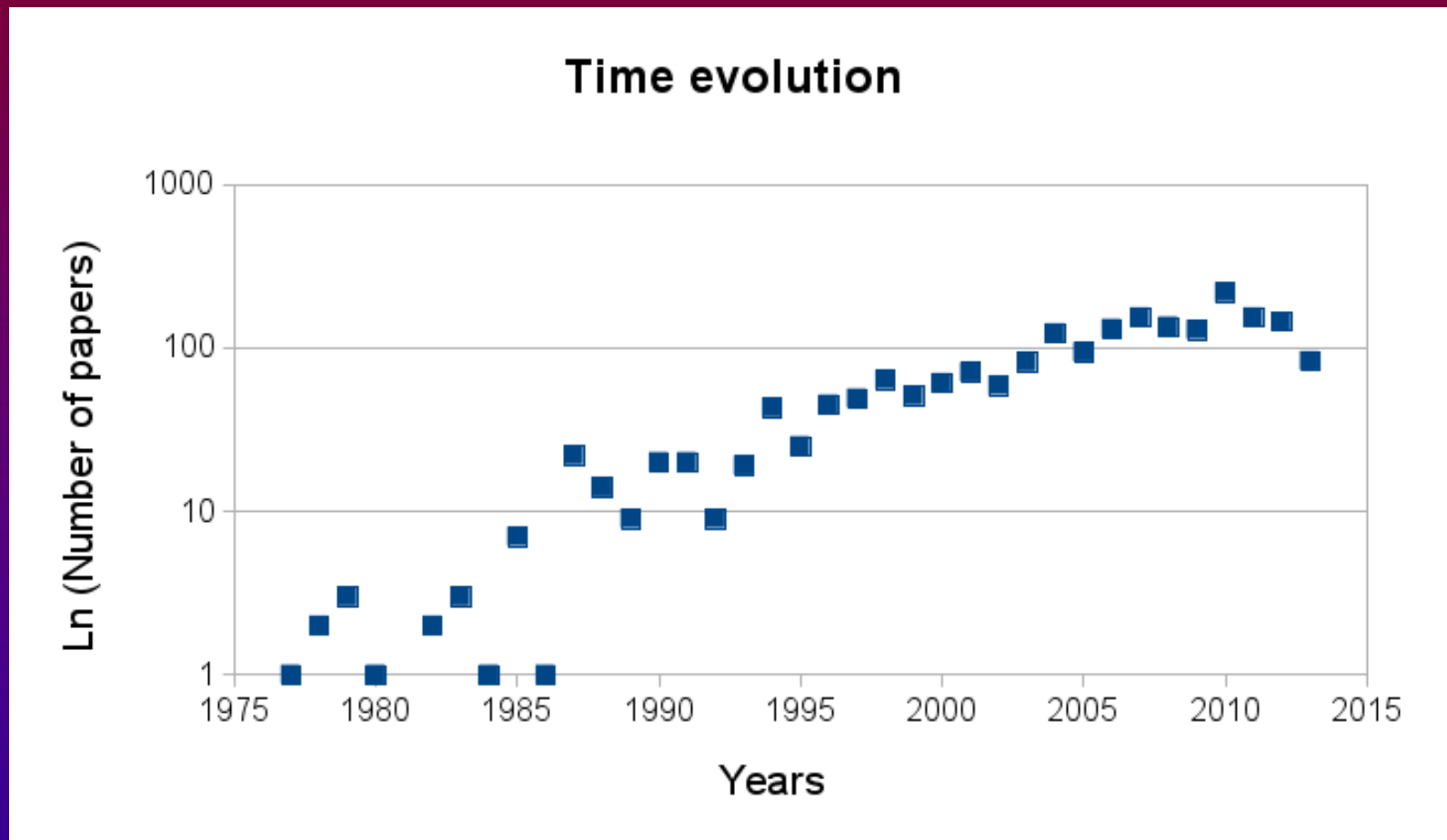


General activities on Energy

- CU=MEXICO AND WC=Energy & Fuels
- Refined by: **[excluding]** Source Titles=(
COMBUSTION AND FLAME OR FUEL
PROCESSING TECHNOLOGY OR FUEL
OR ENERGY FUELS OR PETROLEUM
SCIENCE AND TECHNOLOGY OR OIL
GAS JOURNAL OR COMBUSTION
SCIENCE AND TECHNOLOGY OR AAPG
BULLETIN AMERICAN ASSOCIATION
OF PETROLEUM GEOLOGISTS OR
JOURNAL OF PETROLEUM GEOLOGY



Time evolution



Again it seems we have reached the saturation

The number is also important, we need to promote this area



Document type

Document type	Number
ARTICLE	1101
PROCEEDINGS PAPER	619
ARTICLE; PROCEEDINGS PAPER	247
EDITORIAL MATERIAL	41
REVIEW	26
LETTER	5
NOTE	5
CORRECTION	4
MEETING ABSTRACT	2
BIOGRAPHICAL-ITEM	1

Table: Type of document according to Web of Science database



Prolific authors

Authors	Papers
SEBASTIAN, PJ	119
BEST, R	62
RIVERA, W	56
MATHEW, X	53
HERNANDEZGUERRERO, A	32
HOLLAND, FA	32
ALMANZA, R	30
MORALESACEVEDO, A	29
MEDINA, A	28
ARRIAGA, LG	27
GAMBOA, SA	27
RIVERO, R	24
SOLORZAFERIA, O	23
ESTRADA, CA	22
ROMERO, RJ	21
GARCIAVALLADARES, O	20

- Table: Authors with more than 20 papers in RE
- They are users and providers of information about RE
- Most of the authors works in Mexican Institutions



Participating Country

- Table: From 2051
- Mexico is independent in RE research area.
- USA is participating in less than 10% of the research on RE from Mexico

Country	Papers
MEXICO	1840
USA	131
SPAIN	84
ENGLAND	35
FRANCE	27
ITALY	22
GERMANY	19
INDIA	17
PEOPLES R CHINA	17
CANADA	12
CUBA	11
JAPAN	10



Country collaboration and Language

Country group	Papers
MEXICO	1448
MEXICO:USA	94
MEXICO:SPAIN	65
FRANCE:MEXICO	20
ENGLAND:MEXICO	19
ITALY:MEXICO	15
MEXICO:PEOPLES R CHINA	15
GERMANY:MEXICO	14
INDIA:MEXICO	10

Language	Papers
ENGLISH	2049
FRENCH	1
GERMAN	1

- No Spanish papers

- Table: From 2051 papers
- Almost 3/4 of the research on RE in Mexico is done without contribution of any other country.
- Europe and Asia are the closer collaboration, It is interesting that there is not significant collaboration



Institutions and collaborations

Institution	Papers
UNAM	569
CINVESTAV	194
IPN	115
IIE	114
UNIV GUANAJUATO	100
INST MEXICANO PETR	83
UAEM	77
UNIV AUTONOMA METROPOLITANA IZTAPALAPA	60
UNIV MICHOACANA	46
INST NAACL INVEST NUCL	36
BUAP	29
UNIV GUADALAJARA	27
COMIS FED ELECT	22
INST TECNOL CELAYA	21
INST TECNOL MORELIA	20
ITESM	20

Institution collaborations	Papers
UNAM	264
CINVESTAV	85
IIE	72
IPN	55
UNIV GUANAJUATO	51
INST MEXICANO PETR	40
UAEM	27
UNIV AUTONOMA METROPOLITANA IZTAPALAPA	27
INST NAACL INVEST NUCL	26
UNIV MICHOACANA	20
UNIV GUADALAJARA	18
INST TECNOL MORELIA	16
UAEM:UNAM	16
IPICYT	14
CINVESTAV:UNAM	13
COMIS FED ELECT	13

- Table: From 2051
- Leading organization is UNAM

- There are no collaborative effort
- Morelos-UNAM & CINVESTAV-UNAM are the leading groups



Institutions work alone,



Journals

Journal	Number of papers
SOL ENERG MAT SOL C	212
BIORESOURCE TECHNOL	187
INT J HYDROGEN ENERG	155
APPL THERM ENG	106
SOL ENERGY	90
J POWER SOURCES	65
ENERGY	64
HEAT RECOV SYST CHP	55
RENEW ENERG	50

Table: Journals with more than 50 papers



One- and two-words phrases

ONE word	TWO words
SYSTEM	DEGREES C
ENERGY	HEAT TRANSFER
TEMPERATURE	THIN FILMS
HEAT	SOLAR CELLS
MODEL	H 2
POWER	FUEL CELL
SOLAR	X RAY
C	STEADY STATE
FILMS	RAY DIFFRACTION
FLOW	BAND GAP
WATER	HYDROGEN PRODUCTION
DEGREES	ELECTRON MICROSCOPY
THERMAL	POWER PLANT
HYDROGEN	CURRENT DENSITY

Table: List of most relevant phrases with one or two words



Relevant One words

CHARCOAL	ZRO2
CALDERA	RO
ALBIAN	VA
FILMS	BIOSORPTION
CARROL	SHOCKS
ECOSYSTEM	CAVITY
ECOTAXES	CDTE
CHIMNEY	LINO3

Relevant words, but no so frequent



Two-words relevant phrases

WORKING PAIR	AIR CONDITIONED
OPERATING TEMPERATURES	COMBUSTION CHAMBER
REFLUX RATIO	CHEMICAL EXERGY
CU NI	CLAY LOAM
WALL ROOF	CARBON AEROGEL
SOLAR CHIMNEY	
LINEAR FLOW	NICKEL HYDROXIDE
NH3 LINO3	SEWAGE SLUDGE
ABSORPTION SYSTEMS	TIO 2

Relevant words, but no so frequent



3-words relevant phrases

Phrases
COEFFICIENTS OF PERFORMANCE
HEAT TRANSFER RATE
ENTHALPY BASED COEFFICIENTS
RATIOS CARNOT COEFFICIENTS
COMBINATIONS OF OPERATING
GIBBS PHASE RULE
AMMONIA LITHIUM NITRATE
WORKING FLUID ABSORBENT
TEMPERATURES AND CONCENTRATIONS
FLOW RATIOS CARNOT
AUTOMATION AND CONTROL



Research in the world

¿What topics are hot in the world?



Research in the world

We found 92 papers on the topics of “*solar energy*” ... “*wind energy*” (last year) in prestige journals:

Science, Nature and Plos One



Países	34
USA	48
ENGLAND	15
PEOPLES R CHINA	12
GERMANY	9
AUSTRALIA	7
JAPAN	7
ITALY	6
SWITZERLAND	6
FRANCE	5
CANADA	4
NETHERLANDS	4
SWEDEN	4
AUSTRIA	3
SOUTH KOREA	3
SPAIN	3
BELGIUM	2
DENMARK	2
IRELAND	2
ISRAEL	2
NORTH IRELAND	2
SINGAPORE	2

WORD(S)
QUANTUM DOTS
ELECTRON ACCELERATION
POWER CONVERSION
POLYMER SOLAR
RADIATIVE FORCING
WIND TURBINE
H 2
INCREASED SOLAR
NANOWIRE SOLAR
SINGLE CRYSTAL
SURFACE TEMPERATURES
GALLIUM ARSENIDE
SOLAR CELLS
CARBON NANOTUBES
WIND POWER
THIN FILM
HIGH PERFORMANCE
HIGH ENERGY
CONVERSION EFFICIENCY
ANTHROPOGENIC AEROSOL



CEMIE-Sol

Mexican Center for Innovation in Solar Energy (CeMIESol) is a joint proposal of 67 higher education and research institutions and with 21 companies in response to the call from SENER-CONACyT.

There are 48 projects with more than 100 researcher working.

This is an opportunity



Comments

- Mexico has an active RE research community
- This community is independent, but it is small
- The main topics are related with materials science, thermal performance, geothermal
- We have support from government through Estrategia Nacional de Energía (National Strategy of Energy)
- But still we need to convince about the opportunity
- We are not so strong on **Metrology and Monitoring,**
- **but we need them to use RE**



Thanks!

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