

266632 Bi-National Laboratory on Smart Sustainable Energy Management and Technology Training

“Interdisciplinary, Collaborative and Open Innovation to train in Energy Sustainability through MOOCs Subproject”

María Soledad Ramírez Montoya, MOOC Subproject leader
Laura Patricia Aldape Valdes, MOOC production
Silvia Catalina Farías Gaytán, MOOC production
Sara Alicia González del Bosque, MOOC teaching



May 2019

SENER
SECRETARÍA DE ENERGÍA



CONACYT
Consejo Nacional de Ciencia y Tecnología



FONDO
DE SUSTENTABILIDAD
ENERGÉTICA

**Tecnológico
de Monterrey**

SEP
SECRETARÍA DE
EDUCACIÓN PÚBLICA



TECNOLÓGICO NACIONAL DE MÉXICO

**INSTITUTO NACIONAL
DE ELECTRICIDAD Y
ENERGÍAS LIMPIAS**

CFE

ASU
ARIZONA STATE
UNIVERSITY

Berkeley
UNIVERSITY OF CALIFORNIA

Colaboran:



2019 Nomination

Category: Open Innovation



Open Education Awards for Excellence



“Open Innovation.

Outstanding innovation that brings a new approach to open education. Ideas or solutions that present innovative applications of OER to create new opportunities or address existing challenges in open education.”

(Open Education Consortium, 2019, <https://www.oeconsortium.org/projects/open-education-awards-for-excellence/>).



FONDO DE SUSTENTABILIDAD ENERGÉTICA

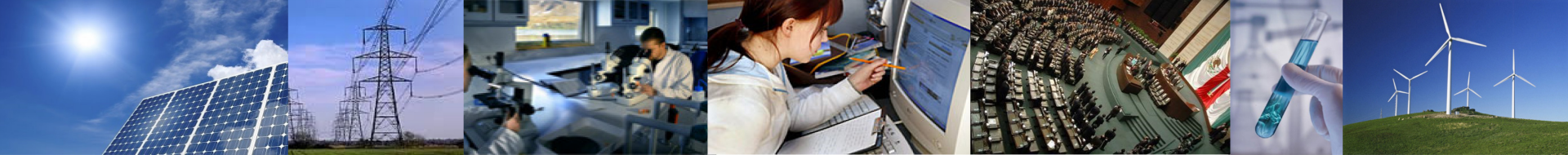
page 02



TECNOLÓGICO NACIONAL DE MÉXICO



Colaboran:



Interdisciplinary, Collaborative and Open Innovation

Energy Sustainability through MOOCs in the Latin American context

In the project we worked with new approaches to open education, integrating training solutions and applying OER through 12 MOOCs with innovative strategies, where we created new entrepreneurship opportunities to face the challenge of energy sustainability.

We linked the open innovation of the quad helix:

- Industry: Federal Electricity Commission,
- Government: National Council of Science and Technology and Secretary of Energy of Mexico,
- Academy: Mexican institutions: Tecnológico de Monterrey, Tecnológico Nacional de México, National Institute of Electricity and Clean Energies and international institutions: Arizona State University, and University of California at Berkeley, as well as networks: research groups of strategic change approach Climate Change and Educational Innovation Research, Openenergy Network and UNESCO Chairs / ICDE Open Educational Movement for Latin America, and
- Civil Society: more than 200,000 participants from more than 50 countries.

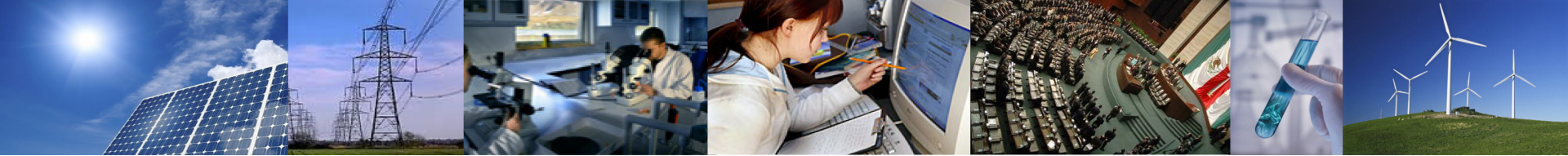


FONDO
DE SUSTENTABILIDAD
ENERGÉTICA



TECNOLÓGICO NACIONAL DE MÉXICO





Global Project

The Bi-National Laboratory on Smart Sustainable Energy Management and Technology Training is an initiative of the Ministry of Energy, the National Council of Science and Technology and the Tecnológico de Monterrey in collaboration with various institutions of higher education, public and private, national and international, which consists of a generation of technology and knowledge platform around energy with which we seek to place Mexico at the height of the most advanced countries in the sector by benefiting it in training, research and infrastructure.



<https://energialab.tec.mx/>



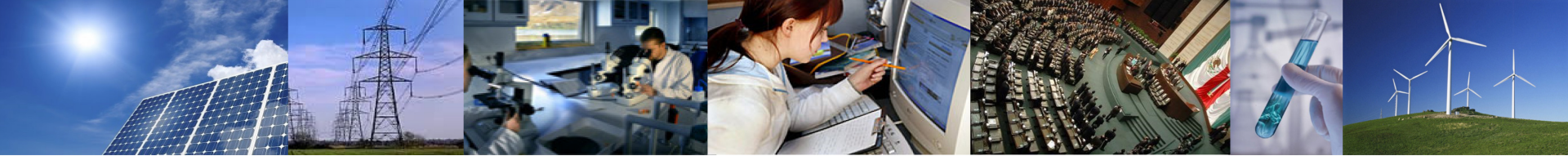
TECNOLÓGICO NACIONAL DE MÉXICO



FONDO DE SUSTENTABILIDAD ENERGÉTICA



Colaboran:



MOOC's Project goal

To support the **formation of human resources specialized in energy sustainability**, and to develop human talent with the necessary capabilities to respond to the technological conditions prevailing in the energy value chain (Power sector), through **graduate programs, massive open online courses** that will be available nationwide, and will be validated through competencies certification processes.

SENER
SECRETARÍA DE ENERGÍA



CONACYT
Consejo Nacional de Ciencia y Tecnología



FONDO
DE SUSTENTABILIDAD
ENERGÉTICA

Tecnológico
de Monterrey

SEP
SECRETARÍA DE
EDUCACIÓN PÚBLICA



TECNOLÓGICO NACIONAL DE MÉXICO

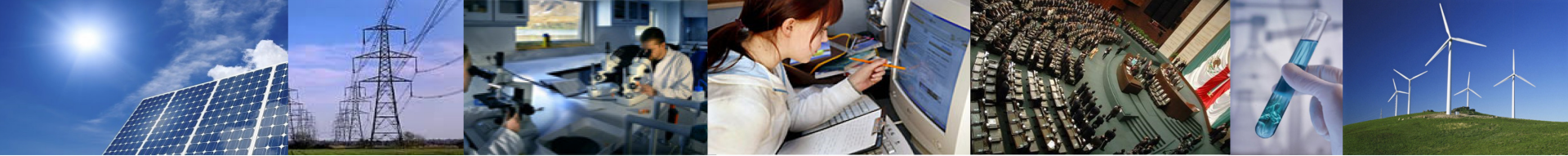
INSTITUTO NACIONAL
DE ELECTRICIDAD Y
ENERGÍAS LIMPIAS

CFE

ASU
ARIZONA STATE
UNIVERSITY

Colaboran:

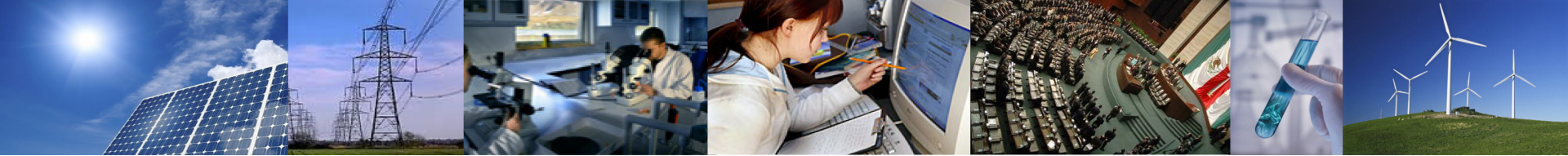
Berkeley
UNIVERSITY OF CALIFORNIA



Project Products

12 MOOC's on Energy sustainability:

1. Energy: past, present and future
2. Clean, conventional energy and their technology
3. Mexico's energy reform and its opportunities
4. Energy markets: business opportunities
5. Carbon markets: a way to mitigate climate change
6. Mexico's new electric power industry
7. Introduction to electric energy
8. Energy saving
9. Electric power transmission
10. Distribution of electric power
11. Smart grid: electricity networks of the future
12. Smart grid: technical foundations



MOOCs Team

Energy Sustainability experts

- Research Group on Energy and Climate Change
- School of Engineering and Sciences
- Business School
- Expert Guests

23

Educational Innovation experts

- School of Humanities and Education
- Graduate Education students

14

Teaching and eLearning experts

- eLearning team
- Teaching team

22



FONDO DE SUSTENTABILIDAD ENERGÉTICA



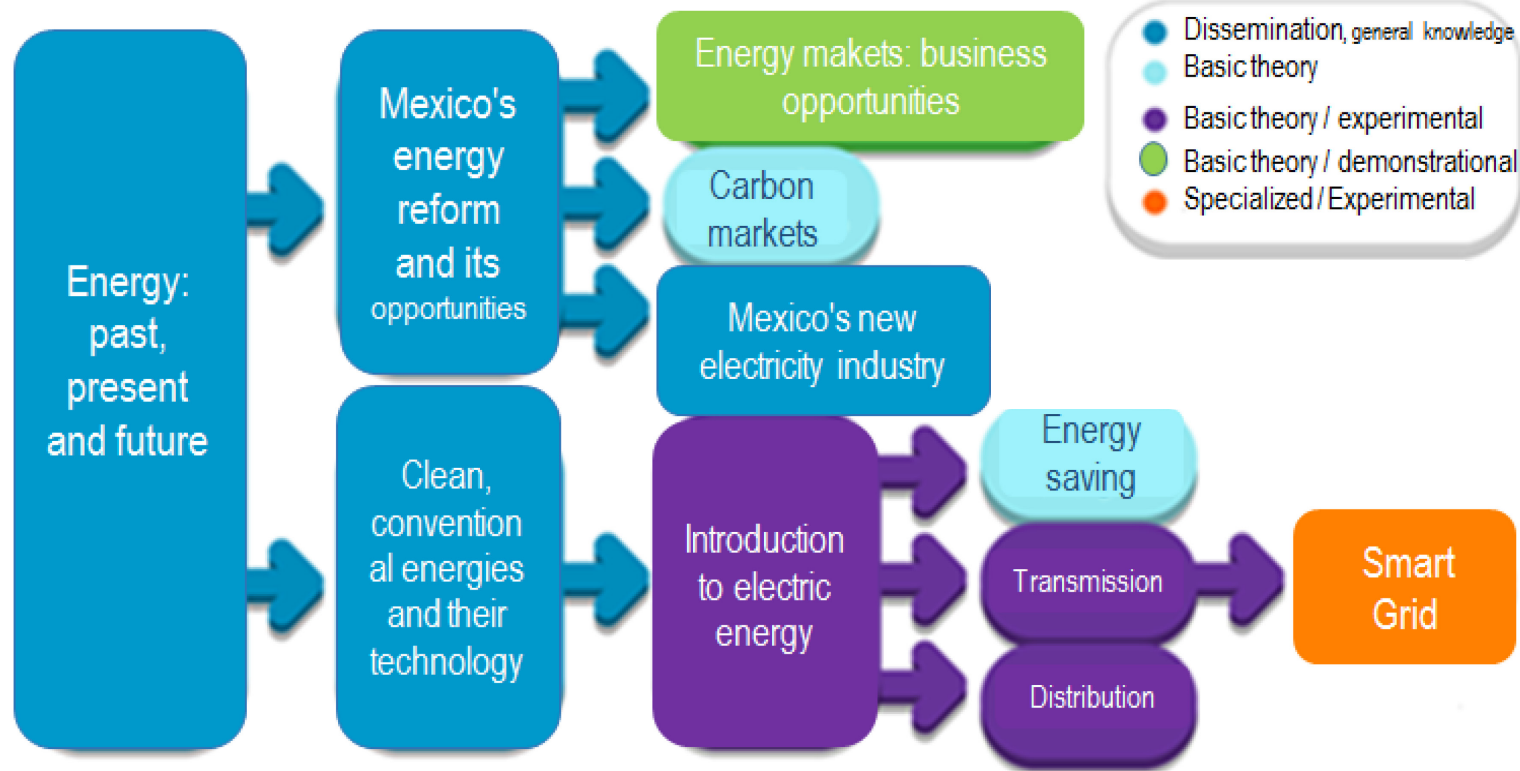
TECNOLÓGICO NACIONAL DE MÉXICO



Colaboran:

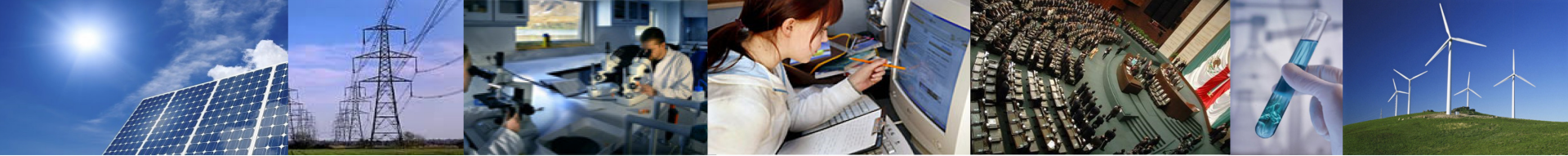


Suggested sequence for taking the courses



Types of courses

- Dissemination, general knowledge
- Basic theory
- Basic theory / experimental
- Basic theory / demonstrational
- Specialized / Experimental



Learners' profile

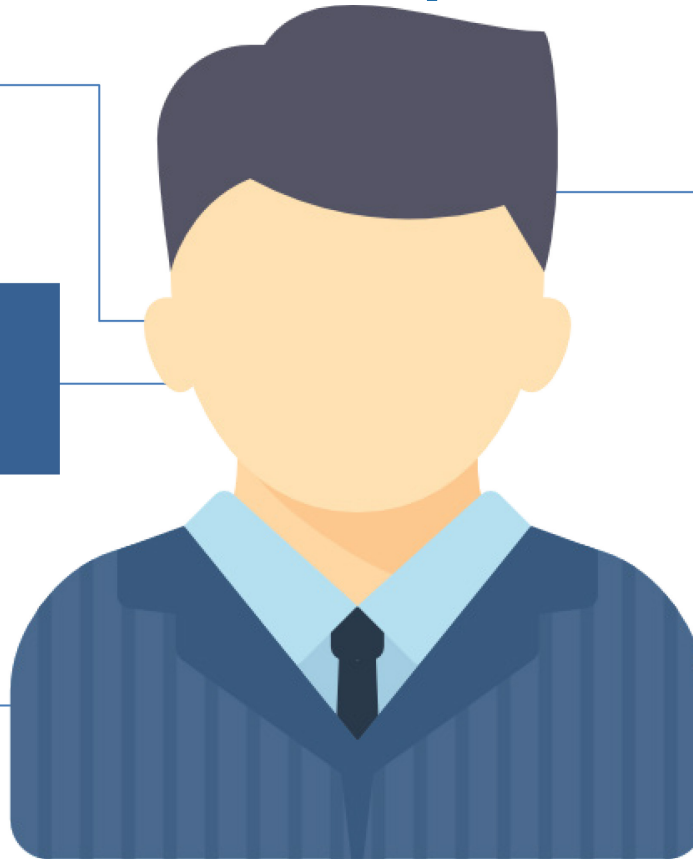
+ 17 years old

Minimum High school studies

Wants to learn about energy sustainability

Chooses xMOOC as a training program to achieve learning goals

CFE or industry related employees



SENER
SECRETARÍA DE ENERGÍA



CONACYT
Consejo Nacional de Ciencia y Tecnología



FONDO DE SUSTENTABILIDAD ENERGÉTICA

Tecnológico de Monterrey

SEP
SECRETARÍA DE EDUCACIÓN PÚBLICA



TECNOLÓGICO NACIONAL DE MÉXICO

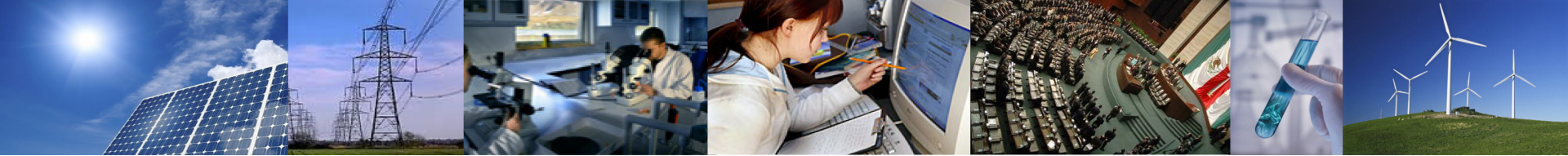
INSTITUTO NACIONAL DE ELECTRICIDAD Y ENERGÍAS LIMPIAS

CFE

ASU
ARIZONA STATE UNIVERSITY

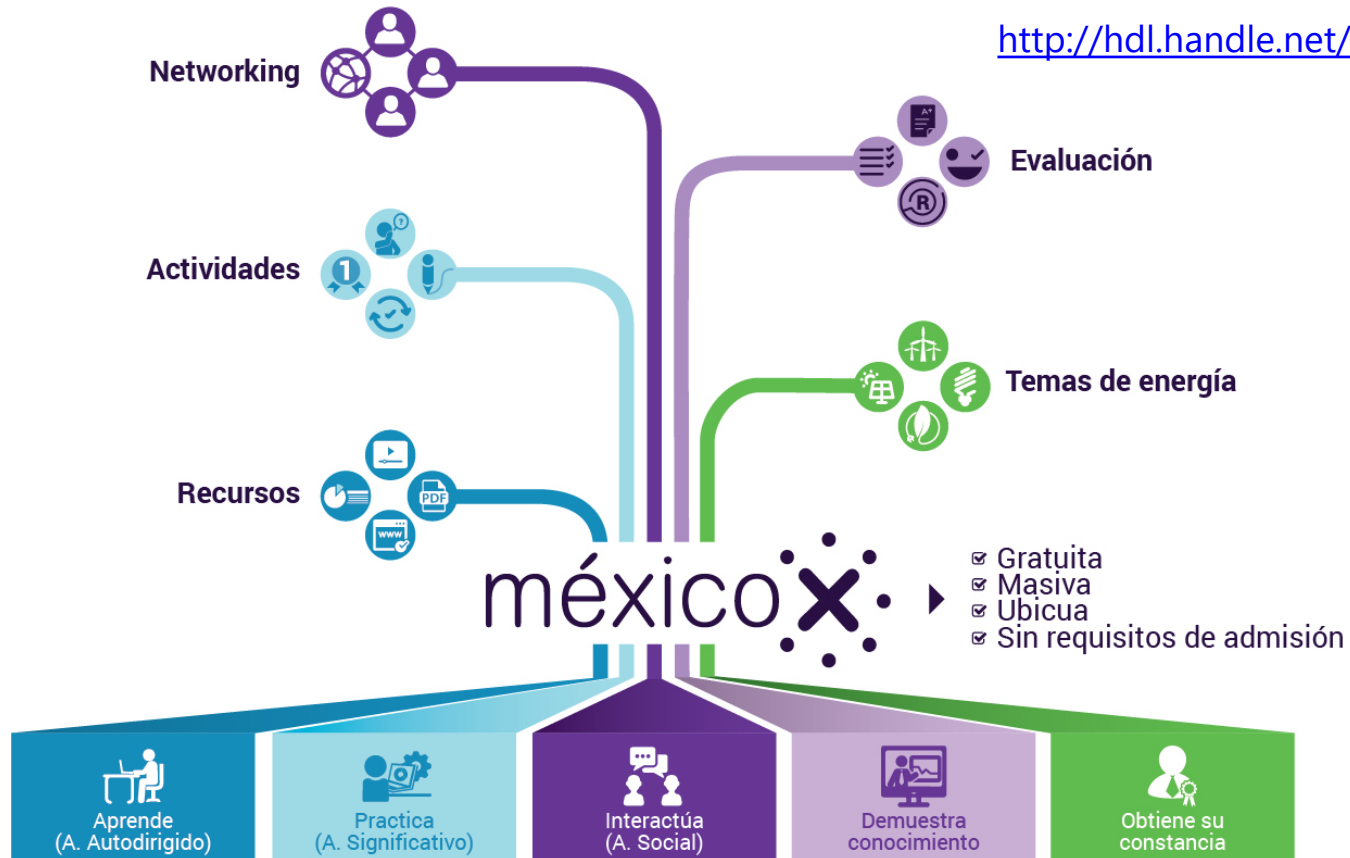
Berkeley
UNIVERSITY OF CALIFORNIA

Colaboran:



Instructional Model

<http://hdl.handle.net/11285/632891>



SENER
SECRETARÍA DE ENERGÍA



CONACYT
Consejo Nacional de Ciencia y Tecnología



FONDO
DE SUSTENTABILIDAD
ENERGÉTICA

**Tecnológico
de Monterrey**

SEP
SECRETARÍA DE
EDUCACIÓN PÚBLICA



TECNOLÓGICO NACIONAL DE MÉXICO

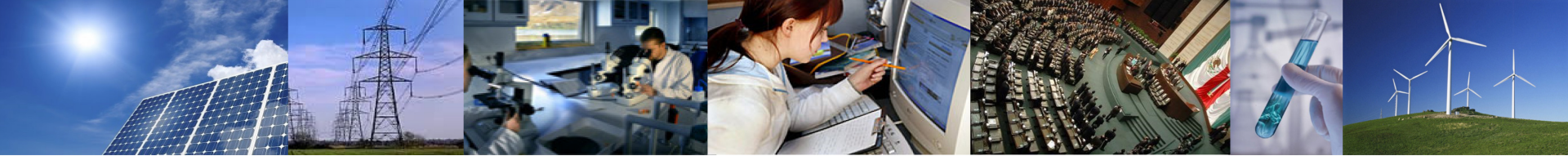
**INSTITUTO NACIONAL
DE ELECTRICIDAD Y
ENERGÍAS LIMPIAS**

CFE

Colaboran:

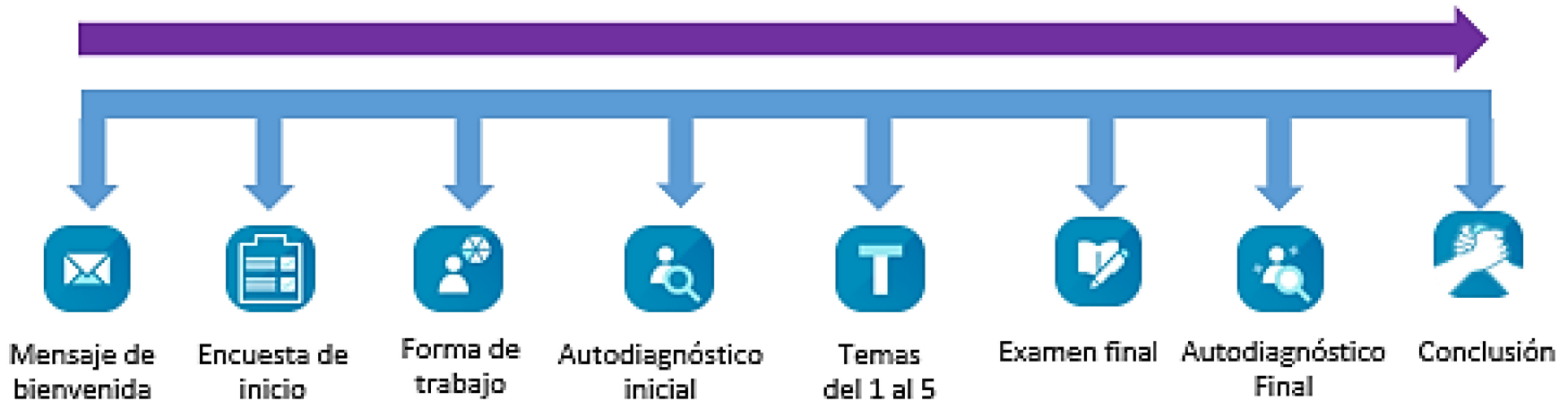
ASU
ARIZONA STATE
UNIVERSITY

Berkeley
UNIVERSITY OF CALIFORNIA



Learning path in a MOOC

Página descriptiva



SENER
SECRETARÍA DE ENERGÍA



CONACYT
Consejo Nacional de Ciencia y Tecnología



FONDO
DE SUSTENTABILIDAD
ENERGÉTICA

Tecnológico
de Monterrey

SEP
SECRETARÍA DE
EDUCACIÓN PÚBLICA



TECNOLÓGICO NACIONAL DE MÉXICO

INSTITUTO NACIONAL
DE ELECTRICIDAD Y
ENERGÍAS LIMPIAS

CFE

ASU
ARIZONA STATE
UNIVERSITY

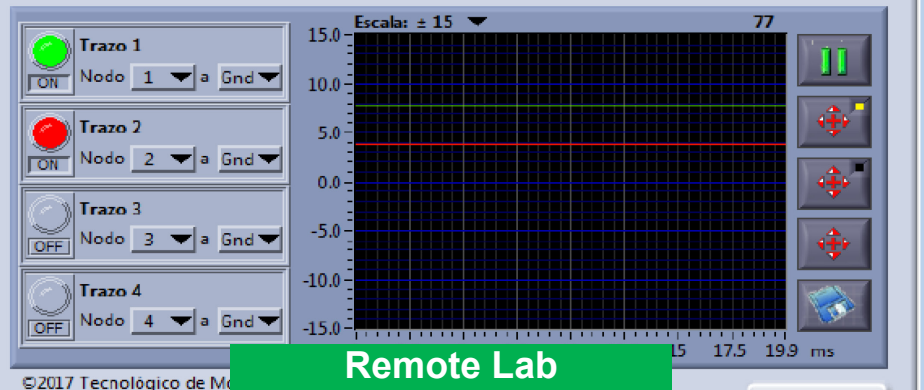
Colaboran:
Berkeley
UNIVERSITY OF CALIFORNIA



Incorporation of Educational Innovation

Usuario	Tiempo en contestar	Número de intento	Insignia
Usuario_1	00:01:23	1	
Usuario_2	00:02:01	2	
Usuario_3	00:02:01	3	

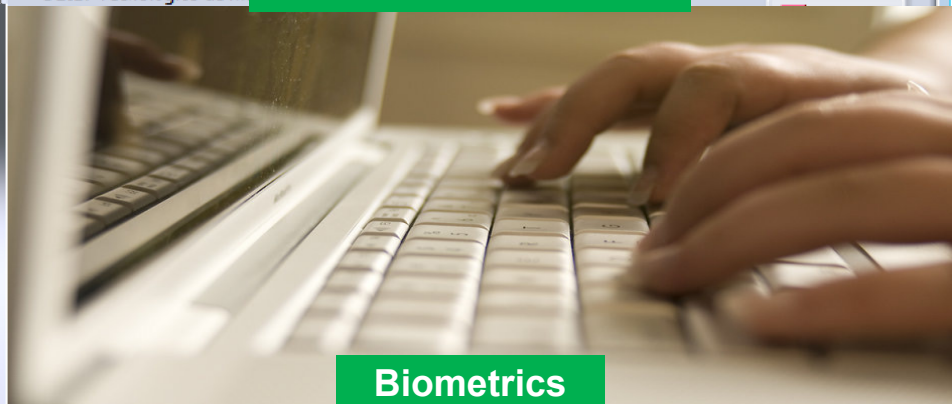
Gamification



Remote Lab



Augmented and Virtual Reality resources

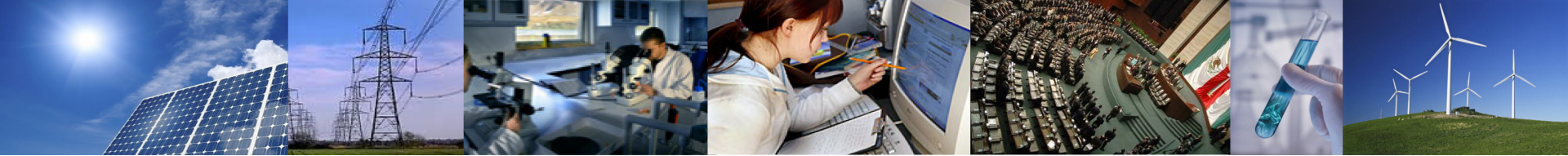


Biometrics



TECNOLÓGICO NACIONAL DE MÉXICO





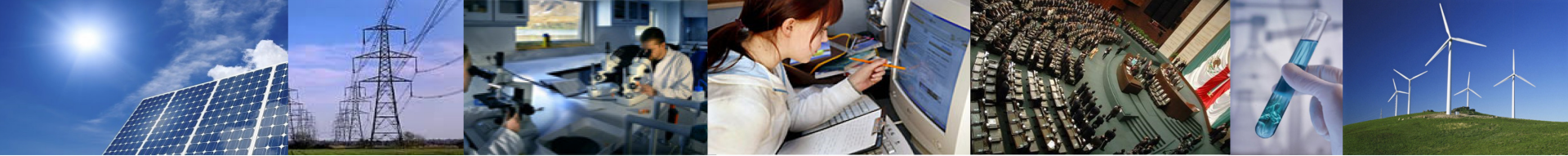
Incorporation of Educational Innovation



Gamification

- In-house development where a question is presented to learners about the content they have studied.
- Badges are assigned to learners that solve the question based on how many opportunities and how long it took them to finish the exercise.

Usuario	Tiempo en contestar	Número de intento	Insignia
Usuario_1	00:01:23	1	
Usuario_2	00:02:01	2	
Usuario_3	00:12:45	3	



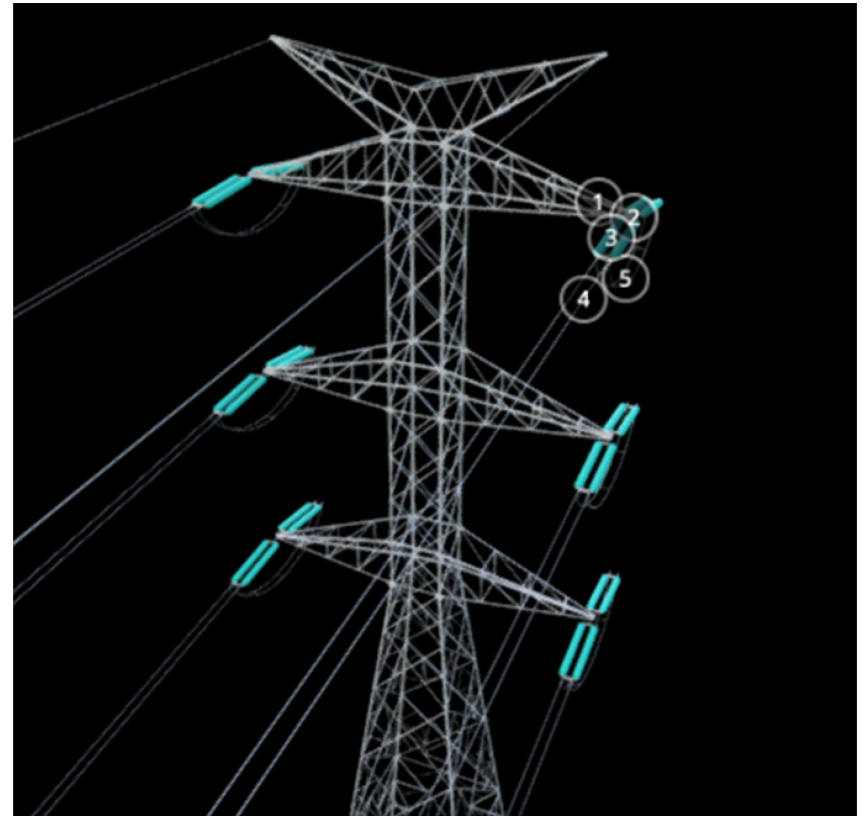
Incorporation of Educational Innovation

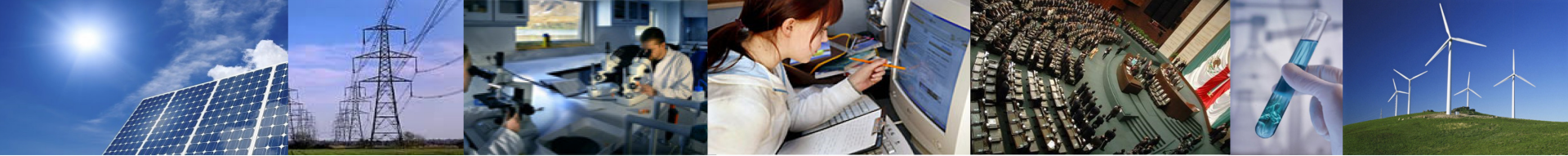


Virtual reality

- The use of these resources allows learners to interact with concepts and promotes active learning.
- The resources are selected on how they best support the learning experience.

https://sketchfab.com/itesm_mooc





Incorporation of Educational Innovation



Augmented reality

- The use of these resources allows learners to interact with concepts and promotes active learning.
- The resources are selected on how they best support the learning experience.



https://sketchfab.com/itesm_mooc



FONDO DE SUSTENTABILIDAD ENERGÉTICA

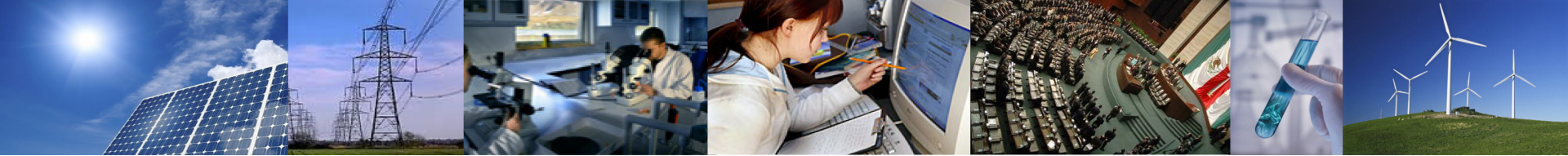


TECNOLÓGICO NACIONAL DE MÉXICO



Colaboran:



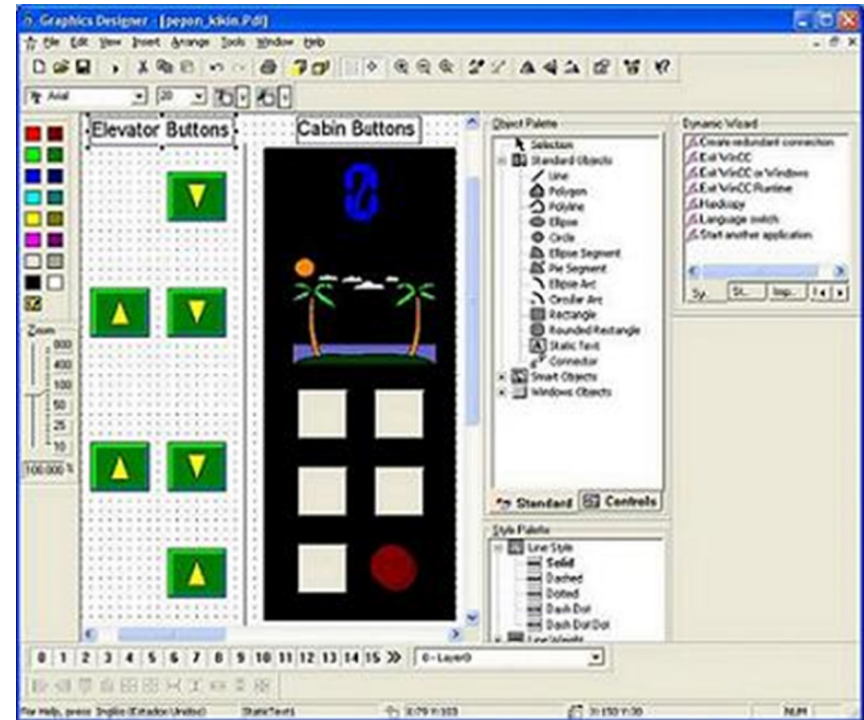


Incorporation of Educational Innovation



Remote lab

- Learners access the remote lab based at Tecnológico de Monterrey and complete several exercises to practice the concepts they have reviewed in the MOOC.
- There is a limited number of seats, so students have to make a reservation beforehand.



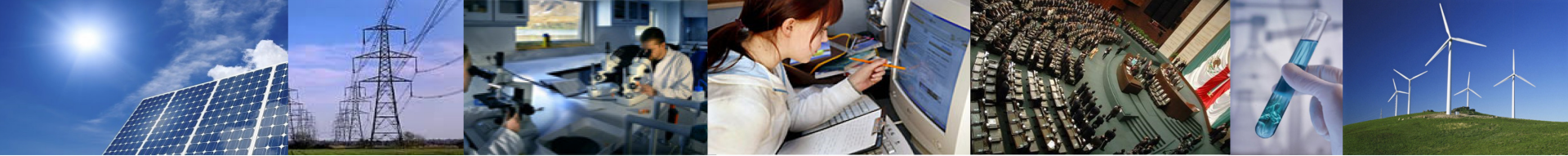
FONDO DE SUSTENTABILIDAD ENERGÉTICA



TECNOLÓGICO NACIONAL DE MÉXICO



Colaboran:



Incorporation of Educational Innovation

Biometrics

- MOOCs were delivered on MexicoX Platform, which is provided by the Mexican government.
- The platform didn't offer the use of biometrics, so this functionality was tested using an external provider and an in-house development.





<https://www.edx.org/school/tecnologico-de-monterrey>

MOOC Enrollment

MOOC's were offered on MéxicoX platform (2017-18) and edX (2018-2019)

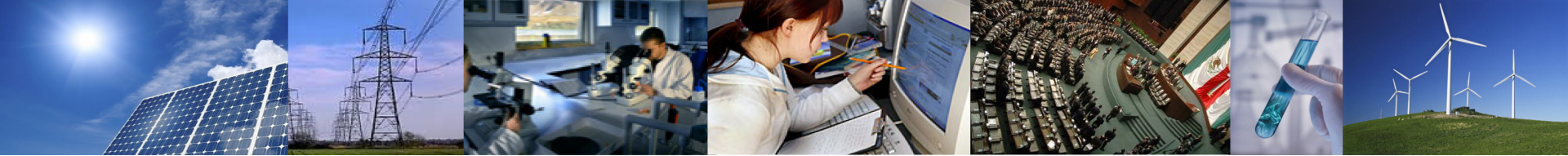
MOOC	Enrolled	Certificates
Energy saving	14,004	2,001
Distribution of electric power	8,262	946
Introduction to electric energy	17,889	1,776
Energy: past, present and future	13,847	2,047
Clean, conventional energy and their technology	20,238	2,721
Mexico's new electric power industry	9,304	1,196
Mexico's energy reform and its opportunities	13,203	1,914
Carbon Markets: a way to mitigate climate change	9,213	1,187
Energy Markets: business opportunities	14,376	1,318
Smart grid: technical foundations	6,729	720
Smart grid: electric networks of the future	9,217	812
Electric power transmission	7,132	1,088
Total	143,414	17,726



TECNOLÓGICO NACIONAL DE MÉXICO



Colaboran:



Learners' experience

MOOC Energy: past, present and future

I have taken many MOOC across platforms...and few courses I have completed among them this course. When I compare it I find that this course has high quality content, resources are well made and the proposed activities are not only quizzes but more motivating such as networking and the gamification challenge, which help me to apply my knowledge and share it with others.

MOOC The Mexican Energy Reform and its opportunities

I want to congratulate Dr. Luis Alberto Serra Barragán and each and every one of the collaborators by the brilliant integration of content, methodology, and presentation of this course, as well as the Tecnológico de Monterrey for his participation in this educational platform. Congratulations.

I would like to thank Dr. Luis Sierra, the teaching staff, MéxicoX platform, and Tecnológico de Monterrey for the present course, certainly is a valuable tool for understanding and learning how to apply the energy reform. Excellent course! Thank you.

SENER
SECRETARÍA DE ENERGÍA



CONACYT
Consejo Nacional de Ciencia y Tecnología



FONDO
DE SUSTENTABILIDAD
ENERGÉTICA

**Tecnológico
de Monterrey**

SEP
SECRETARÍA DE
EDUCACIÓN PÚBLICA



TECNOLÓGICO NACIONAL DE MÉXICO

**INSTITUTO NACIONAL
DE ELECTRICIDAD Y
ENERGÍAS LIMPIAS**

CFE

ASU
ARIZONA STATE
UNIVERSITY

Berkeley
UNIVERSITY OF CALIFORNIA

Colaboran:



Incorporation of OER

MOOC

OER Anthology

Clean, conventional energy and their technology

<http://temoa.info/es/node/768242>

Energy: past, present and future

<http://temoa.info/es/node/768241>

Mexico's energy reform and its opportunities

<http://temoa.info/es/node/768430>

Mexico's new electric power industry

<http://temoa.info/es/node/768244>

Introduction to electric energy

<http://temoa.info/es/node/768524>

Energy saving

<http://temoa.info/es/node/768499>

Carbon markets: a way to mitigate climate change

<http://temoa.info/es/node/768527>

Energy markets: business opportunities

<http://temoa.info/es/node/768506>

Electric power transmission

<http://temoa.info/es/node/776262>

Distribution of electric power

<http://temoa.info/es/node/776644>

Smart grid: technical foundations

<http://temoa.tec.mx/es/node/782631>

Smart grid: electric networks of the future

<http://temoa.tec.mx/es/node/782630>



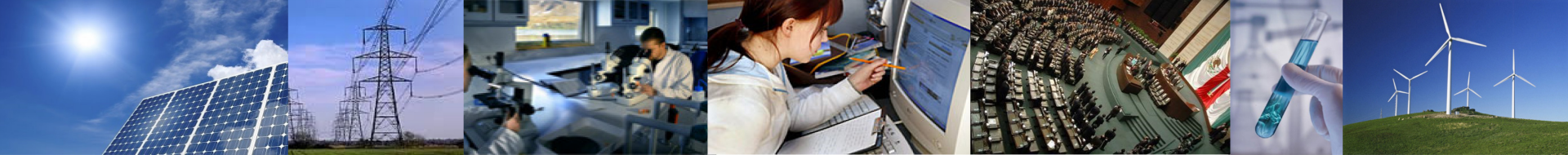
FONDO
DE SUSTENTABILIDAD
ENERGÉTICA



TECNOLÓGICO NACIONAL DE MÉXICO



Colaboran:



Publication of MOOC resources as OER on open repository RITEC



<https://tinyurl.com/repositorio-itescm-mx>

español ▾ Login

🏠 [Página de Inicio](#) / [Buscar](#)

Por fecha de envío

Materias

Mi cuenta

Acceder

Registro

Descubre

Autor

Alejandro Ibarra Yúnez (119)

Ibarra Yúnez, Alejandro (119)

Alberto Mendoza Domínguez (112)

Mendoza Domínguez, Alberto (112)

Mancilla Méndez, Yasmany (110)

Yasmany Mancilla Méndez (110)

Luis Alberto Serra Barragán (108)

Serra Barragán, Luis Alberto (107)

Anaya Zamora, Rodolfo (99)

Contreras Hinojosa, Cornelio (99)

... más

Materia

Energía (849)

Energy conservation & General works (803)

Ingeniería (General) (671)

MOOC (664)

Energía (150)

Ingeniería (General) (150)

Oportunidades de negocio (115)

Electricidad (113)

Reforma energética (113)

Historia (112)

... más

Disciplina

Mostrando ítems 1-10 de 963 Exportar ⚙️

Estadísticas de Impartición de MOOC's

Ramírez Montoya, María S.; López Cardenas, Victor H. (Tecnológico de Monterrey, 2017-03)

Estadísticas de Impartición de Moocs del proyecto **266632** Laboratorio Binacional para la Gestión Inteligente de la Sustentabilidad Energética y Formación Tecnológica

Antologías con Recursos Educativos Abiertos (REA) para cursos MOOC's, y documentación de producción académica en el Repositorio Institucional (RITEC.)

Ramírez Montoya, María S.; Burgos Aguilar, José V. (Tecnológico de Monterrey, 2017-04)

Presentación del Proyecto **266632** Laboratorio Binacional para la Gestión Inteligente de la Sustentabilidad Energética y Formación Tecnológica. Tecnológico de Monterrey, México.

Articulación de los componentes principales del subproyecto Mocc's y de la Red Openergy

Ramírez Montoya, María S.; González-Pérez, Laura I.; Burgos Aguilar, José V.; Farías, S.; Ricaurte Quijano, Paola; López Cardenas, Victor H. (Tecnológico de Monterrey, 2017-03)

Imagen de la Articulación de los componentes principales del subproyecto Mocc's y de la Red Openergy. **266632** Laboratorio Binacional para la Gestión Inteligente de la Sustentabilidad Energética y Formación Tecnológica

Subproyecto MOOC's energía - Red openergy

Ramírez Montoya, María S.; González-Pérez, Laura I.; Burgos Aguilar, José V.; Farías, S.; Ricaurte Quijano, Paola; López Cardenas, Victor H. (Tecnológico de Monterrey, 2017-03)

Imagen que muestra las actividades del subproyecto MOOC's en relación con las actividades de la Red Openergy. del proyecto **266632** Laboratorio Binacional para la Gestión Inteligente de la Sustentabilidad Energética y Formación Tecnológica



Publication of MOOC video resources as OER

<https://tinyurl.com/y6otdx3u>




Energía: Pasado, presente y futuro


23 videos • 1,488 vistas • Se actualizó por última vez el 26 jun. 2017




A través de un recorrido histórico, los videos explican la manera en la cual ha evolucionado la obtención de energía, y permite entender la relación entre la disponibilidad del recurso energético y su aprovechamiento.


<http://mx.mexicox.gob.mx/courses/cour...>


1  **Energía: Pasado, presente y futuro. Promocional del curso**
Tecnológico de Monterrey | Innovación Educativa

2  **Metodología**
Tecnológico de Monterrey | Innovación Educativa

3  **Guía de navegación**
Tecnológico de Monterrey | Innovación Educativa

4  **Políticas**
Tecnológico de Monterrey | Innovación Educativa

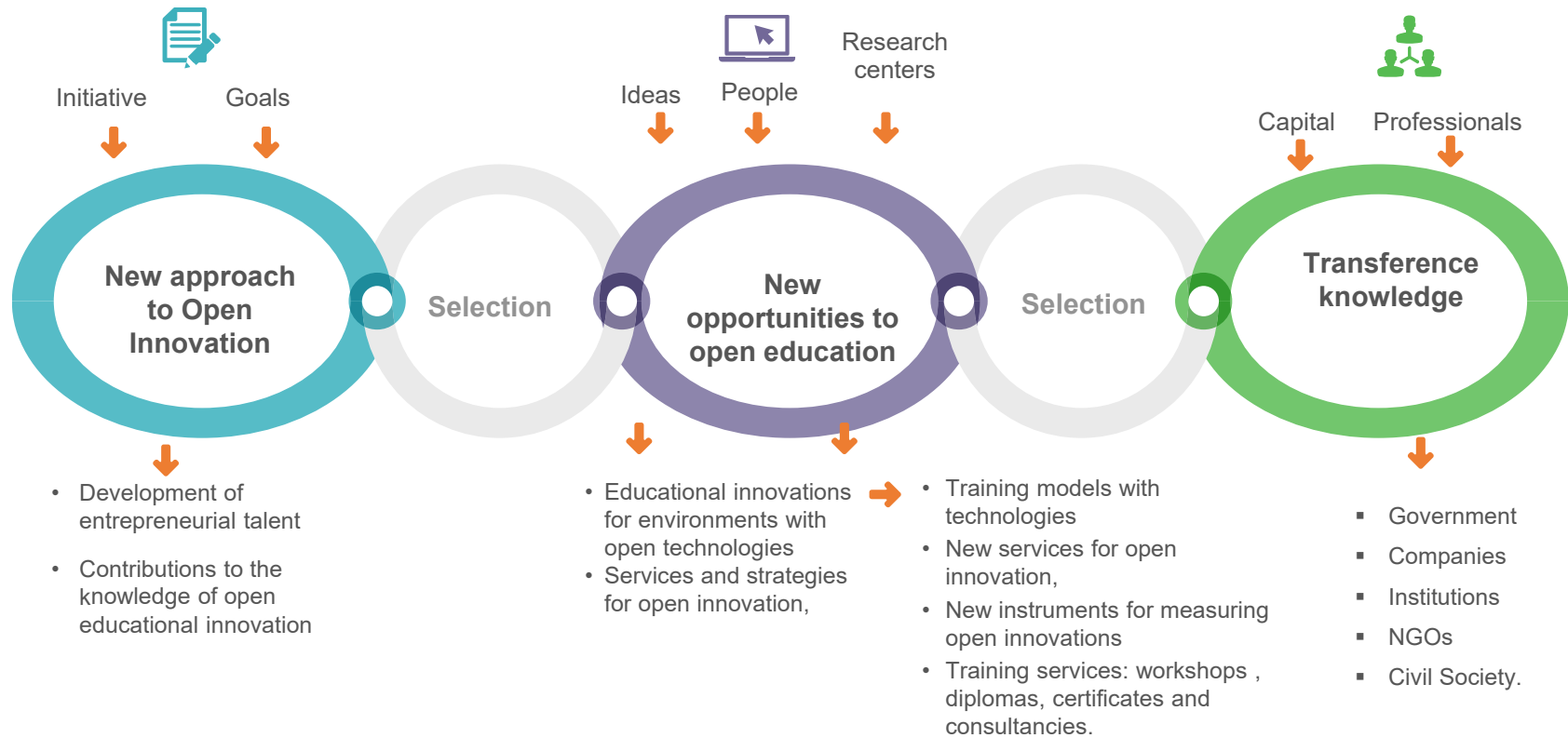
5  **¿Qué es el poder calorífico y la densidad energética?**
Tecnológico de Monterrey | Innovación Educativa

 **¿Qué es la intensidad energética?**



Open Innovation project

Results



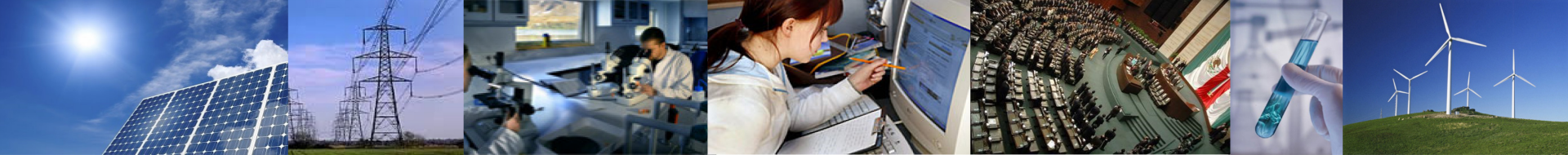
FONDO DE SUSTENTABILIDAD ENERGÉTICA



TECNOLÓGICO NACIONAL DE MÉXICO



Colaboran:



The intellectual work contained in this material is shared by means of a Creative Commons license (CC BY-NC-ND 2.5 MX) of type Attribution-NonCommercial-NoDerivs 2.5 Mexico, to know in detail the permitted uses, consult the website in :

<https://creativecommons.org/licenses/by-nc-nd/2.5/mx/deed.en>

It is allowed to copy, distribute, reproduce and publicly communicate the work without cost under the condition of not modifying or altering the material and recognizing the intellectual authorship of the work in the specific terms by the author himself. You can not use this material for commercial purposes, and if you want to alter, transform or create a different work from the original, you must request authorization in writing to the Tecnológico de Monterrey

This research is a product of the Project 266632 "Laboratorio Binacional para la Gestión Inteligente de la Sustentabilidad Energética y la Formación Tecnológica" ["Bi-National Laboratory on Smart Sustainable Energy Management and Technology Training"], funded by the CONACYT SENER Fund for Energy Sustainability (Agreement: S0019-2014-01).

SENER
SECRETARÍA DE ENERGÍA



CONACYT
Consejo Nacional de Ciencia y Tecnología



FONDO
DE SUSTENTABILIDAD
ENERGÉTICA

**Tecnológico
de Monterrey**

SEP
SECRETARÍA DE
EDUCACIÓN PÚBLICA



TECNOLÓGICO NACIONAL DE MÉXICO

**INSTITUTO NACIONAL
DE ELECTRICIDAD Y
ENERGÍAS LIMPIAS**

CFE

ASU
ARIZONA STATE
UNIVERSITY

Berkeley
UNIVERSITY OF CALIFORNIA

Colaboran: