



# ***"Science in Latin America and the U.N. Sustainable Development Goals"***

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@ International Symposium on the occasion of the International Year of Basic Sciences for Sustainable  
Development, 20220620

Società Italiana de Física

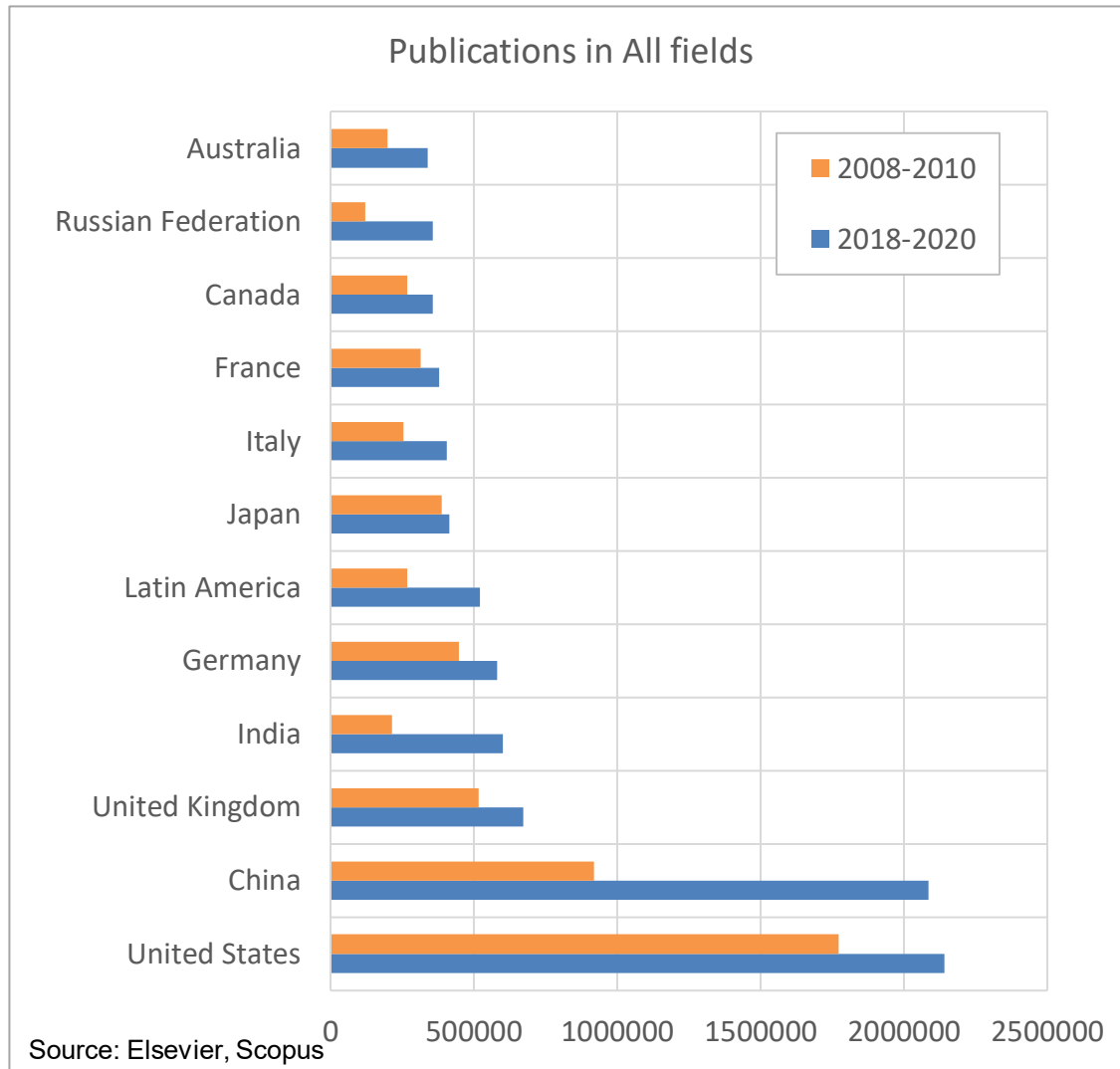
- How much does research in Latin America target sustainable development? What are the impacts?
  - Approximation 1: How do research publications with authors in developing countries target sustainable development goals?
  - Approximation 2: U.N.'s Sustainable Development Goals describe well Sustainable Development
- The U.N. Sustainable Development Goals (SDGs)
- Science and the SDGs
  - Assessing SDG related research mining information in bibliometric databases
  - Cases from Latin America
    - Clean Energy
    - Opportunities for research funding bodies to foster collaborations
    - A role for fundamental Research and facilities

# Latin America

- 24 countries (35 w. Caribbean reg)
- Two main languages
- 652 million people (2020)
- GDP: PPP\$ 10 trillion (2020)
- GDP per capita: PPP\$ 15k (2020)

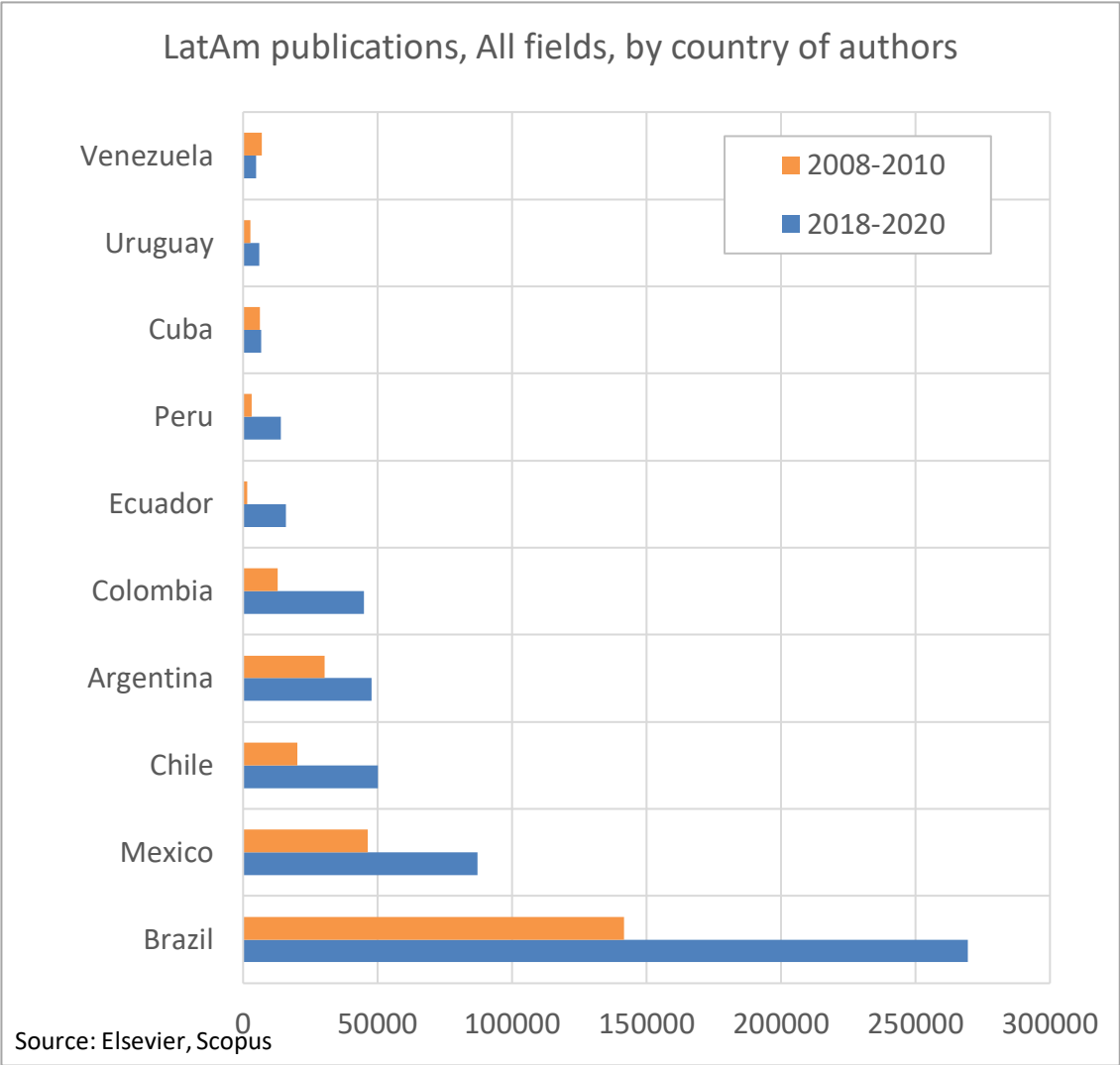


# 520,042 publications in 2018-2020 with authors in Latin America, All fields

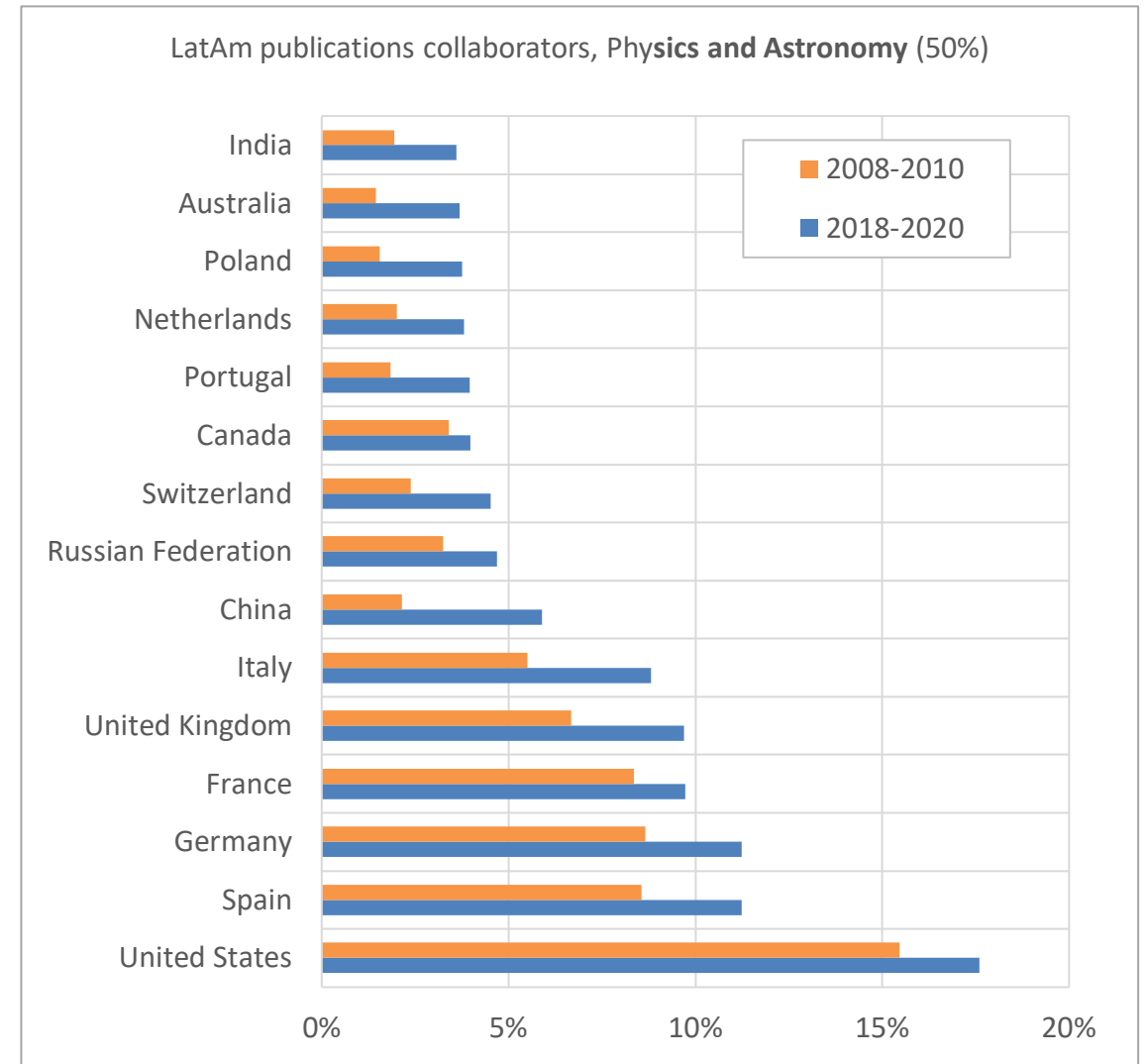
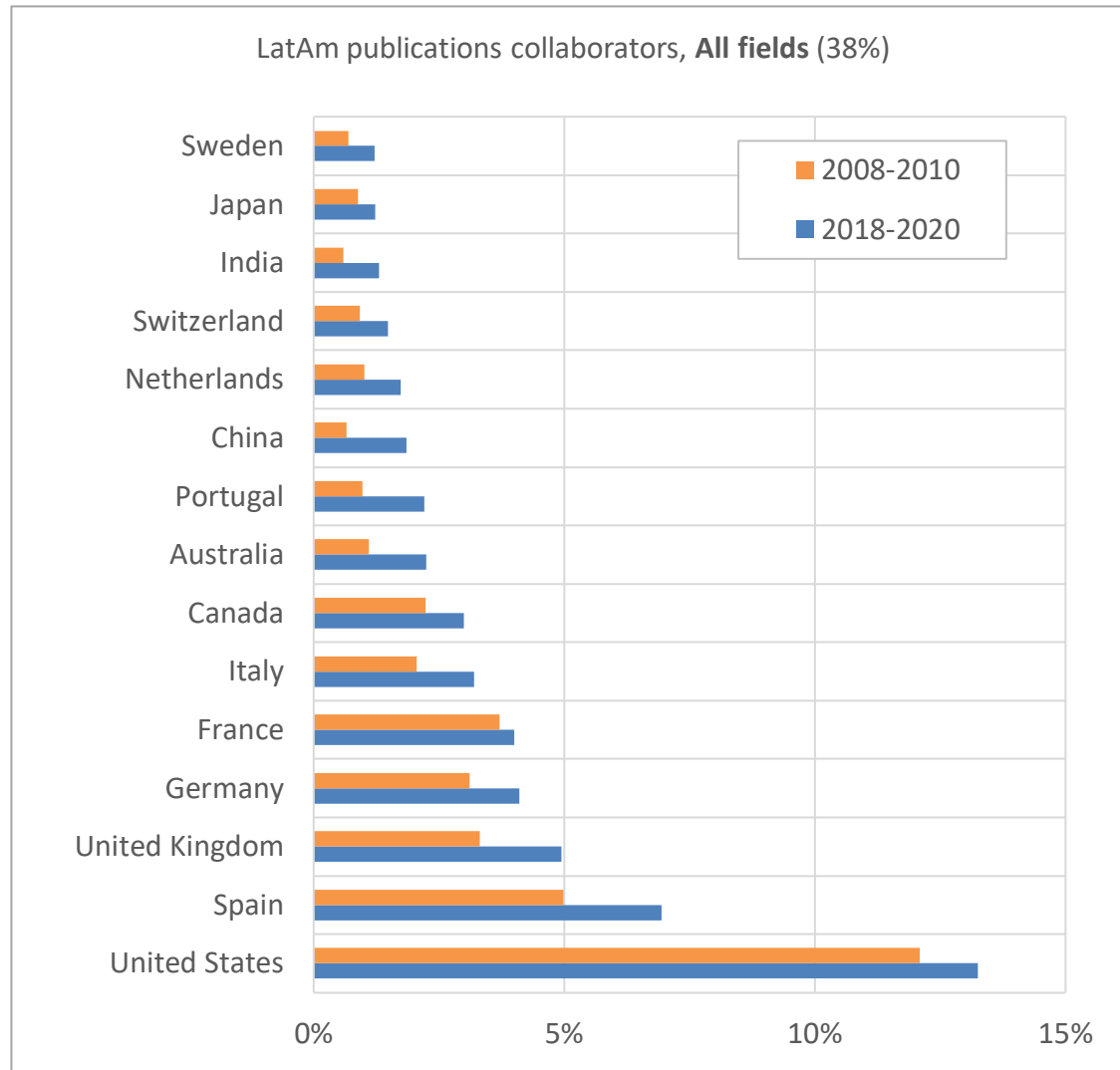


- In 2018-2020, 520,042 publications had authors in Latin America
  - 5.2% of the World total, 2020
  - 2.6% of the World total, 2000
  - 0.8% of the World total, 1980
- Of these, 49,540 were in Physics and Astronomy
  - 4.3% of the World total, 2020
  - 3.5% of the World total, 2000
  - 1.3% of the World total, 1980
- Direct connection to a sustainable future
  - 30-60% of LatAm publications (all fields) target one of the U.N. SDGs

# All fields, 2018-2020: 520,042 publications with authors in Latin America



# 2018-2020: 38% of publications (all fields) with authors in Latin America had international co-authors



## *The 16+1 SDGs, all with main target dates for 2030*

- SDG 01: No Poverty
- SDG 02: Zero Hunger
- SDG 03: Good Health and Well-being
- SDG 04: Quality Education
- SDG 05: Gender Equality
- SDG 06: Clean Water and Sanitation
- SDG 07: Affordable and Clean Energy
- SDG 08: Decent Work and Economic Growth

- SDG 09: Industry, Innovation and Infrastructure
- SDG 10: Reduced Inequality
- SDG 11: Sustainable Cities and Communities
- SDG 12: Responsible Consumption and Production
- SDG 13: Climate Action
- SDG 14: Life Below Water
- SDG 15: Life on Land
- SDG 16: Peace, Justice and Strong Institutions

# *U.N. SDGs: 5 interlinked dimensions*

- People
  - End poverty and hunger
- Planet
  - Protect the planet from degradation and take urgent action on climate change.
- Prosperity
  - Ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occurs in harmony with nature.
- Peace
  - Foster peaceful, just and inclusive societies which are free from fear and violence.
- Partnership
  - Mobilize the means required to through a Global Partnership for Sustainable Development.
- The interlinkages and integrated nature of the Sustainable Development Goals are of crucial importance in ensuring that the purpose of the new Agenda is realized.



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The knowledge that can help the world drive SDG attainment

# ***MINING SDG RELATED INFORMATION IN BIBLIOMETRIC DATABASES***

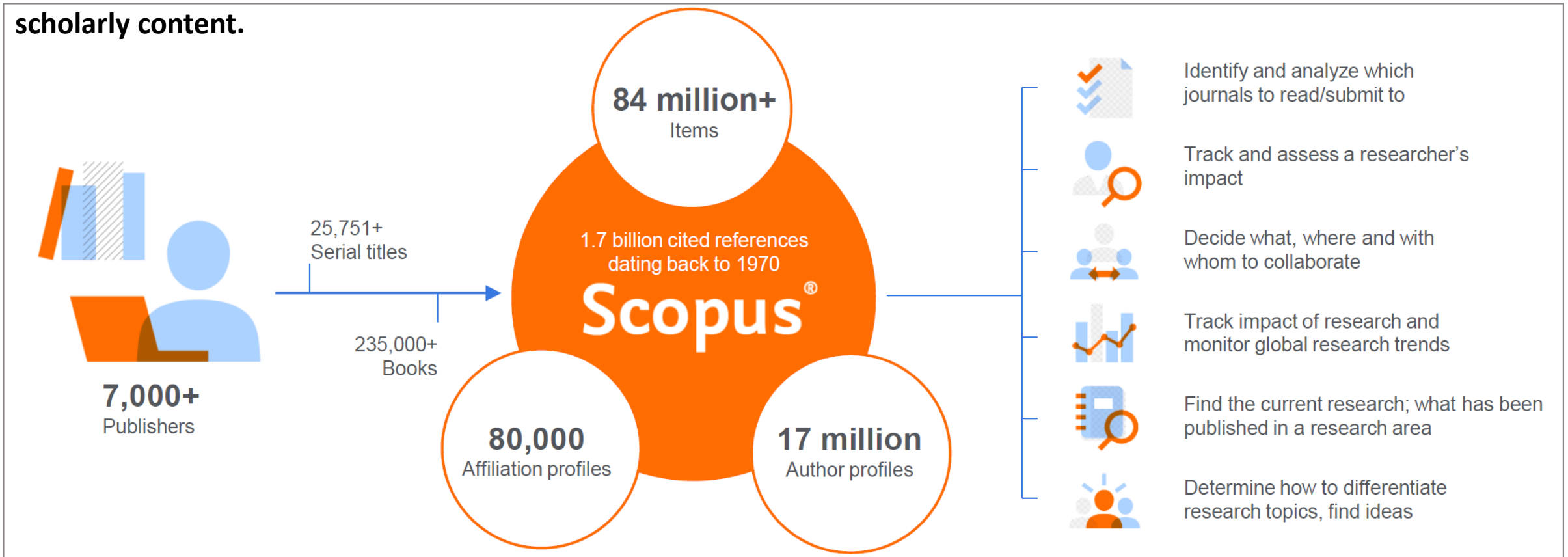
## *What is the knowledge base that will help the world to face the challenges related to each SDG?*

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- How can this knowledge base be identified?
  - Grants by funders? Publications? Research fields?
  - A wide coverage, credible, and homogeneous database would be useful
- Bibliometric databases have metadata on millions of research publications
- Build searches that will categorize publications according to the SDGs
- One such database is Elsevier's SCOPUS

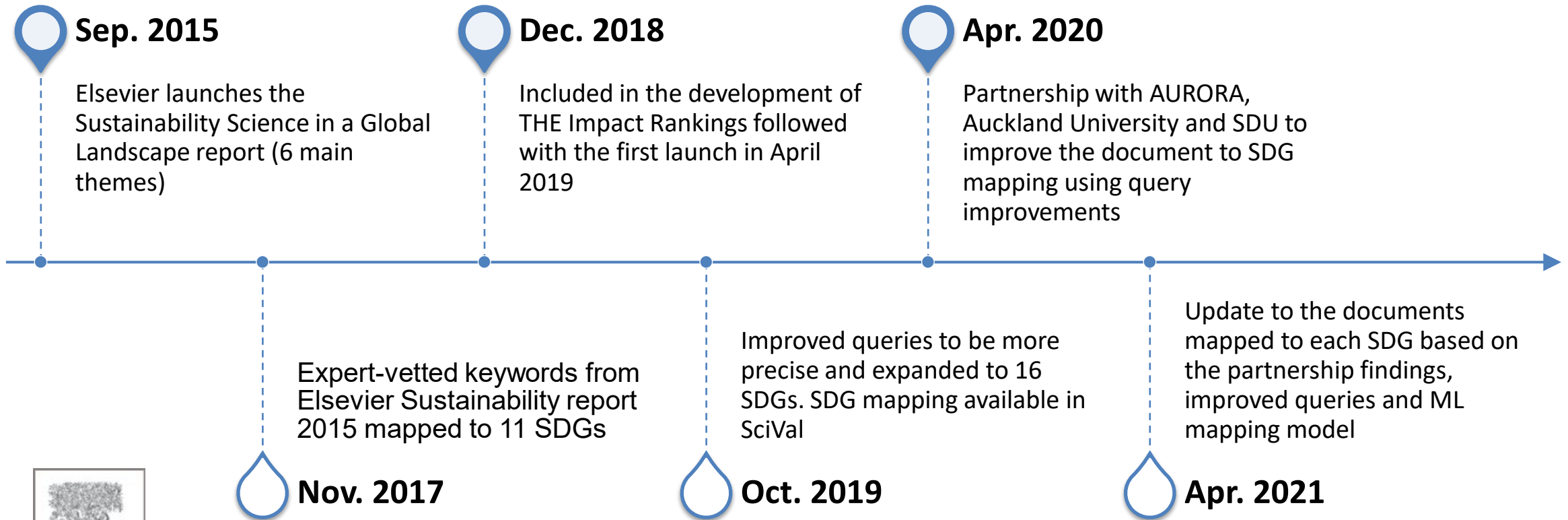
# Scopus is the underlying research output mapped to SDG

**Scopus** uniquely combines a comprehensive, curated abstract and citation database with enriched data and linked scholarly content.



**Quickly find relevant and trusted research, identify experts, and access reliable data, metrics and analytical tools to support confident decisions around research strategy – all from one database and one subscription.**

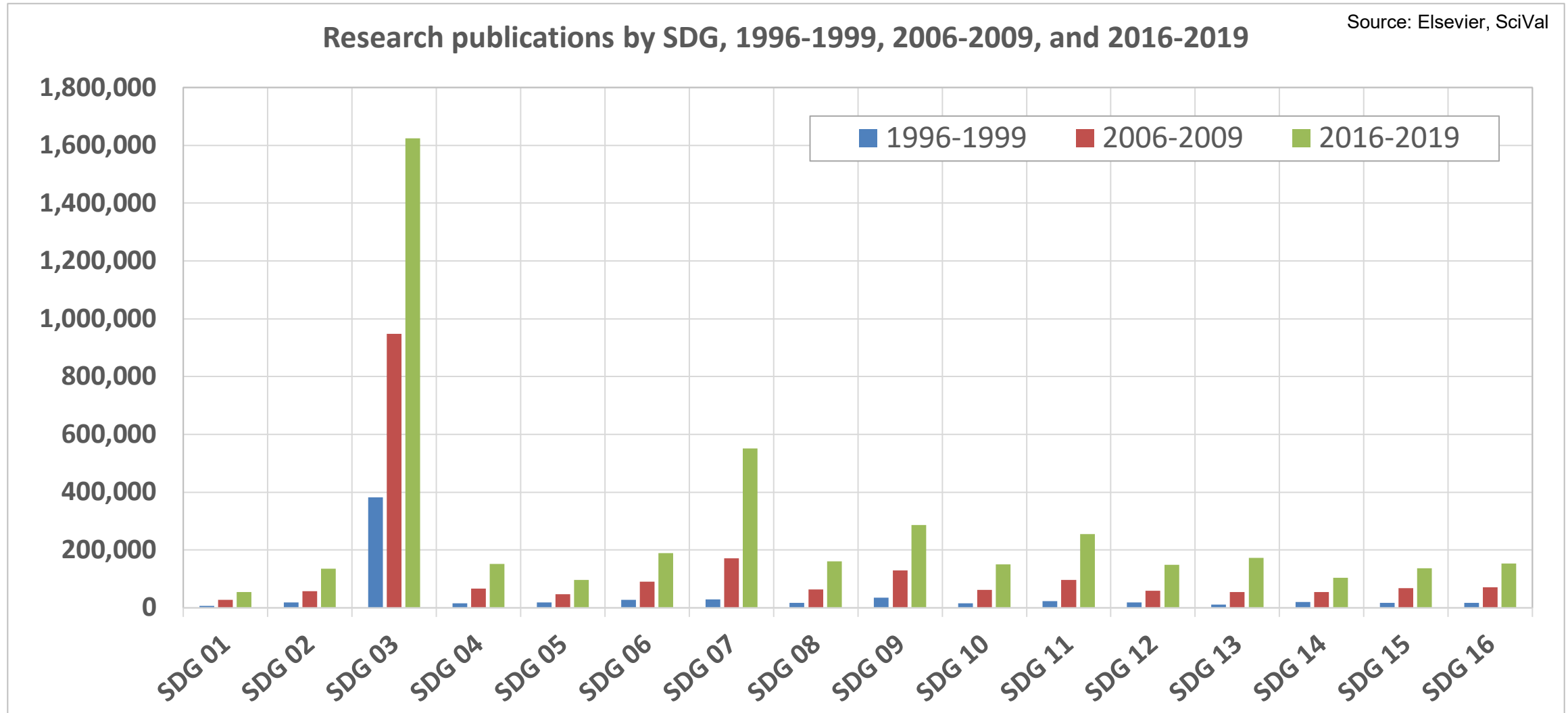
# Development of the Elsevier SDG queries, 2015-2021



<https://elsevier.digitalcommonsdata.com/datasets/9sxdykm8s4/4>

<https://www.elsevier.com/about/partnerships/sdg-research-mapping-initiative>

# World: publications by SDG, triennia starting on 1996, 2006, 2016



$$RAI = \frac{\left[ \frac{\text{Publications on SDG N w. authors in entity}}{\text{Total of publications w. authors in entity}} \right]}{\left[ \frac{\text{Publications on SDG N in the world}}{\text{Total of publications in the world}} \right]}$$

# Latin America: Relative Activity Index (RAI), by SDG



- RAI highlights (50% above World average)
  - SDG 02: Zero Hunger
  - SDG 04: Quality Education
  - SDG 06: Clean Water
  - SDG 08: Decent Work
  - SDG 12: Responsible consumption
  - SDG 14: Life below Water
  - SDG 15: Life on Land

Source: Elsevier, SciVal

# Brazil and Mexico, 2016-2019, by SDG

Relative Activity Index (RAI), Brazil

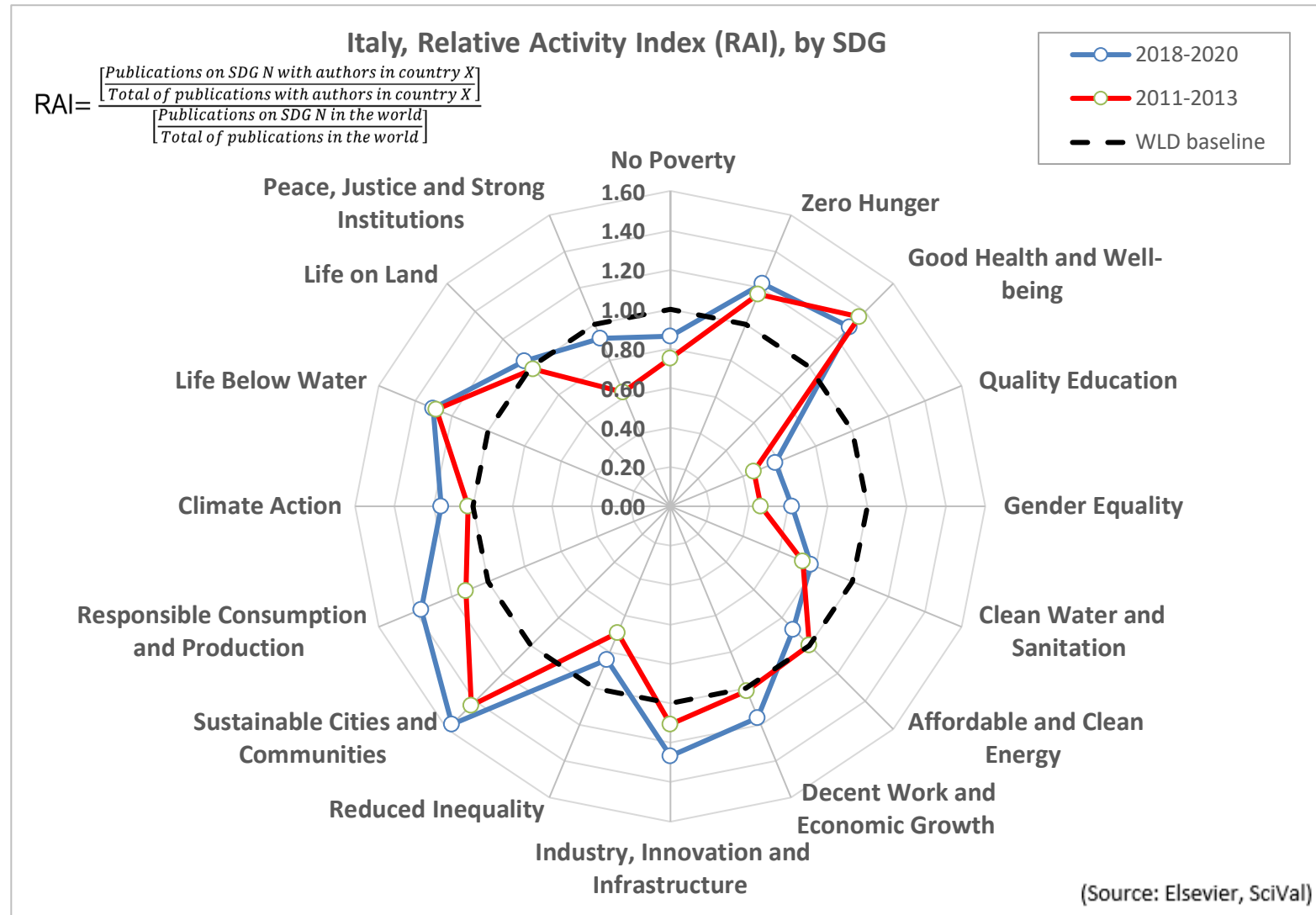


Relative Activity Index (RAI), Mexico





# Relative Activity Index, Italy, 2011-2013 and 2018-2020



# Colombia and Chile, 2016-2019, by SDG

Relative Activity Index (RAI), Colombia



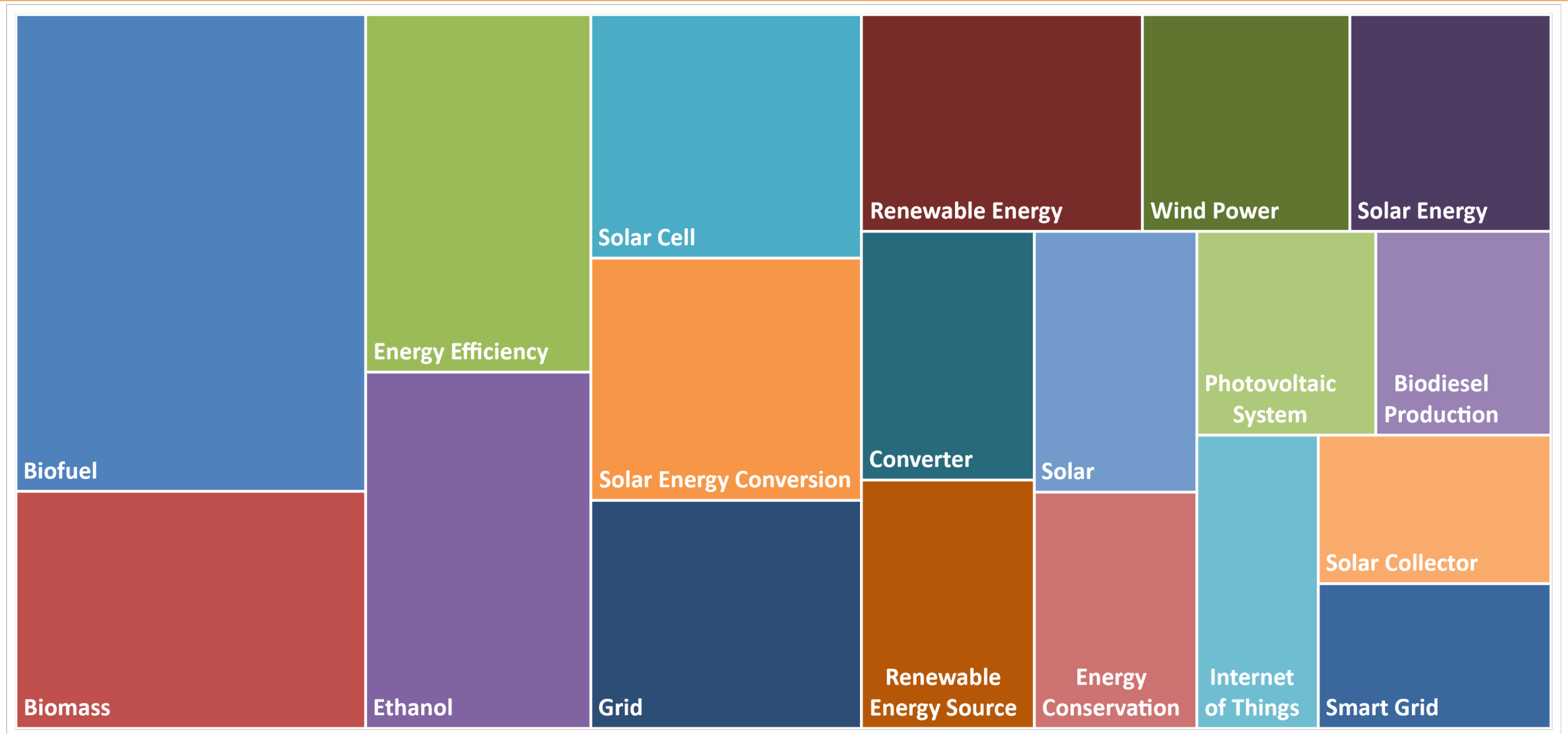
Relative Activity Index (RAI), Chile



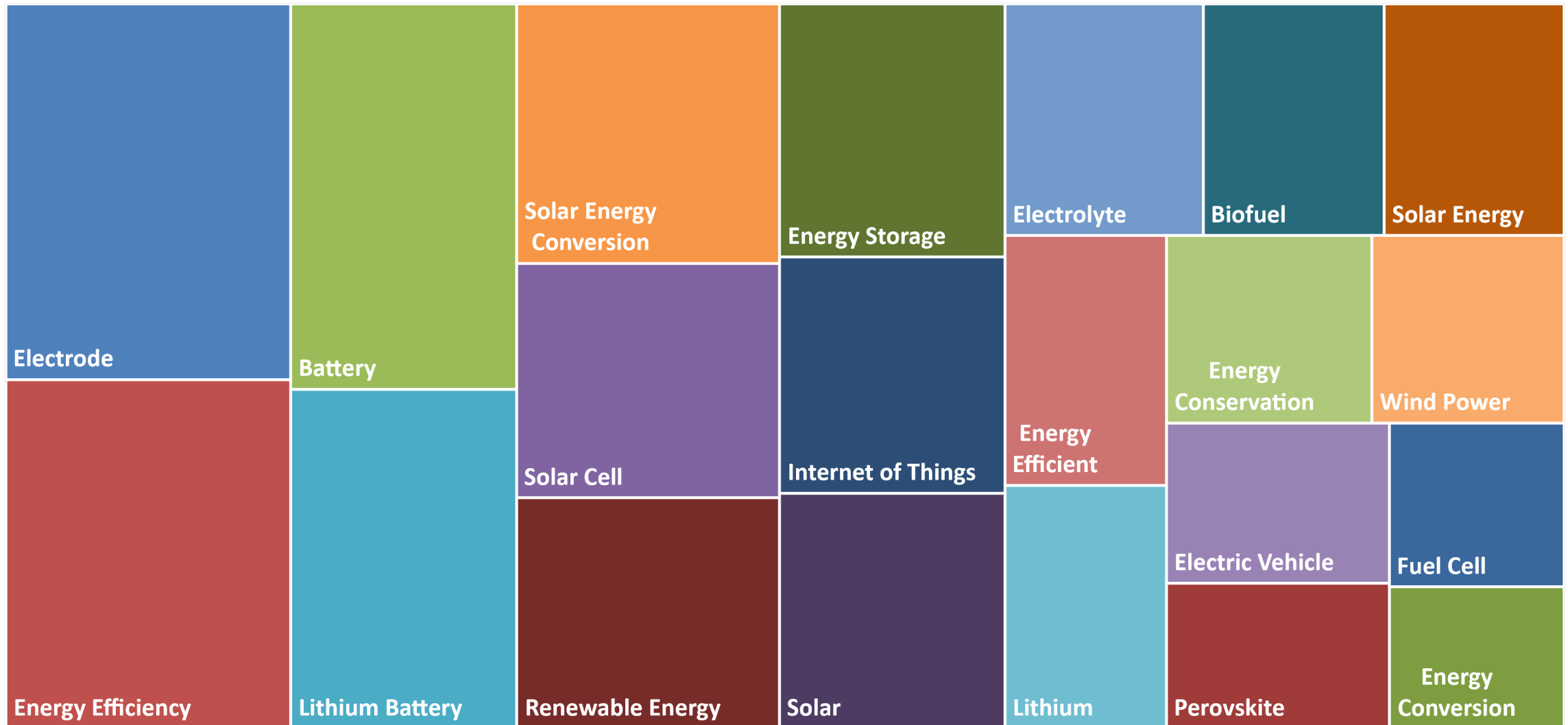
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# ***SDG 07: CLEAN ENERGY RESEARCH***

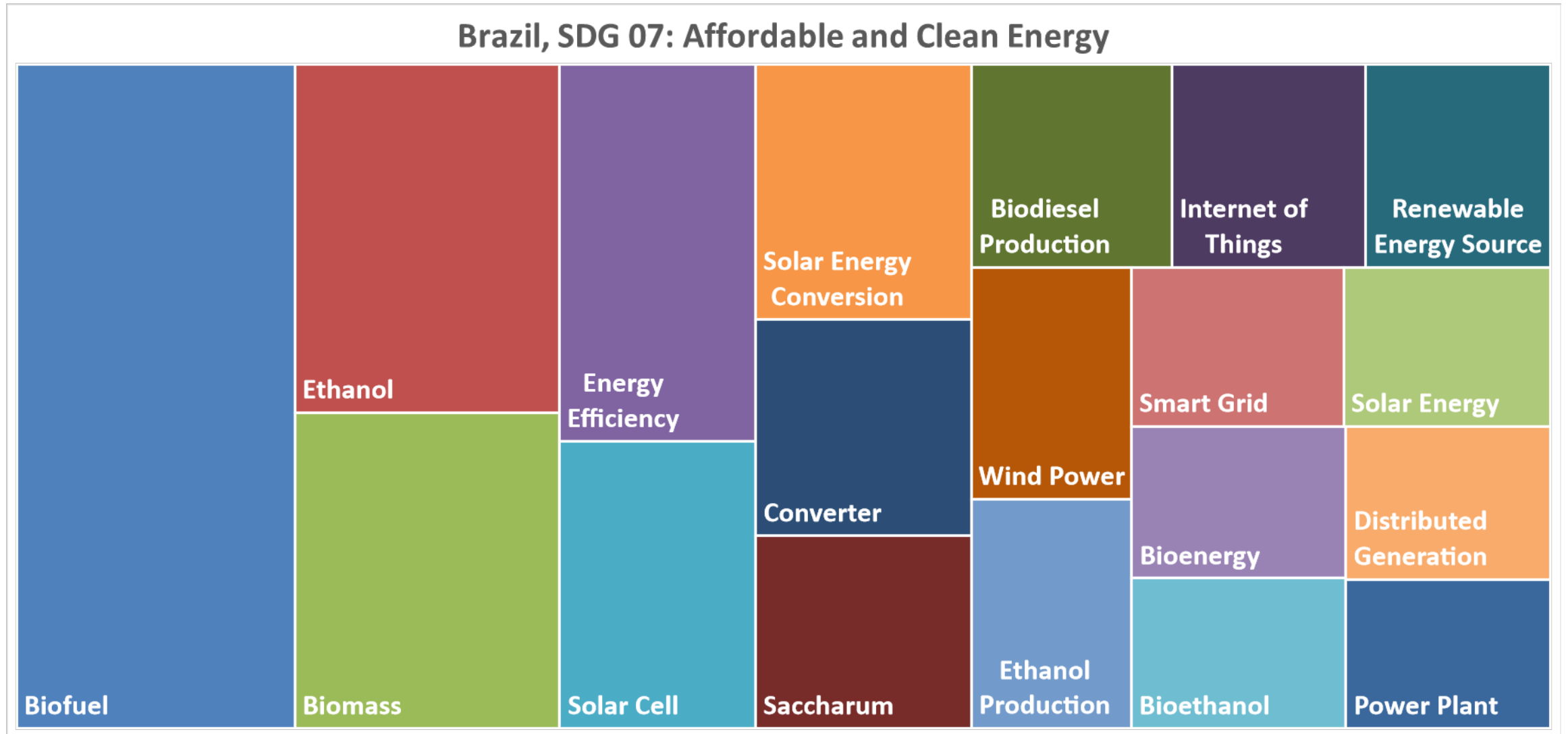
# South American Countries: main keyphrases on SDG 07 publications, 2011-2020



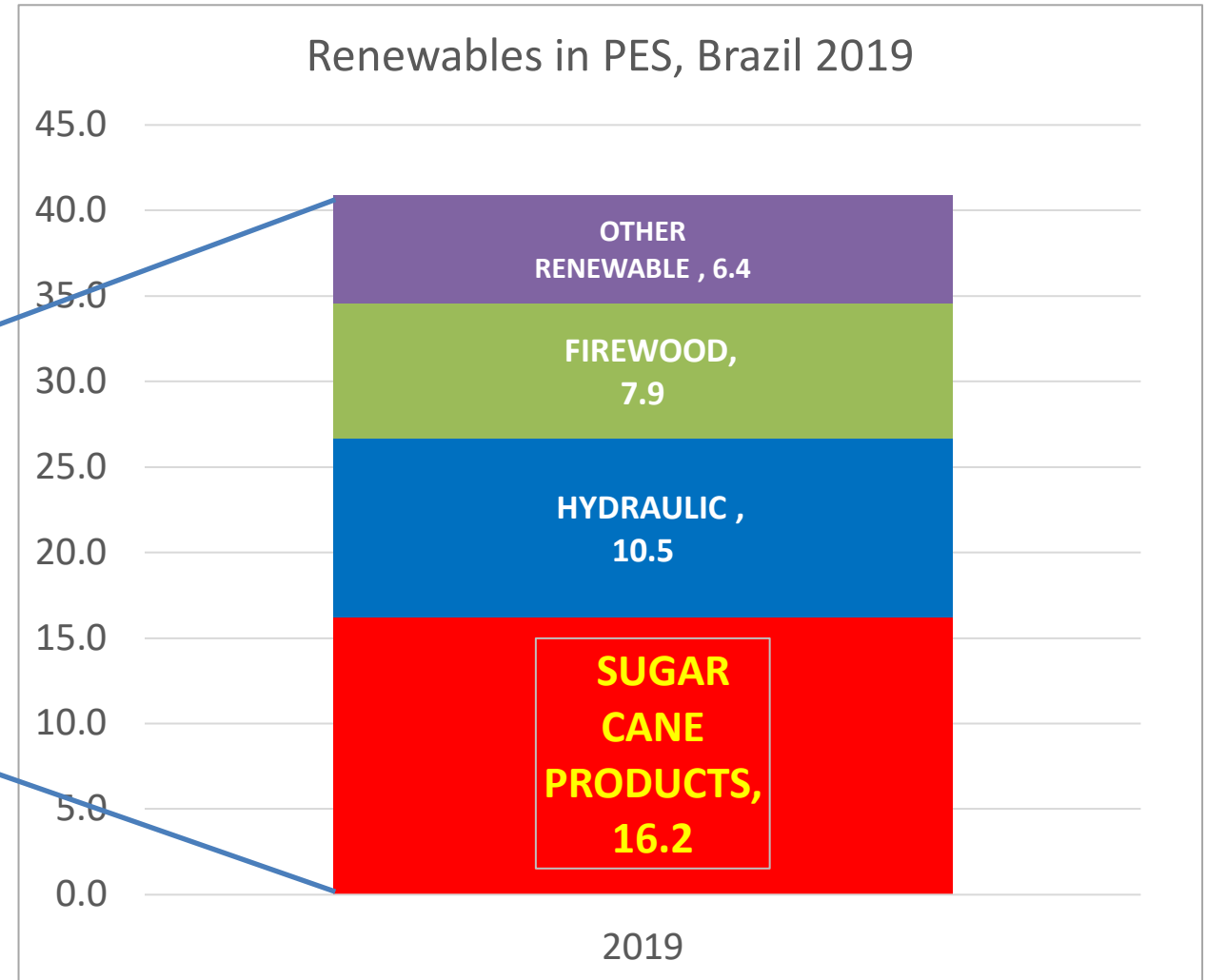
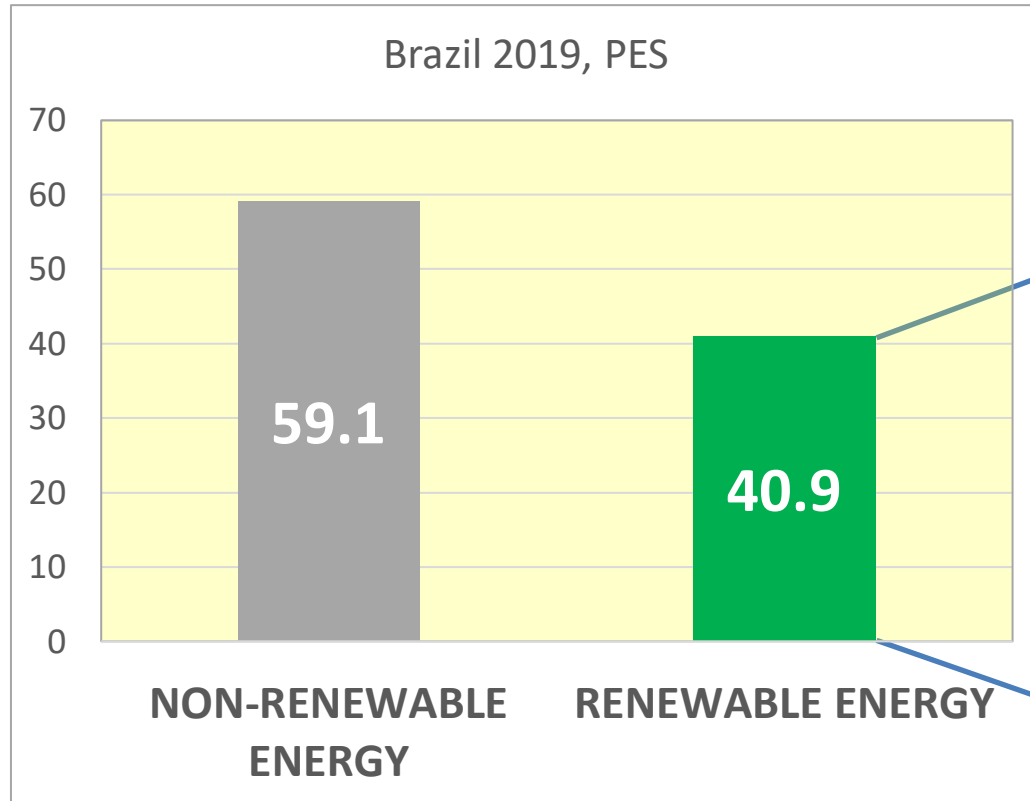
## USA: main research topics in SDG 07: Affordable and Clean Energy



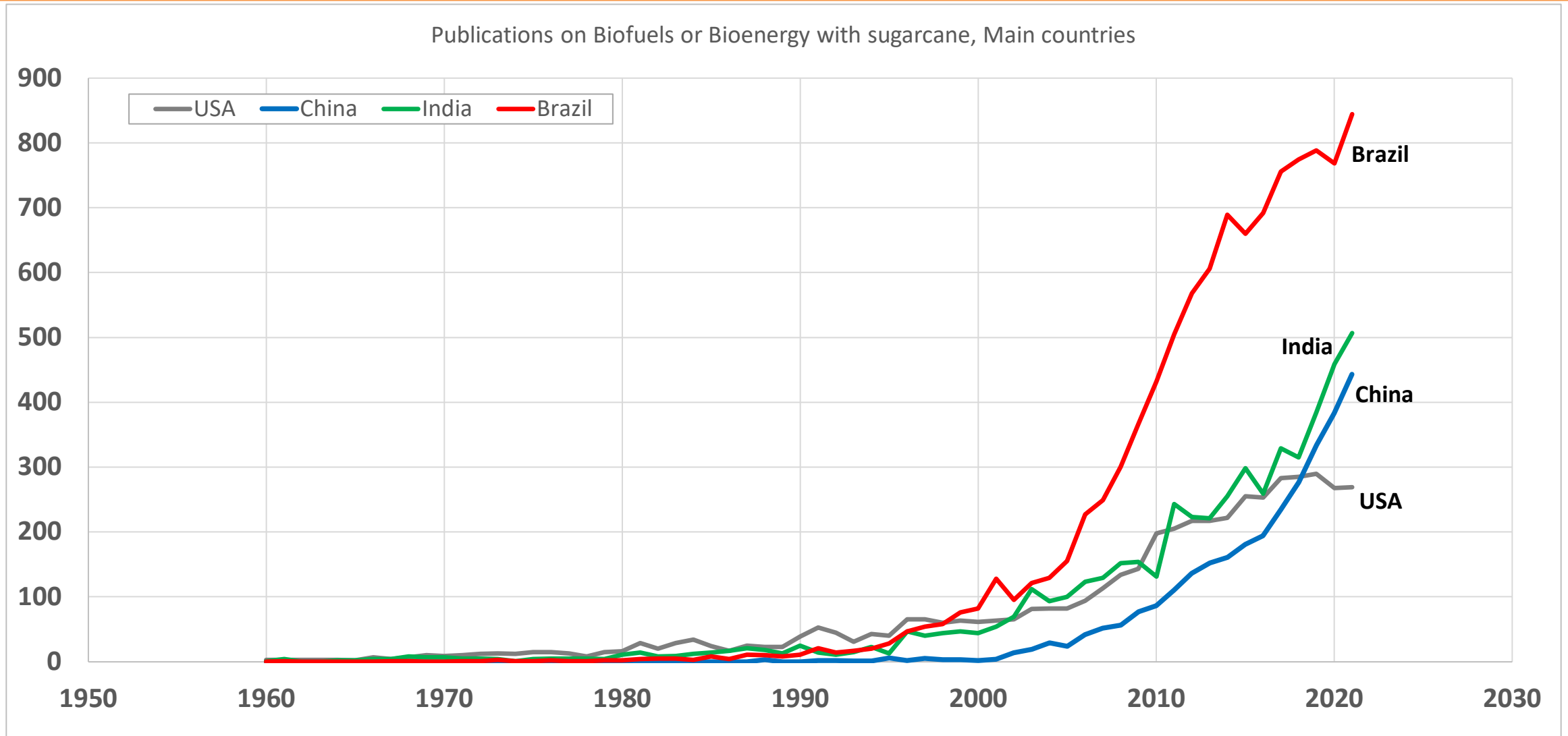
# *Brazil: research topics in SDG 07, 2011-2020*



# *Brazil Energy Supply, 2019: 16% of Primary Energy Supply (PES) from sugar cane*

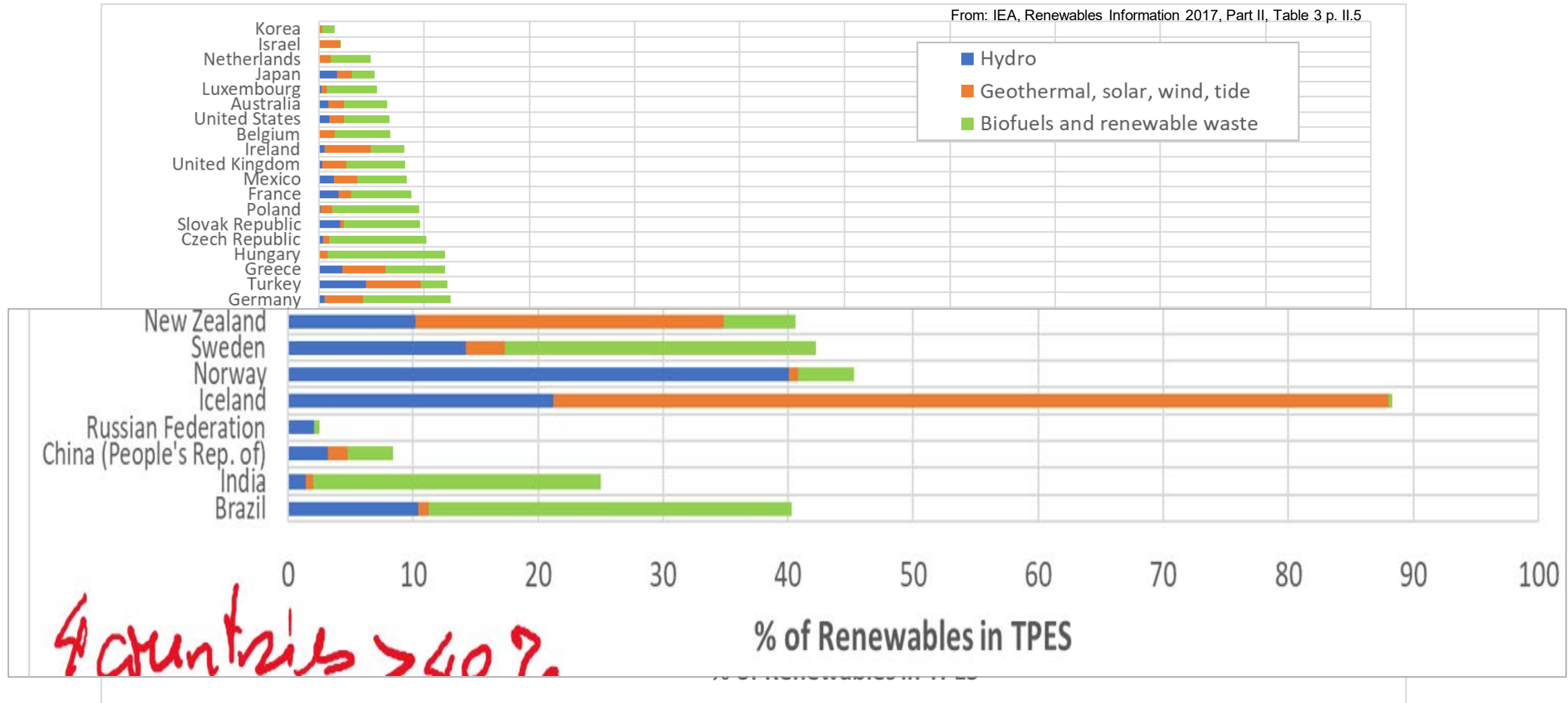


# *Sugarcane research for bioenergy: Brazil, India, China, USA*





# BRIC and OECD countries: % renewables in Total Primary Energy Supply, by type



**Higher productivity sugarcane:  
84 → 148 → 212 → 381 ton/Ha??**

Review article

# Sugarcane for bioenergy production: an assessment of yield and regulation of sucrose content

Alessandro J. Wacławovsky<sup>1,†,‡</sup>, Paloma M. Sato<sup>1,‡</sup>, Carolina G. Lembke<sup>1</sup>, Paul H. Moore<sup>2</sup> and Glaucia M. Souza<sup>1,\*</sup>

<sup>1</sup>Departamento de Bioquímica, Instituto de Química, Av. Prof. Lineu Prestes, São Paulo, Brazil

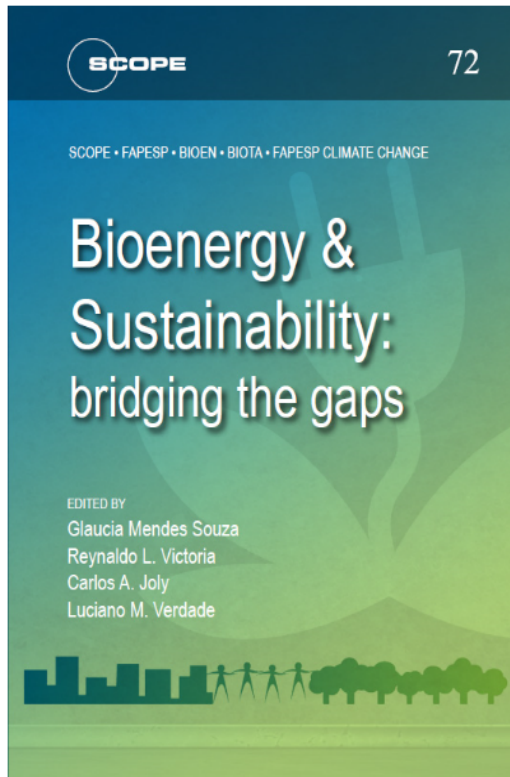
<sup>2</sup>Hawaii Agriculture Research Center, Kūia, HI, USA

**Table 1** Average, maximum and theoretical sugarcane yields (Australia, Colombia, and South Africa) and total dry matter production

Type of yield	Cane yield	Biomass*	
	t/(ha yr)	t/(ha yr)	g/(m <sup>2</sup> d)
Commercial Average	84	39	10.7
Commercial maximum	148	69	18.8
Experimental maximum	212	98	27.0
Theoretical maximum	381	177	48.5

# Sustainable Bioenergy: researchers in Brazil contribute to the international debate

Bioenergy & Sustainability: bridging the gaps



**SCOPE Bioenergy & Sustainability is a collective effort with contributions from 137 researchers of 82 institutions in 24 countries.**

The volume is the outcome of an assessment that included a meeting held at UNESCO, Paris, in December 2013. Fifty experts discussed bioenergy sustainability across its whole lifeline and crosscutting aspects including energy security, food security, environmental and climate security, sustainable development and innovation.

Goldemberg J et al., “Energy Balance for Ethyl Alcohol Production from Crops”, Science 201 p. 903-906 (1978)

**Green house gases emissions in the production and use of ethanol from sugarcane in Brazil: The 2005/2006 averages and a prediction for 2020**

Isaias C. Macedo<sup>a,\*</sup>, Joaquim E.A. Seabra<sup>b</sup>, João E.A.R. Silva<sup>c</sup>

<sup>a</sup>Interdisciplinary Center for Energy Planning (NIPE), State University of Campinas (Unicamp), CEP 13084-971, Campinas, SP, Brazil

<sup>b</sup>College of Mechanical Engineering, State University of Campinas, Cidade Universitária “Zeferino Vaz”, CEP 13083-970, Barão Geraldo, Campinas-SP, Brazil

<sup>c</sup>Centro de Tecnologia Canavieira (CTC), CEP 13400-040, Piracicaba, SP, Brazil

Review article

**Sugarcane for bioenergy production: an assessment of yield and regulation of sucrose content**

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<sup>1</sup>Departamento de Bioquímica, Instituto de Química, Av. Prof. Lineu Prestes, São Paulo, Brazil

<sup>2</sup>Hawaii Agriculture Research Center, Kunia, HI, USA

**Potential of Sugarcane in Modern Energy Development in Southern Africa**

Simone P. Souza<sup>1\*</sup>, Luiz A. Horta Nogueira<sup>1</sup>, Helen K. Watson<sup>2</sup>, Lee Rybeck Lynd<sup>3</sup>, Mosad Elmissiry<sup>4</sup> and Luis A. B. Cortez<sup>5</sup>

<sup>1</sup>Interdisciplinary Center for Energy Planning, University of Campinas (UNICAMP), Campinas, SP, Brazil, <sup>2</sup>School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Durban, KZN, South Africa, <sup>3</sup>Dartmouth College, Thayer School of Engineering, Dartmouth, NH, USA, <sup>4</sup>New Partnership for Africa's Development (NEPAD), Johannesburg, GT, South Africa, <sup>5</sup>Faculty of Agricultural Engineering, University of Campinas (UNICAMP), Campinas, SP, Brazil



ELSEVIER

Renewable and Sustainable Energy Reviews

Volume 76, September 2017, Pages 292-308



## Sustainable and Integrated Bioenergy Assessment for Latin America, Caribbean and Africa (SIByl-LACAf): The path from feasibility to acceptability

Luiz Augusto Horta Nogueira <sup>a</sup>, Luiz Gustavo Antonio de Souza <sup>a</sup> ✉, Luís Augusto Barbosa Cortez <sup>b</sup>, Manoel Regis Lima Verde Leal <sup>c</sup>

✚ Show more

Review | Open Access | Published: 12 February 2015

## Bioenergy and African transformation

Lee R Lynd, Mariam Sow, Annie FA Chimphango, Luis AB Cortez, Carlos H Brito Cruz, I Mark Laser, Ibrahim A Mayaki, Marcia AFD Moraes, Luiz AH Nogueira, Gideon M Wolf & Willem H van Zyl ✉

*Biotechnology for Biofuels* 8, Article number: 18 (2015) | Cite this article

8793 Accesses | 37 Citations | 19 Altmetric | Metrics

## Sugarcane: a way out of energy poverty



First published: 05 May 2016 | <https://doi.org/10.1002/bbb.1648>

João G.D.B. Leite, Interdisciplinary Center for Energy Planning (Nipe/Unicamp), Campinas, Brazil  
Manoel R.L.V. Leal, Brazilian Bioethanol Science and Technology Laboratory (CTBE), Campinas, Brazil  
Luiz A.H. Nogueira, Interdisciplinary Center for Energy Planning (Nipe/Unicamp), Campinas, Brazil  
Luis A.B. Cortez, School of Agriculture Engineering (Feagri/Unicamp), Campinas, Brazil  
Bruce E. Dale, Michigan State University, East Lansing, MI, USA  
Rui C. da Maia, Technical University of Mozambique (UDM), Maputo, Mozambique  
Clement Adjorlolo, South African National Space Agency (SANSA), Pretoria, South Africa

ORIGINAL RESEARCH article

Front. Energy Res., 26 December 2016 | <https://doi.org/10.3389/fenrg.2016.00039>



## Potential of Sugarcane in Modern Energy Development in Southern Africa

Simone P. Souza<sup>1\*</sup>, Luiz A. Horta Nogueira<sup>1</sup>, Helen K. Watson<sup>2</sup>, Lee Rybeck Lynd<sup>3</sup>, Mosad Elmissiry<sup>4</sup> and Luís A. B. Cortez<sup>5</sup>

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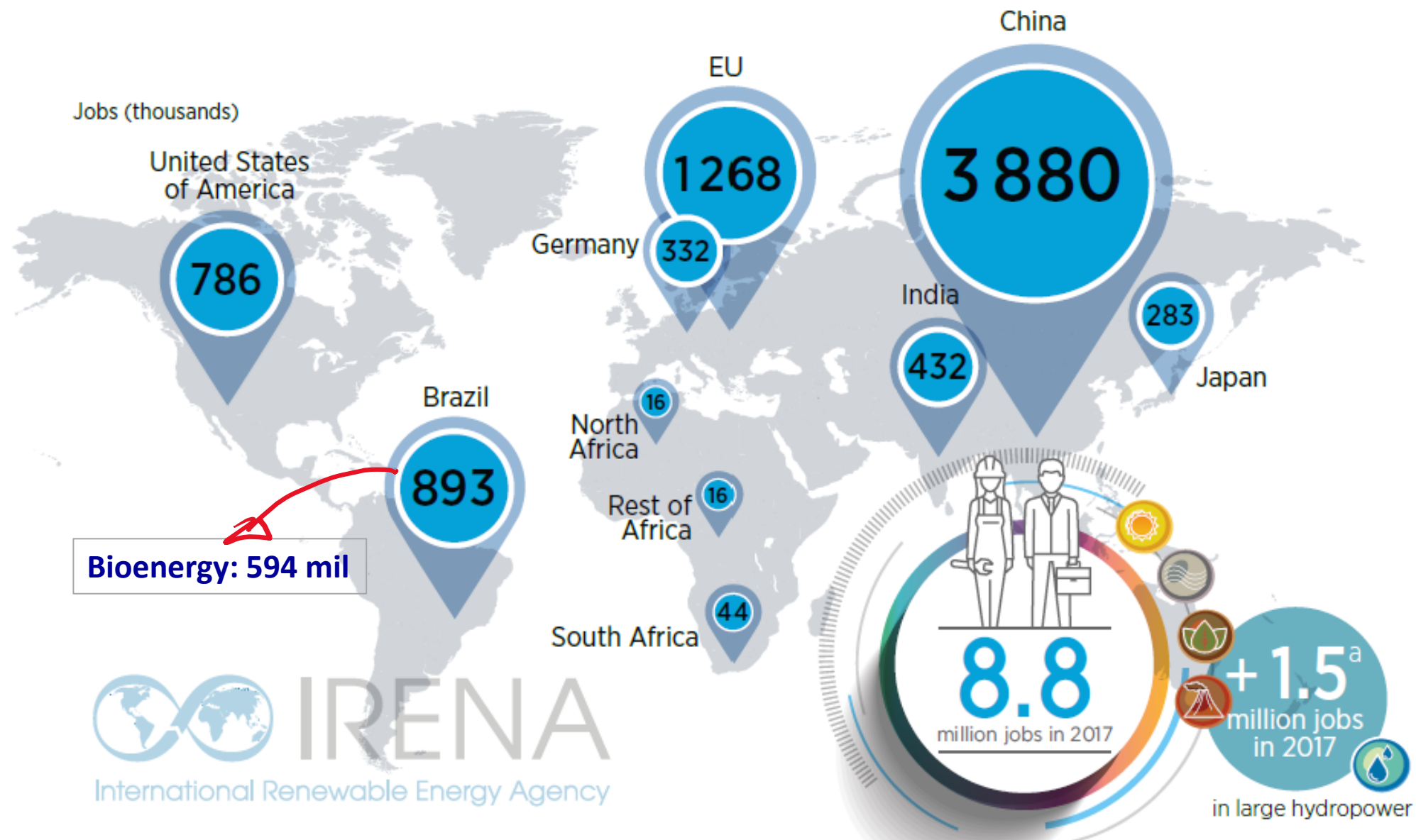
<sup>3</sup>Dartmouth College, Thayer School of Engineering, Dartmouth, NH, USA

<sup>4</sup>New Partnership for Africa's Development (NEPAD), Johannesburg, GT, South Africa

<sup>5</sup>Faculty of Agricultural Engineering, University of Campinas (UNICAMP), Campinas, SP, Brazil



FIGURE 8: RENEWABLE ENERGY EMPLOYMENT IN SELECTED COUNTRIES



Source: IRENA jobs database.

<sup>a</sup> Jobs in large hydropower are not included in the country totals given differences in methodology and uncertainties in underlying data. However, data for the EU and Germany include large hydropower jobs.

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***FUNDAMENTAL RESEARCH AND LARGE  
FACILITIES ALSO HAVE A PLACE***

# Astrophysics in Chile







Physicists Ana Machado and Ettore Segreto trundled their car along an Italian road, headed from Gran Sasso National Laboratory.....

<https://www.symmetrismagazine.org/article/arapuca-let-there-be-light-traps>

## ciência

### Brasil projeta 'arapuca' para detectar neutrinos

SALVADOR NOGUEIRA  
COLABORAÇÃO PARA A FOLHA

01/10/2016 02h00

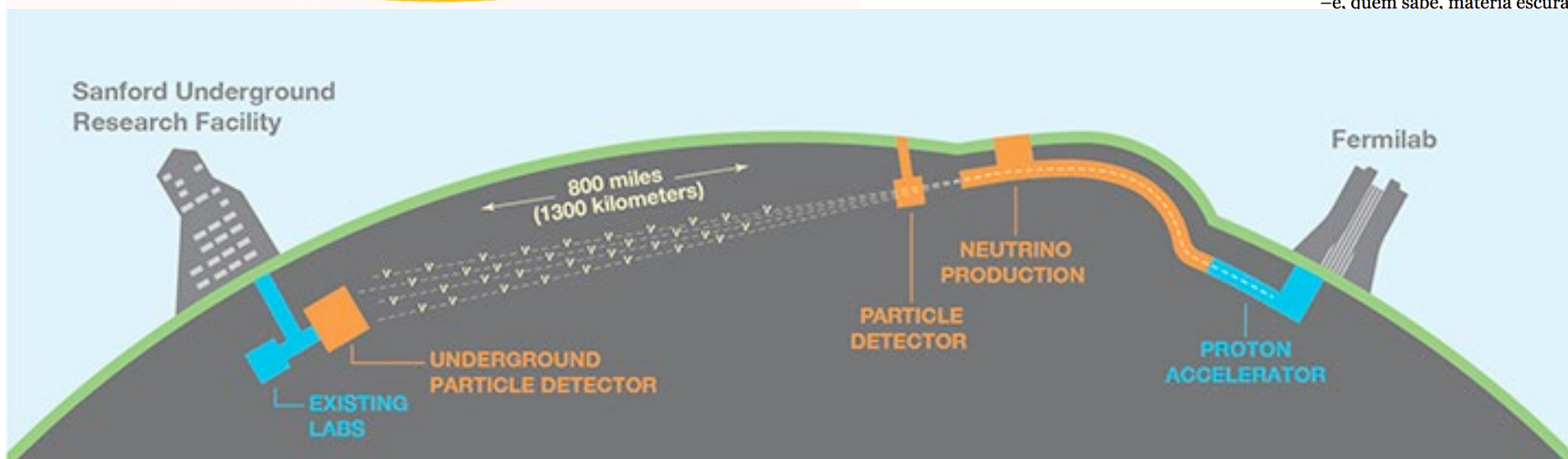
[f](#) Compartilhar [t](#) [g+](#) [in](#) [e](#) 794 [OUVR O TEXTO](#) [+ Mais opções](#)

Um grupo de pesquisadores no Brasil está desenvolvendo uma arapuca para detectar neutrinos –e, quem sabe, matéria escura.

te Arapuca, é  
Machado, da  
P), e Ettore Segreto,



is estão envolvidos na enorme cooperação  
nilab, em Chicago (EUA), para a construção  
s sensível detector de neutrinos do mundo.





# Enhancing Neutrino Detection: the ARAPUCA light trap



PUBLISHED BY IOP PUBLISHING FOR SISSA MEDIALAB

RECEIVED: November 15, 2015

ACCEPTED: December 16, 2015

PUBLISHED: February 2, 2016

LIGHT DETECTION IN NOBLE ELEMENTS (LIDINE2015)  
AUGUST 28–30, 2015  
ALBANY, NY, U.S.A.

## ARAPUCA a new device for liquid argon scintillation light detection

**A.A. Machado<sup>1</sup> and E. Segreto**

*Instituto de Física Gleb Wataghin Universidade Estadual de Campinas – Unicamp,  
Rua Sérgio Buarque de Holanda, No 777, CEP 13083-859 Campinas, São Paulo, Brazil*

PREPARED FOR SUBMISSION TO JINST

LIDINE 2017: LIGHT DETECTION IN NOBLE ELEMENTS  
22-24 SEPTEMBER 2017  
SLAC NATIONAL ACCELERATOR LABORATORY

## Increasing the efficiency of photon collection in LArTPCs: the ARAPUCA light trap

G. Cancelo,<sup>a</sup> F. Cavanna,<sup>a</sup> C. O. Escobar,<sup>a</sup> E. Kemp,<sup>a,b,1</sup> A. A. Machado,<sup>c</sup> A. Para,<sup>a</sup> E. Segreto,<sup>b</sup> D. Totani,<sup>e</sup> D. Warner<sup>f</sup>

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<sup>d</sup>*Università degli Studi dell'Aquila,  
L'Aquila, 67100 (ABR), Italia*

<sup>e</sup>*Colorado State University,  
Fort Collins, 80523 (CO), USA*

*E-mail: [kemp@ifi.unicamp.br](mailto:kemp@ifi.unicamp.br)*

# Deep Underground Neutrino Experiment (DUNE): ARAPUCA photon detector test

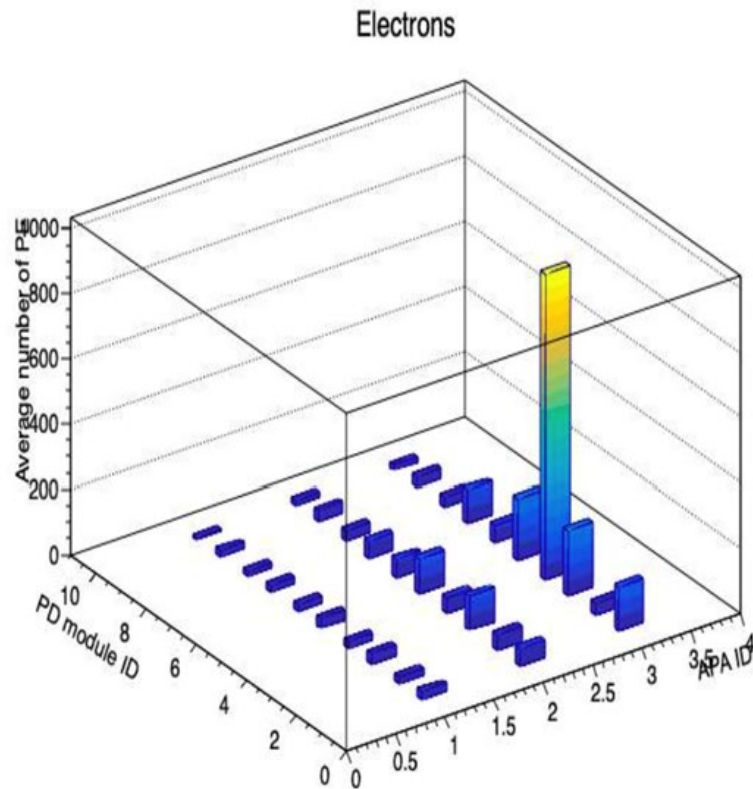


Figure 6: Average number of photons detected by the Photon Detection modules as a function of their position in the detector. The highest peak is the ARAPUCA signal.

- Highest peak is from the ARAPUCA detector
  - Ettore Segretto and Ana Amelia Machado, IFGW, Unicamp
- Others are from other teams (MIT, Indiana,...)

## NP04 summary

Momentum	Total Triggers	Expected Pi trig.	Expected Proton trig.	Expected Electr. trig.	Expected Kaon trig.
0.3 GeV/c	269K	0	0	242K	0
0.5 GeV/c	340K	1.5K	1.5K	296K	0
1 GeV/c	1089K	382K	420K	262K	0
2 GeV/c	728K	333K	128K	194K	5K
3 GeV/c	568K	284K	107K	113K	15K
6 GeV/c	702K	394K	8K	199K	28K
7 GeV/c	477K	299K	51K	88K	24K

- Very stable operation from the cryogenics point of view
- Operating the TPC with the cathode at -180 kV
- Drifting electron lifetimes > 6 ms and still improving
- Very good signal to noise and therefore image quality
- 3D reconstruction and analysis on real data ongoing

Probably the best LAr TPC ever constructed !!!

# *SIRIUS, Brazilian Synchrotron Light Source: LINAC and Booster inaugurated on Nov , 2018; first beam line in 2020*

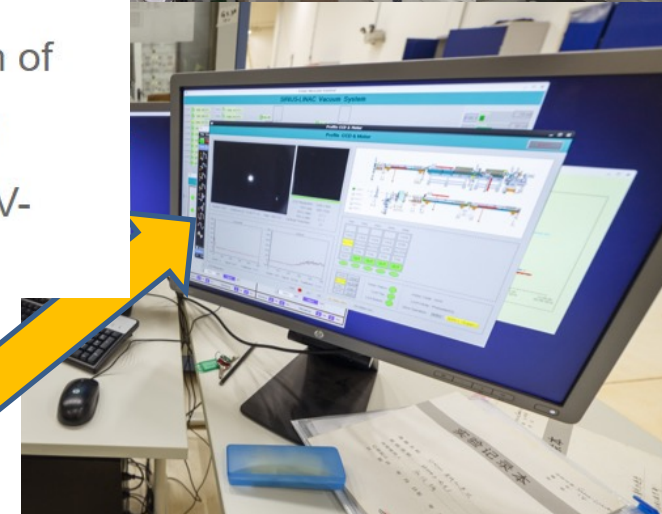
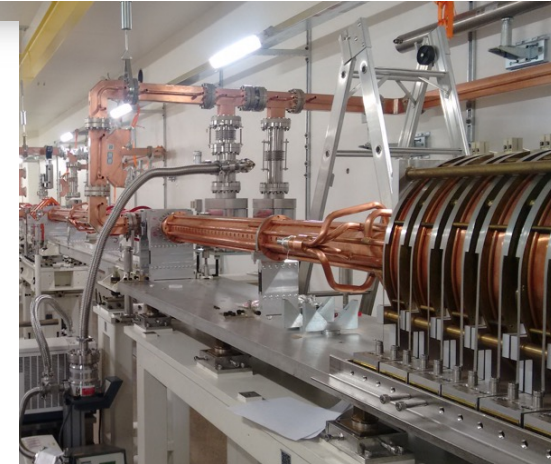


## Brazilian synchrotron light source helps scientists look for COVID-19 drugs in first experiment

November 04, 2020



**By Maria Fernanda Ziegler | Agência FAPESP** – A powerful beam of synchrotron light has enabled scientists to determine the structure of more than 200 protein crystals from the novel coronavirus SARS-CoV-2.



- Research in Latin America connects to the sustainable development goals
- The connection predates the SDGs
- The U.N. SDGs brought a convenient way to classify sustainability related Research
- Astrophysics in Chile as a Strong point in basic Science
- Bioenergy in Brazil as an interesting case for societal and economic impact of Research in a large scale
- Opportunities for Young Investigators with bold ideas