2023'e Doğru TÜBİTAK ile Geleceğe Bakış

Türkiye Cumhuriyeti
SANAYİ VE TEKNOLOJİ BAKANLIĞI

TÜBİTAK

Co-Creating and Succeeding Together towards Sustainable Development in the Post-COVID-19 World

NSTDA Presidents' Forum: Bio-Circular-Green Economy: Turning Challenges into Opportunities in the Post-COVID-19 World

NAC2021
16th NSTDA Annual Conference
การประชุมวิชาการประจำปี สวทช. ครั้งที่ ๑๖

NSTDA 36th Anniversary

Prof. Dr. Hasan MANDAL
TÜBİTAK President

March 26, 2021

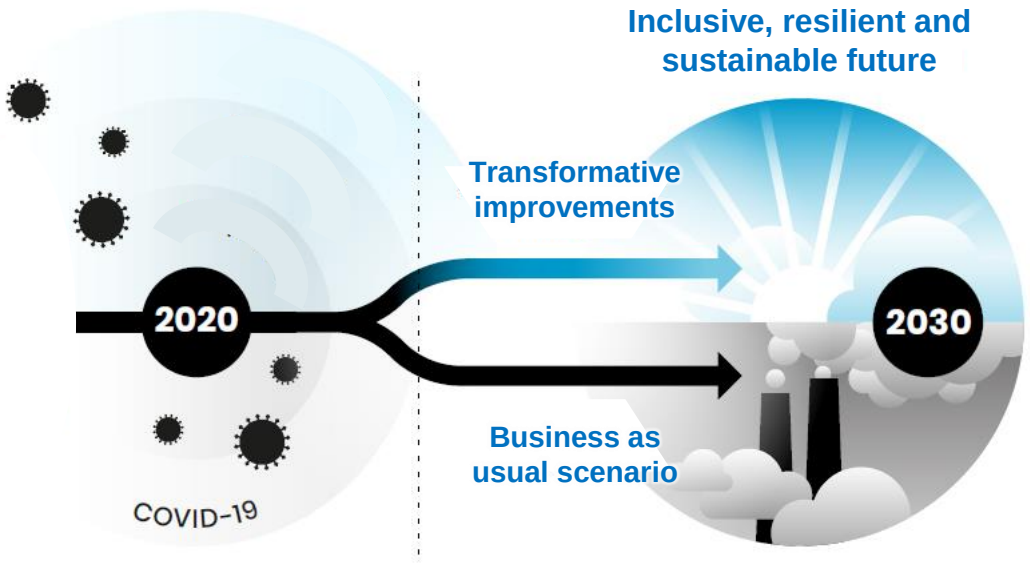
Transformation in R&D and Innovation Processes

- From linear to → **Reiterative innovation**
- From closed to → **Open innovation**
- From technological to → **Systemic challenge-driven innovation**
- From individual to → **Collaborative** and interdisciplinary innovation
- From spontaneous to → **Systematic innovation**
- From exchange-based innovation to → **Co-creation** in innovation
- From innovation projects to → **Common innovation cultures**

- Reiterative
- Open
- Systemic challenge-driven
- Collaborative
- Inter/trans-disciplinary
- Systemic innovation
- Co-creation
- Common cultures

Resolving Systemic Challenges with Transdisciplinary Approaches

Transdisciplinary approaches are necessary to resolve systemic challenges in environmental and socio-economics systems and make progress towards the direction of sustainable development.



INCREASING POSITIVE IMPACT WITH TRANSDISCIPLINARY APPROACHES

Sources: UN Research Roadmap for the COVID-19 Recovery (November 2020); https://www.un.org/development/desa/en/news/sustainable/sustainable-development-goals.html

TÜBİTAK in the R&D and Innovation Ecosystem

- **R&D infrastructure support in scientific and technological areas**

Establishment: 1963

1. Funding R&D and Innovation
2. STI Human Resources Development
3. Science and Society Activities
4. Performing R&D
5. International ST&I Cooperation

The **flagship institution** of science, technology and innovation celebrated the 57th anniversary on **July 24, 2020**

- **Establish research centers and institutes in strategic areas to strengthen the technological infrastructure of the country**

- **Work in coordination with the Presidential Policy Boards on scientific and technological R&D activities**

23 INSTITUTES

~4.600 RESEARCH PERSONNEL

Directing Our Policy Tools Towards Achieving Impact

Stronger

More targeted

Collaborative interactions

High value added

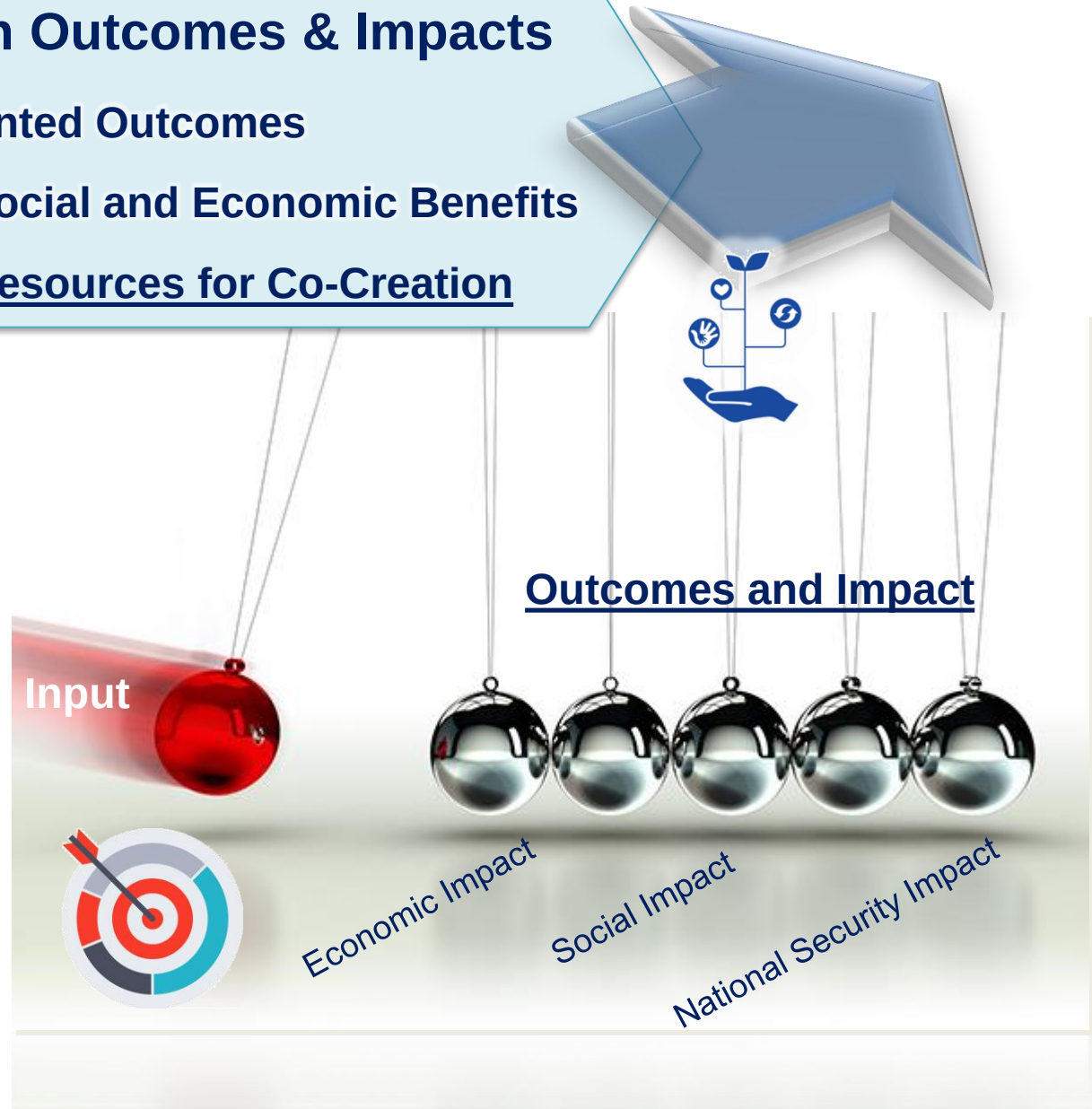
Societal and economic benefits

"Succeed Together"

Focusing on R&D and Innovation Outcomes & Impacts

- National Target Oriented Outcomes
- Transformation of Outcomes to Social and Economic Benefits
- New Knowledge and Human Resources for Co-Creation

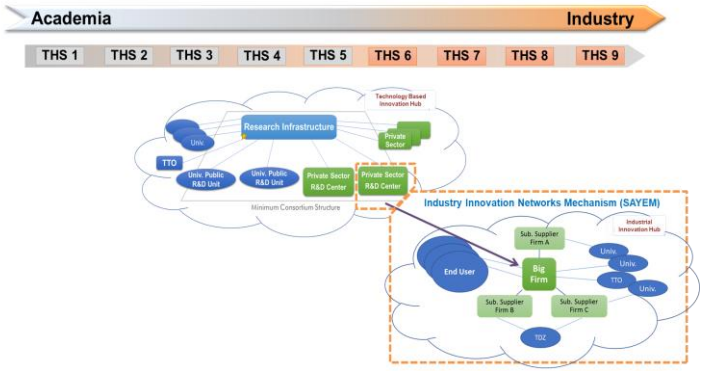
Impact oriented co-creation models



Impact Oriented Co-Creation Models for the Ecosystem

Mobilizing the R&D and innovation accumulation within the scope of co-creation models

Co-Creation Based New Knowledge



TÜBİTAK High Technology Platforms and Mechanism

- 9 platforms are implementing Strategic Research Programs
- **Integration of EU institutions and industrial firms**
- Phase II call of Industrial Innovation Network Mechanism

- SME Support for Demand Based R&D Projects (**Order R&D**)
- Supporting Patent-Based Technology Transfer (**Patent License**)

Priority R&D topics incentive also in bottom-up programs

New evaluation incentive for proposals addressing the European Green Deal

Co-Creation Oriented Human Resources

- **127 outstanding researchers from 21 countries** are pursuing impact with R&D projects in Turkey

- Providing an attractive arena for **frontier research with a new national frontier research scheme**

Impact Oriented National Co-Creation Models in the Ecosystem

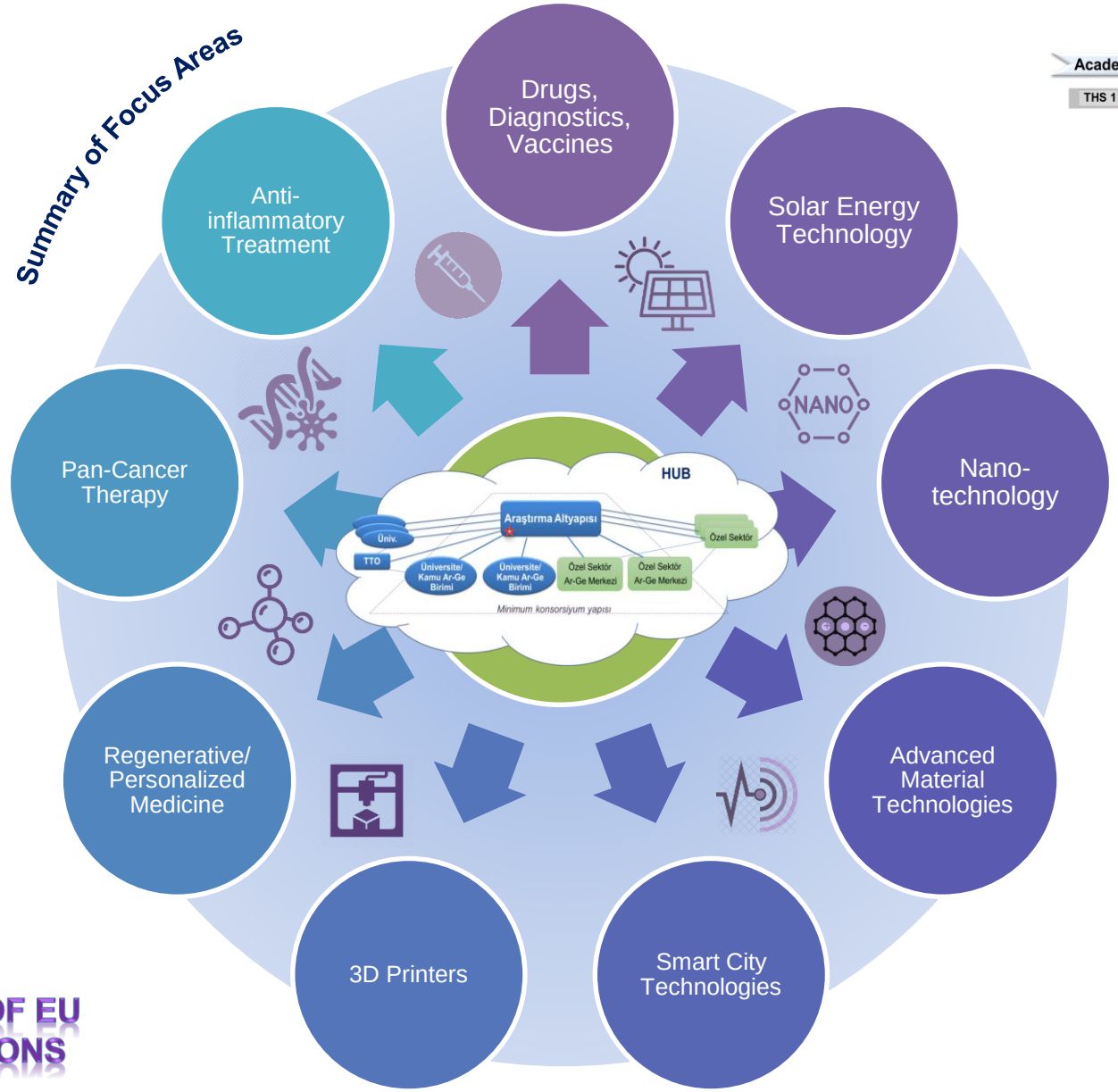
> 200

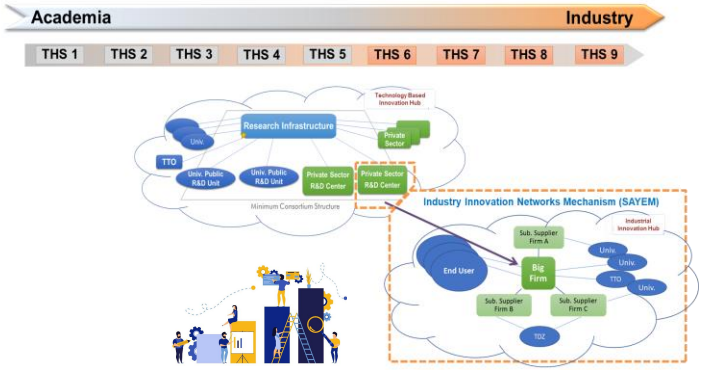
INSTITUTIONS AND COMPANIES FROM OUR ECOSYSTEM

17

CURRENT NUMBER OF EU PARTNER INSTITUTIONS

Summary of Focus Areas



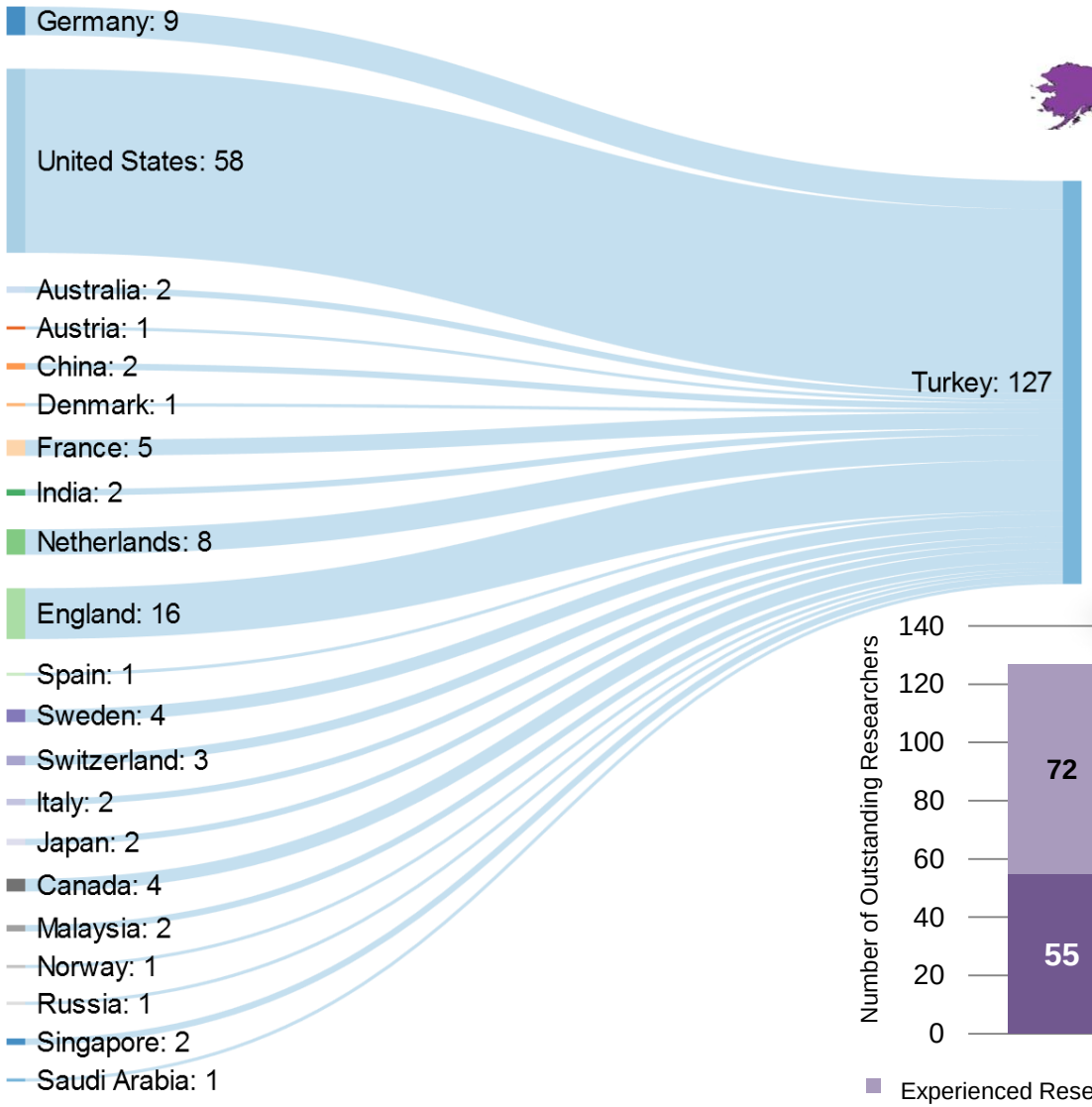


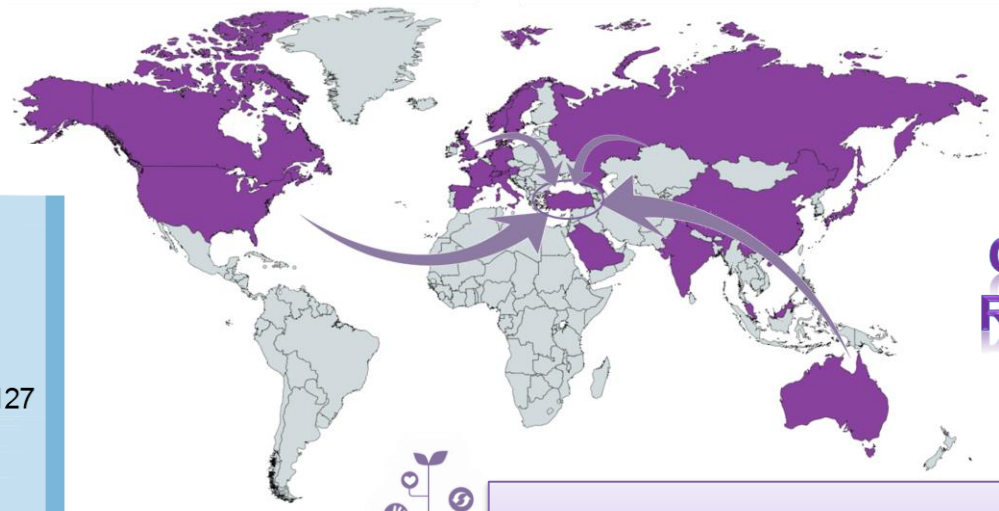
CO-CREATION WITH FOCUS ON OUTPUT AND IMPACT

Technology / Commercialization Roadmaps

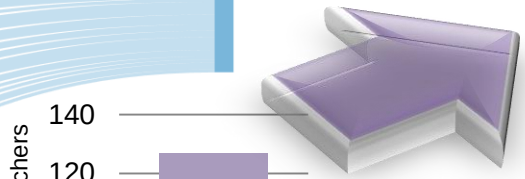
SAYEM 2. Phase Calls have opened

Outstanding Research Fellows Are Integrated With the Ecosystem





127
OUTSTANDING RESEARCHERS
IN THE FIRST CALL



Research Projects are Being Transformed into Impact

New 2021 Call for Outstanding Researchers (Across All Sectors)

- Launch of Call: March 2021
- Closure of Call: June 2021

Source: TÜBİTAK <https://tubitak.gov.tr/tr/burslar/doktora-sonrasi/arastirma-burs-programlari/icerik-2232-a-uluslararasi-lider-arastirmacilar-programi>

Co-Creation Oriented Human Resources: Industry Doctorate Program

Human resources that will contribute to co-creation are raised in areas that are demanded by the industry with university-industry co-advisors and additional support for the employment of doctoral researchers!

1162 DOCTORATE STUDENTS

80 UNIVERSITIES

224 INDUSTRIAL FIRMS

308 PROJECTS WHERE QUALIFIED HUMAN RESOURCES WILL BE RAISED TOGETHER

Source: TÜBİTAK <https://www.tubitak.gov.tr/tr/duyuru/2244-sanayi-doktora-programinin-ikinci-cagri-duyurusunun-sonuclari-aciklandi>

Supporting Scientific and Technological Advances Through Co-Creation

The COVID-19 Turkey Platform is accelerating R&D and innovation processes based on co-creation and the integration of new opportunities based on emerging technologies.

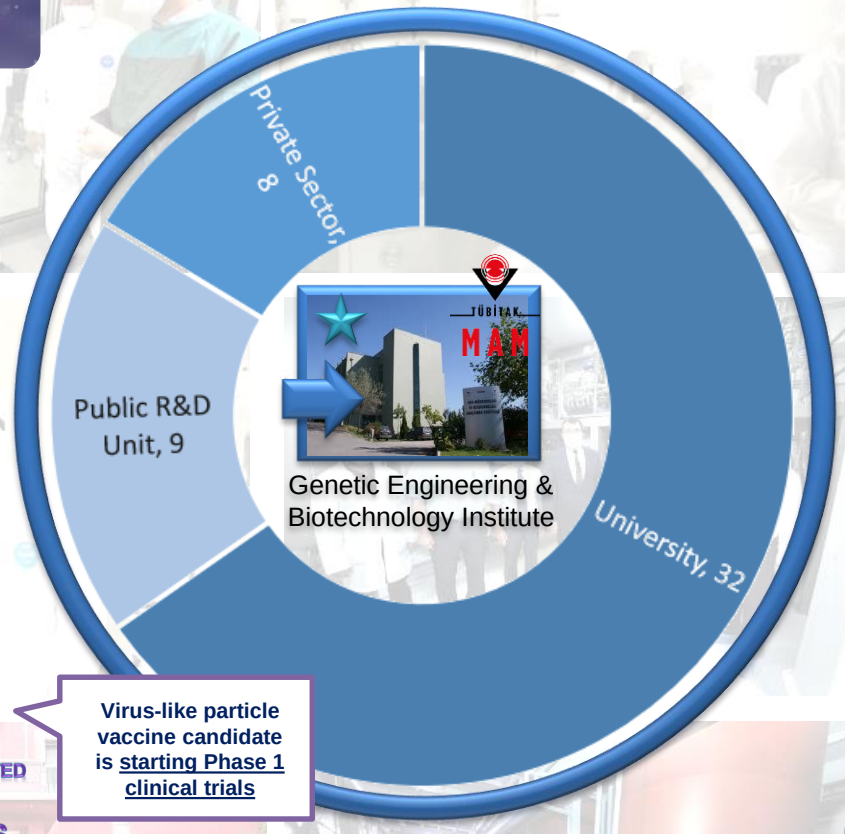
COVID-19 TÜRKİYE Platformu

ACCELERATING R&D AND INNOVATION WITH CO-CREATION AND EMERGING TECHNOLOGIES

436
RESEARCHERS

- **118** researchers from 32 universities
- **67** researchers from 9 public R&D units
- **38** researchers from 8 private sector firms
- **213** scholars including 167 STAR scholars

49
DIFFERENT INSTITUTIONS



17
PROJECTS

7
IMMUNITY ORIENTED VACCINE PROJECTS

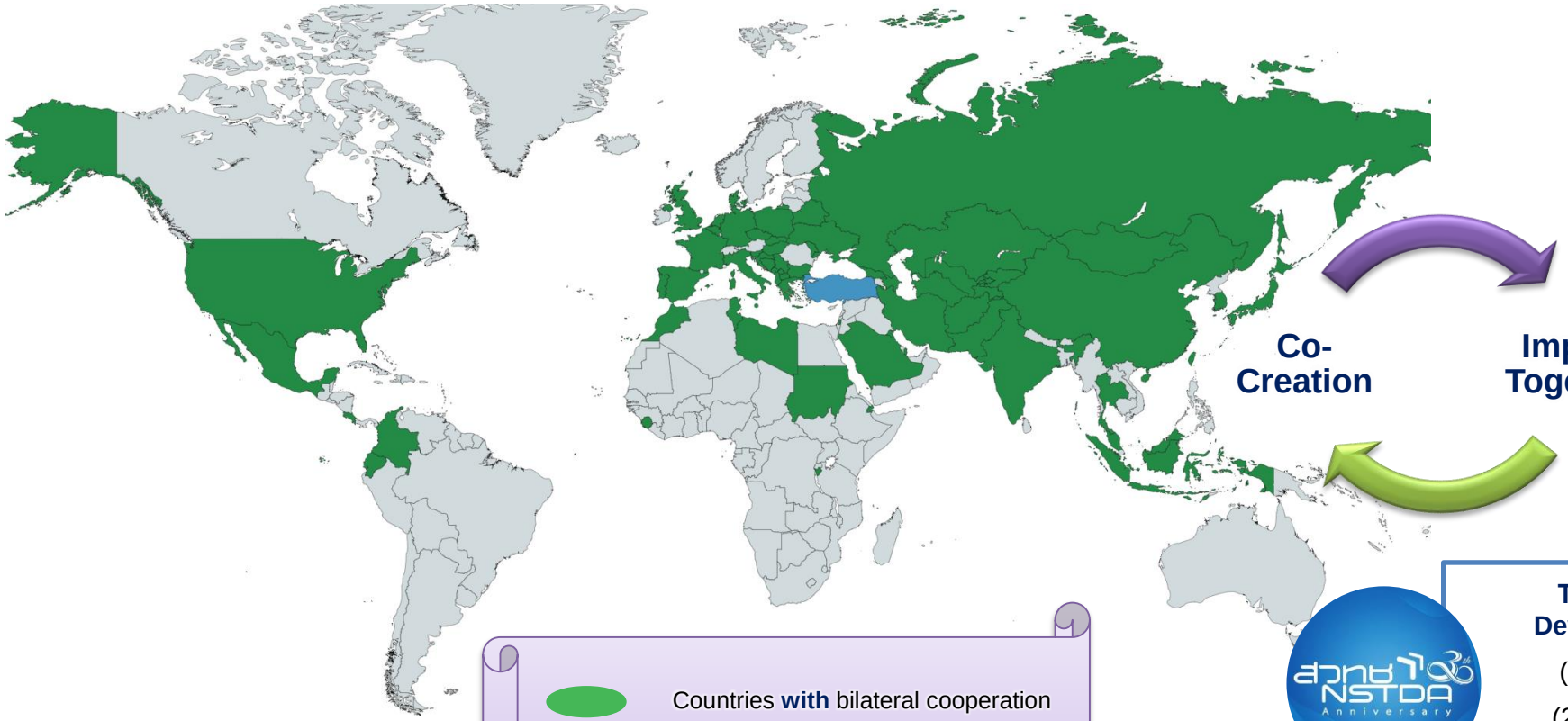
Virus-like particle vaccine candidate is starting Phase 1 clinical trials

10
TREATMENT ORIENTED DRUG PROJECTS

Sharing of resources and human resources

- Molecular Modelling
- Drug Repurposing
- Gene Sequencing

Global View of International Scientific and Technological Cooperation



Bilateral Cooperation with 63 Countries – 89 Institutions

- Joint Research and Innovation Projects, Scientific Activities, Researcher Exchange
- Additional cooperation with more than **100 countries through multilateral unions & platforms**
- **548 Ongoing International Cooperation Projects**

TÜBİTAK - National Science and Technology Development Agency (NSTDA) MoU signed 2018

(2019 Call: Food security, Biodiversity, and IoT)

(2020 Call: Food security, Biomedicals, Sensors)

New agreements and calls continue in 2021

Co-Creation Solutions in the New Normal Order Towards Post COVID-19

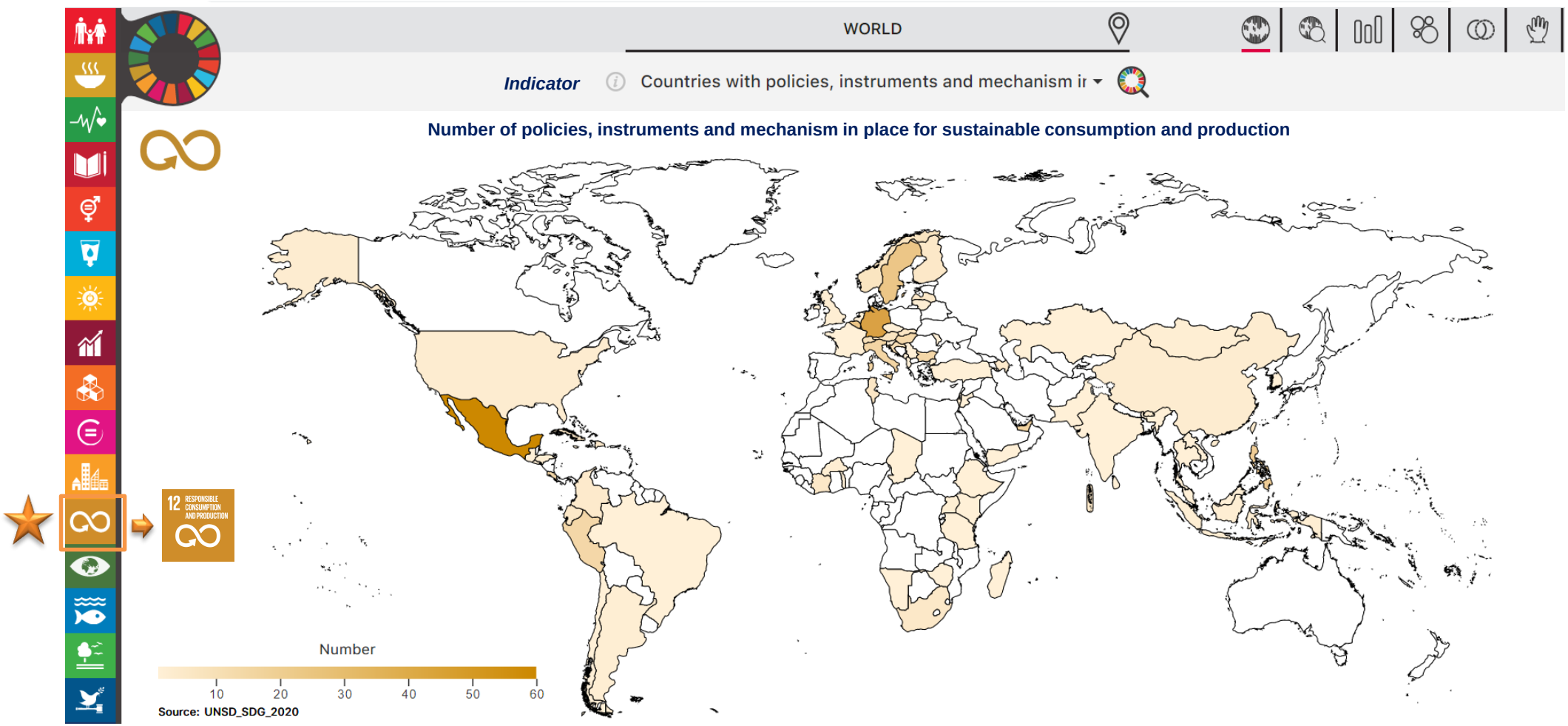
Previous Feature	Transformed Feature	Evaluation of its Importance During the COVID-19 Outbreak
Linear innovation	→ Reiterative innovation	✓ **Providing speed to R&D and innovation-oriented solutions**
Closed innovation	→ Open innovation	✓ **Inclusion of necessary resources in R&D and innovation processes**
Technology-driven innovation	→ Systemic challenge driven innovation	✓ **Combatting the challenge in a multi-faceted manner**
Individual innovation	→ Cooperative and multi-disciplinary innovation	✓ **Actors coming together for more effective solutions**
Spontaneous innovation	→ Systematic innovation	✓ **Emphasis on the importance and urgency of strategic approaches**
Innovation focused on knowledge transfer	→ Co-creation based innovation	✓ **Emphasis on common processes leading to the path to success**
Innovation projects	→ Innovation culture	✓ **Ensuring that a sustained paradigm shift takes place**

Source: Mandal, H. (2020) R&D and Innovation Approaches and Co-Creation Solutions in the New Normal Order

SDG12

Towards Sustainable Consumption and Production with Co-Creation

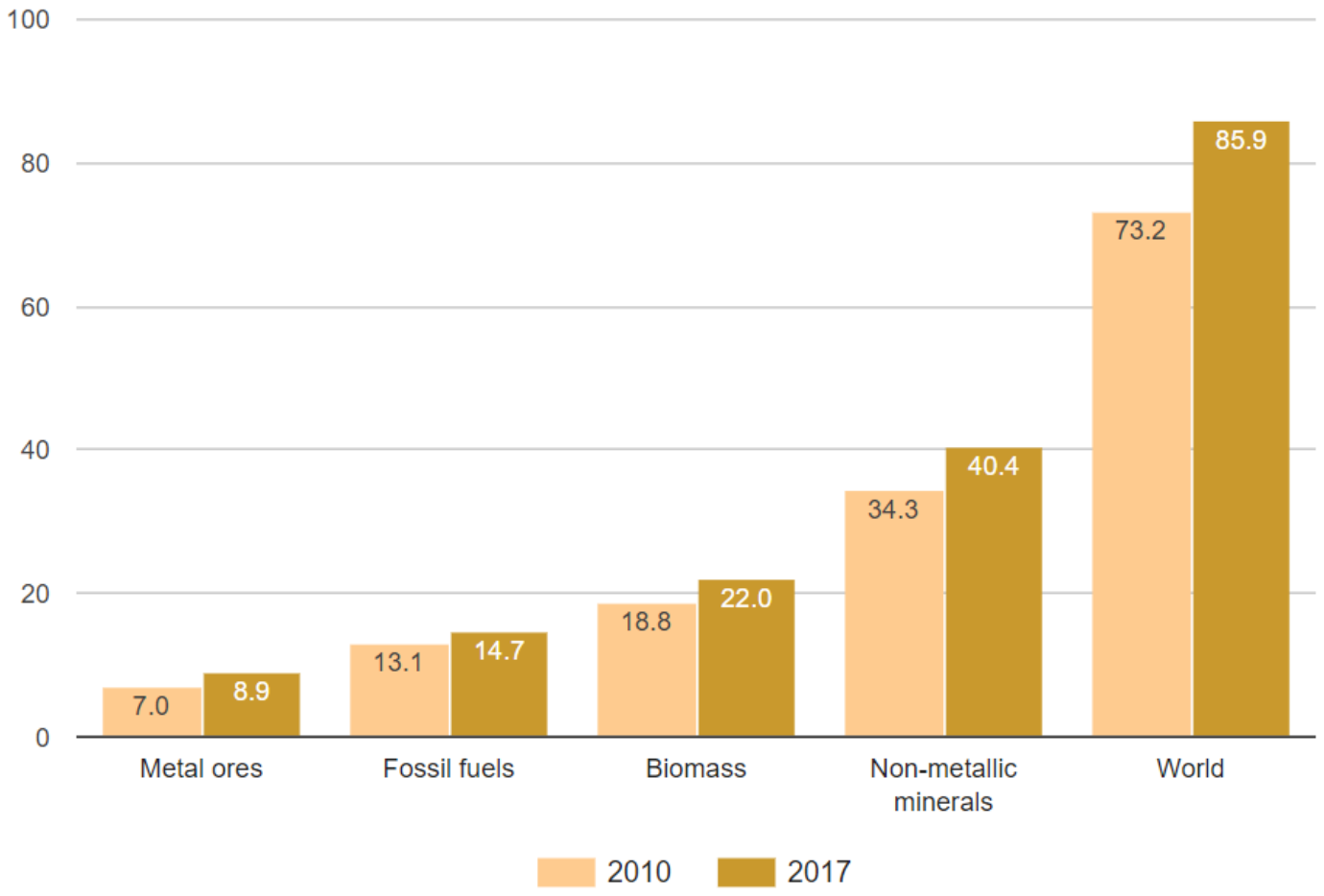
As policies, instruments and mechanisms to support progress towards SDG12 is increasing, it is important that <u>these policies are supported with co-creation based R&D and innovation</u>.



Source: SDGs Dashboard <https://www.sdgsdashboard.org/>

Transformation in R&D and Innovation Can Transform Material Use

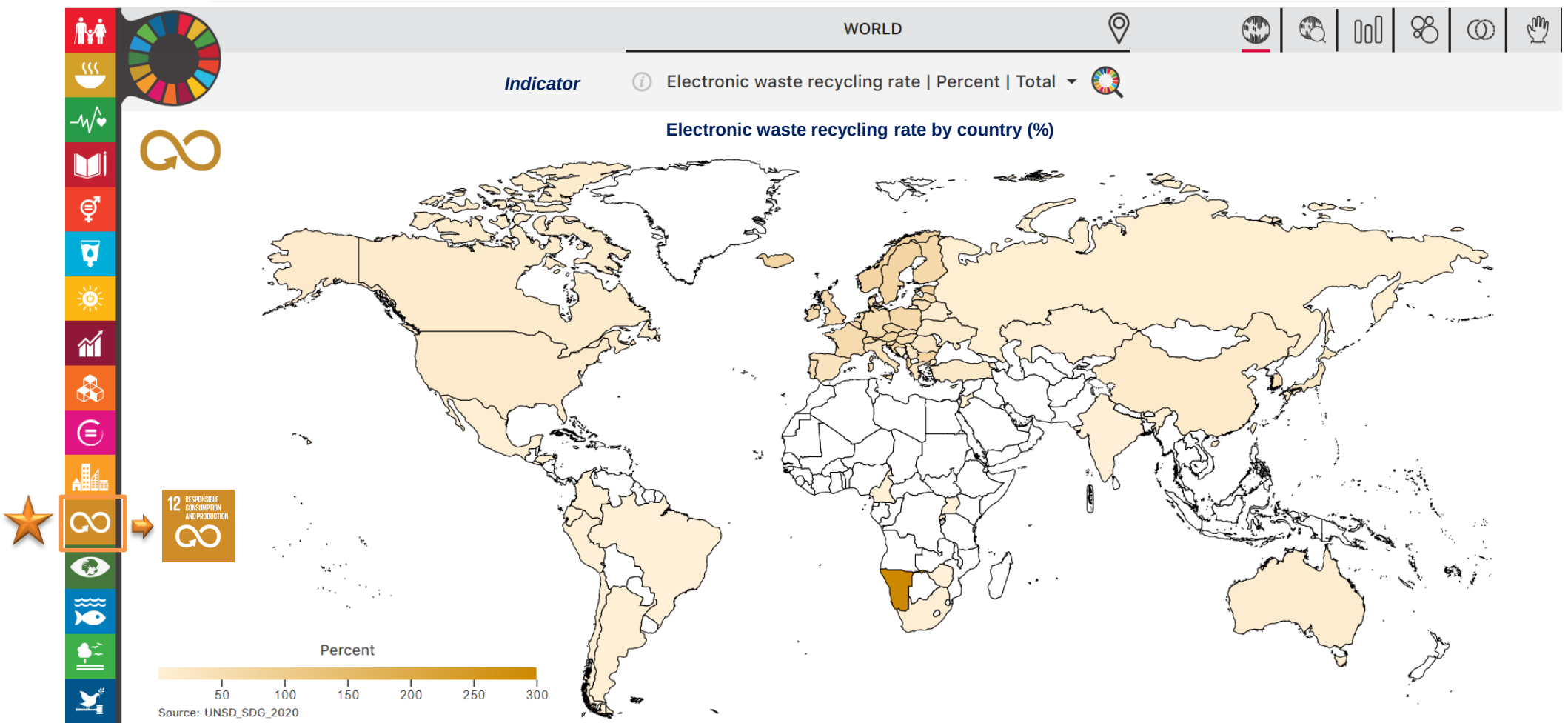
Within this decade, there has been a 17.4% increase in the use of natural resources with the global material footprint growing from 73.2 billion metric tons in 2010 to 85.9 billion metric tons in 2017.



NEED FOR CIRCULAR ECONOMY PRINCIPLES

Source: SDGs Report 2020 <https://unstats.un.org/sdgs/report/2020/goal-12/>

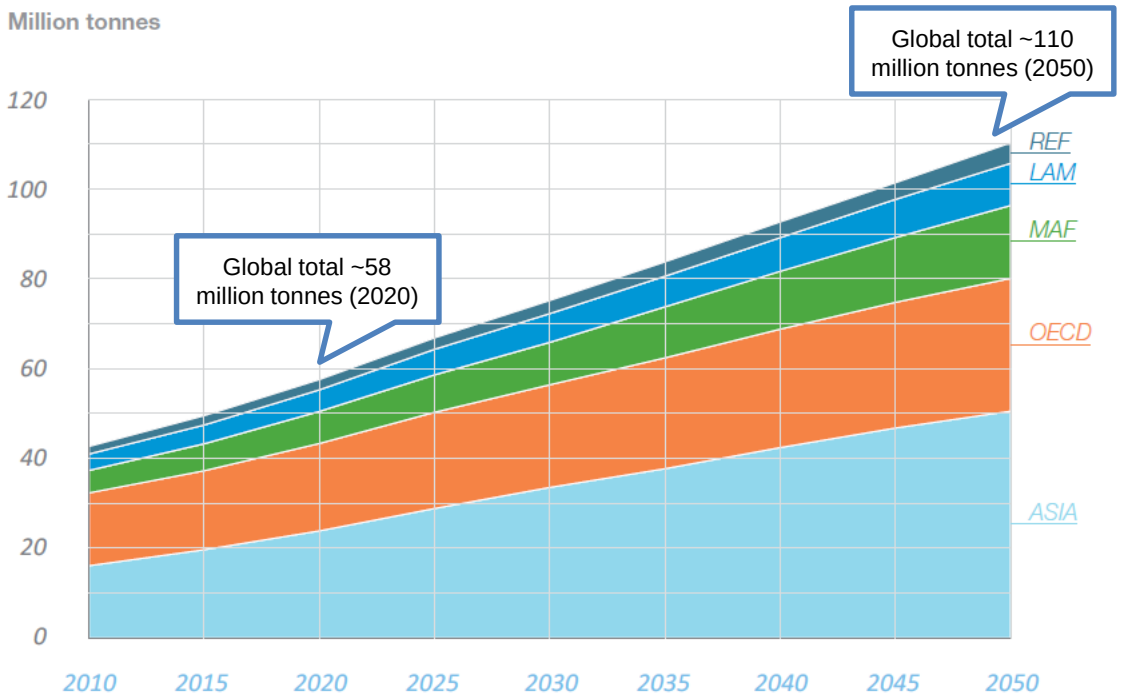
Another common indicator for SDG12 based on the electronic waste recycling rate further requires progress based on R&D and innovation for shifting the direction of electronic waste generation.



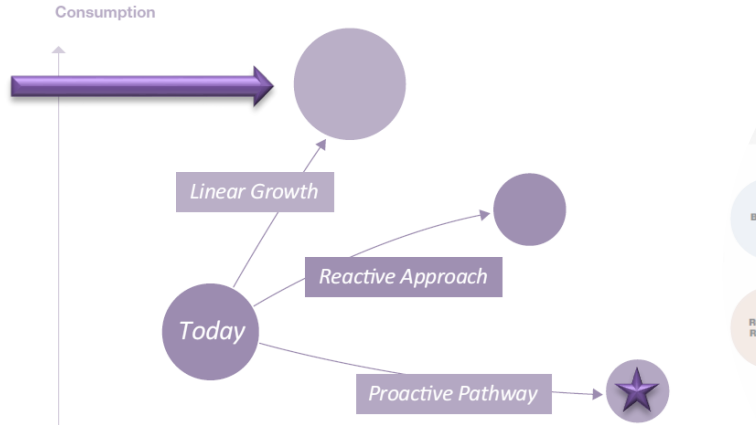
Source: SDGs Dashboard <https://www.sdgsdashboard.org/>

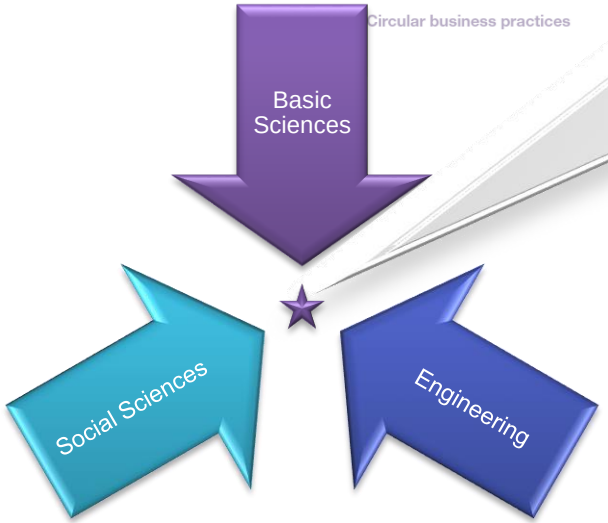
Towards Sustainable Consumption and Production with Co-Creation

Electronic waste is projected to grow to ~110 million tonnes by 2050 while a proactive pathway that brings together technology, policies, management and users can effectively reduce these impacts.



REF: countries from the Reforming Economies of Eastern Europe and the Former Soviet Union
LAM: countries of Latin America and the Caribbean
MAF: countries of the Middle East and Africa
OECD: OECD 90 and EU member states and candidates
ASIA: Asian countries with the exception of the Middle East, Japan and Former Soviet Union states





Source: Parajuly, K. et al. (2019), Future E-waste Scenarios / United Nations University - STEP Initiative

Existing Situation and the Need to Transition Towards a Circular Economy

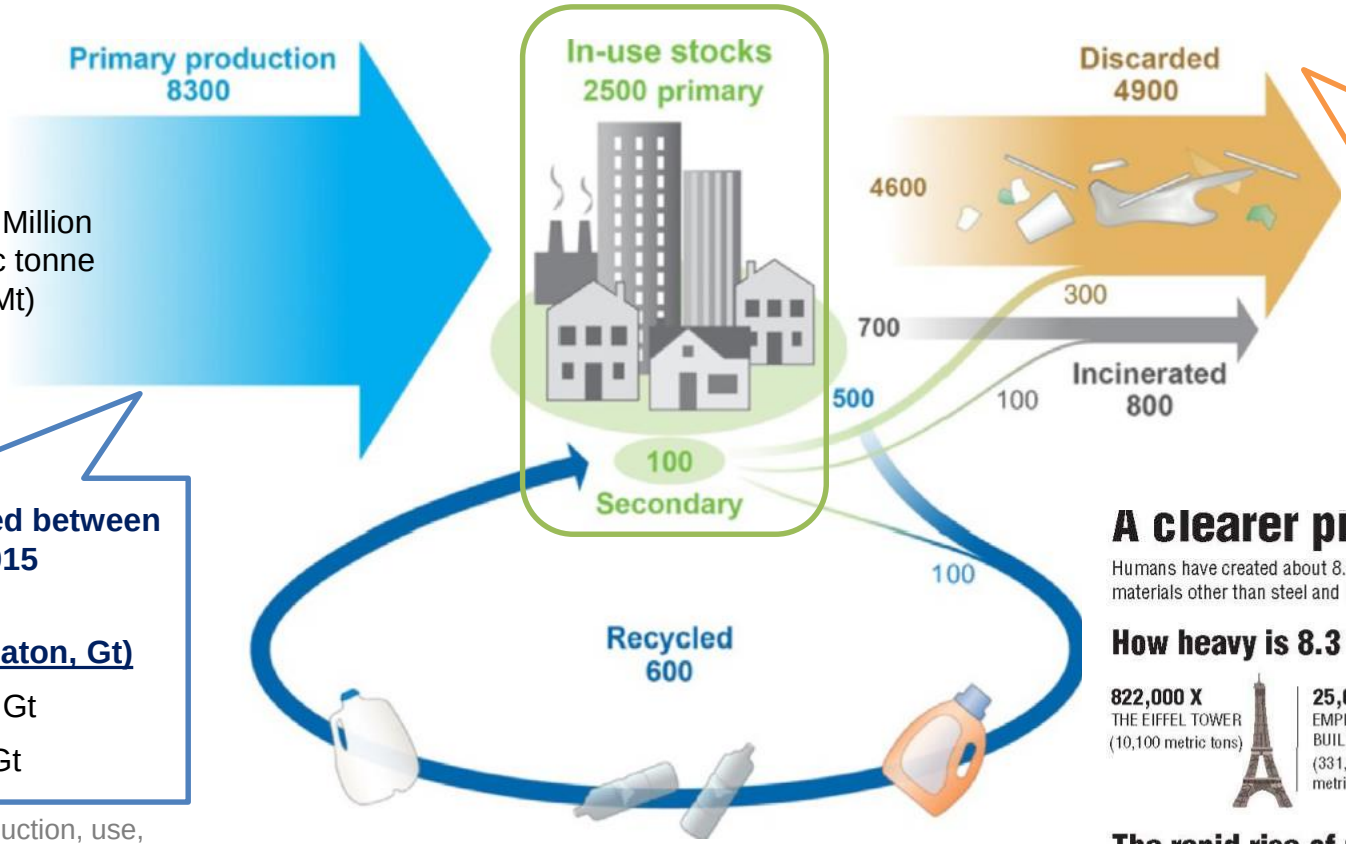
Rather than linear approaches where materials are produced, used and disposed, processes that are based on the circular economy approach and biomaterials are needed for the future.

Example: Plastics

Dominance of synthetic materials:

- Availability
- Flexibility
- Durability
- Light-Weight
- Economic Applicability

Unit: Million metric tonne (Mt)



Synthetic Plastic Problem:

- Plastics that are in-use 2.6 Gt (primary and secondary stocks)
- Burned 0.8 Gt
- **Plastics that are discarded as un-usable waste: 4.9 Gt**

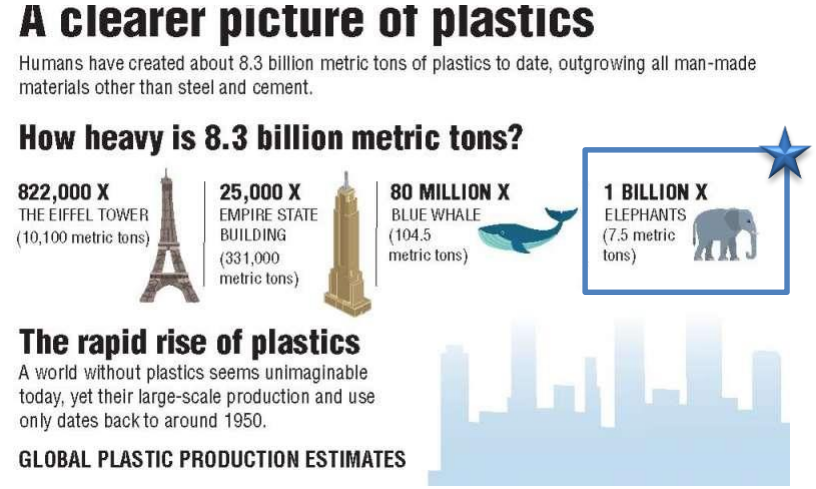
Total synthetic plastics used between the years 1950 – 2015

8.3 billion metric ton (Gigaton, Gt)

- Before 2015 : 6.3 Gt
- 2015-2017: 2.0 Gt

Source: Geyer vd. (2017), Production, use, and fate of all plastics ever made, *Science Advances* 3(7): e1700782.

Sustainable materials that increase the possibilities for a circular economy approach?

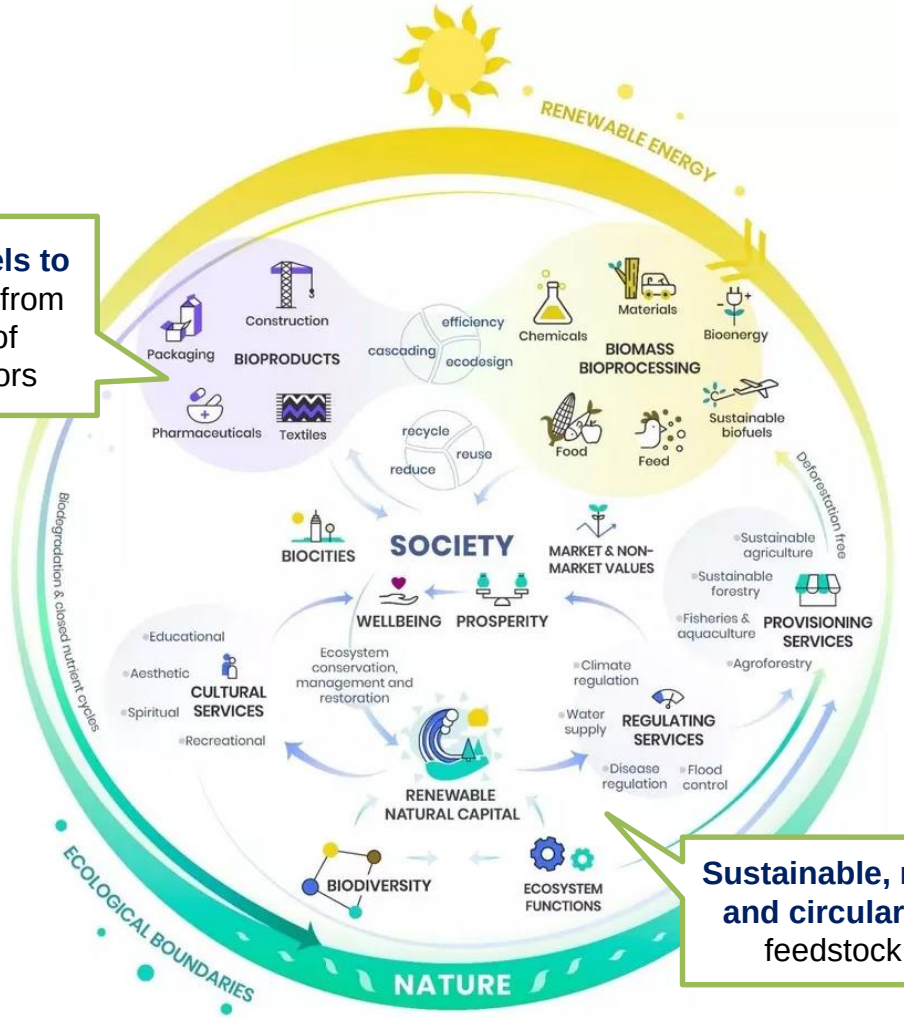


Picture Source: https://phys.org/news/2017-07-billion-metric-tons-scientists-total.html

Building the Circular Bioeconomy of the Future with R&D and Innovation

The ability to remain within the ecological boundaries of our planet by <u>decoupling economic growth from environmental pressure</u> depends on the realization of a circular bioeconomy.

New business models to decouple prosperity from the consumption of products in all sectors



Sustainable, regenerative and circular forestry or feedstock systems

Example Biomaterials

- **Nanocellulose** → Five times stronger, five times lighter than steel
- **Wood-based textiles** → Five-times lower carbon footprint than plastic fibers
- **Cross laminate timber** → Alternative to concrete and steel in urban development

Source: WEF (2020) / European Forest Institute (2020), A 10-point Action Plan for a Circular Bioeconomy of Wellbeing <https://www.weforum.org/agenda/2020/10/circular-bioeconomy-nature-reset/>

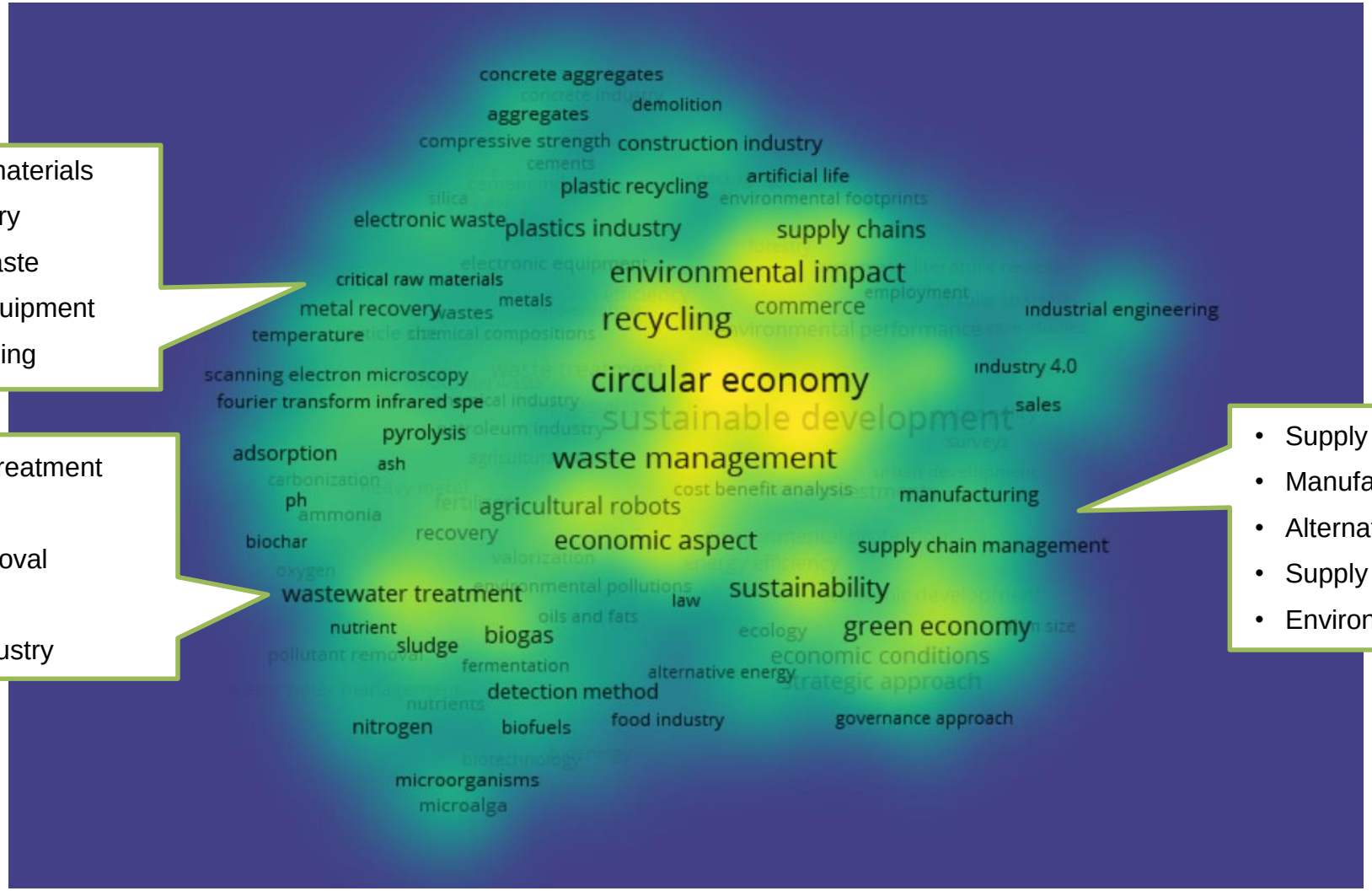
Recent Scientific Landscape on Circular Economy and Bioeconomy

The scientific landscape on circular economy, bioeconomy and zero waste includes a wide spectrum of contributing topics from critical raw materials to supply chain management.

Example Topics

- Critical raw materials
- Metal recovery
- Electronic waste
- Electronic equipment
- Plastic recycling

- Wastewater treatment
- Biochar
- Pollutant removal
- Nutrients
- Chemical industry



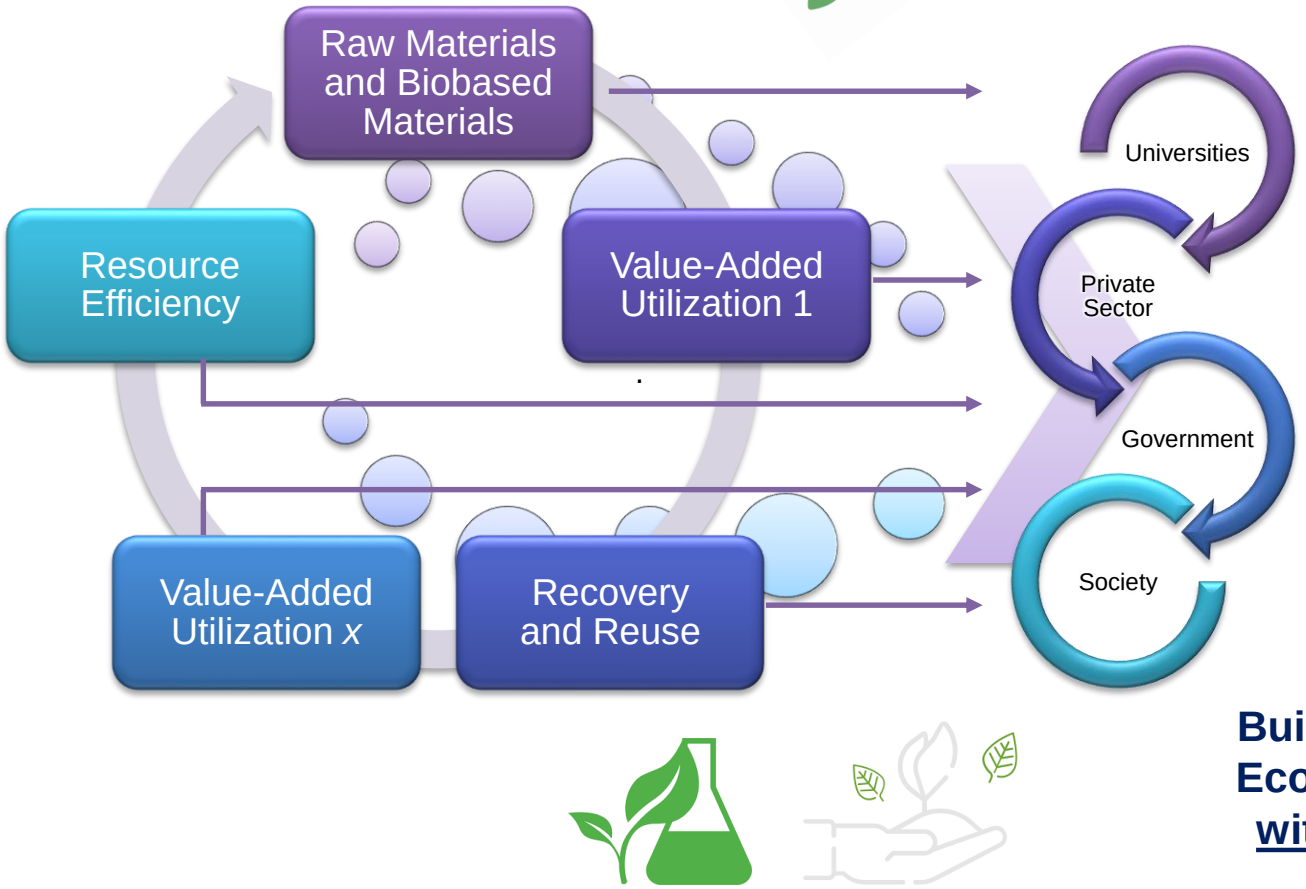
Example Topics

- Supply chain management
- Manufacturing
- Alternative energy
- Supply chains
- Environmental impact

Originally drawn based on SCOPUS advanced search with keywords of biobased economy, circular economy, green economy or zero waste as included among SDG12 keywords. The search is limited to the most recent 2021 article and review publications.

Co-Creation Across the Ecosystem is Necessary for Realizing Impact

The effective use of raw materials, opportunities for material recovery from waste and shifting supply chains towards more sustainable sources requires changes in collaboration approaches.



Recovery of existing raw materials

- Critical raw materials in electronic equipment
- Renewable energy technologies and batteries

Material substitution towards biomaterials

- Reduction of fossil-fuel based materials
- Restructuring of supply chains and demands

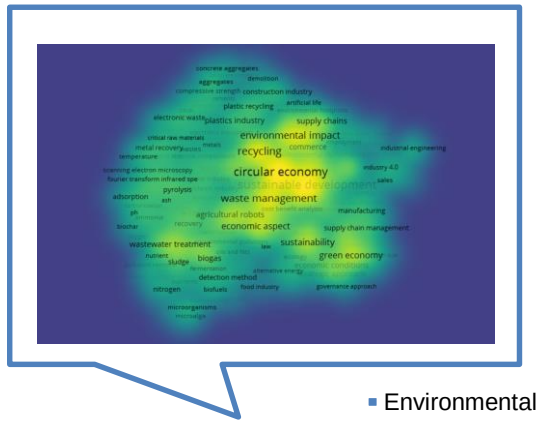
Circular reuse and recovery of materials

- New opportunities for utilization
- New approaches for zero waste

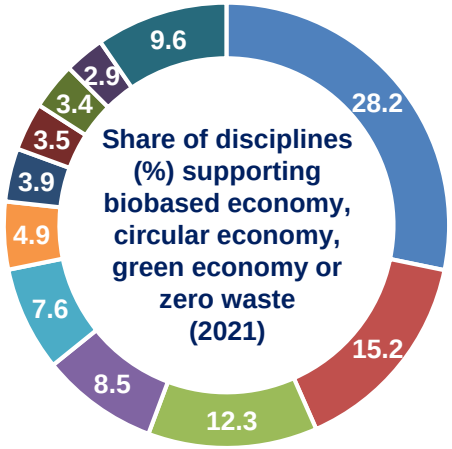
Building a Circular Economy Together with Co-Creation

Enabling Transitions Towards Circular Economy and Bioeconomy

Enabling transitions towards a more circular bioeconomy to capture multiple co-benefits for the environment and society will require support from multiple disciplines engaging multiple sectors.



Distribution of disciplines



- Environmental Science
- Energy
- Engineering
- Business, Management and Accounting
- Social Sciences
- Chemical Engineering
- Materials Science
- Economics, Econometrics and Finance
- Chemistry
- Agricultural and Biological Sciences
- Other

Source: Based on SCOPUS 2021 articles and review publications with the keywords biobased economy, circular economy, green economy or zero waste (total 1,205).

Distribution of sectors

Transition

Sectors	Circular and resource-efficient models for materials	Nature-positive metals and minerals extraction	Sustainable materials supply chains	Nature-positive energy transition
Advanced manufacturing	Principal			Enabling
Aerospace				
Agriculture, food & beverages	Principal			
Automotive	Principal			Principal
Aviation, travel & tourism				Enabling
Banking & investors				
Chemicals & advanced materials	Principal	Principal		
Electronics	Principal			
Energy & utilities				Principal
Health & healthcare				
IT & digital communications				
Infrastructure & urban development	Principal			
Insurance & asset management				
Media, entertainment & information				
Mining & metals	Principal	Principal	Principal	
Oil & gas	Principal			Principal
Professional services				
Retail, consumer goods & lifestyle	Principal			
Supply chain & transportation			Principal	

Circular and resource-efficient models for materials
Nature-positive metals and minerals extraction
Sustainable materials supply chains
Nature-positive energy transition

Circular and resource-efficient models for materials
Nature-positive metals and minerals extraction
Sustainable materials supply chains
Nature-positive energy transition

Sector role in transition
Principal[1]
Enabling[2]

Sectors with Principal Roles

- Advanced manufacturing
- Agriculture, food and beverages
- Automotive
- Chemicals and advanced materials
- Electronics
- Energy and utilities
- Infrastructure and urban development
- Mining and metals / oil and gas
- Retail, consumer goods and lifestyle
- Supply chain and transportation

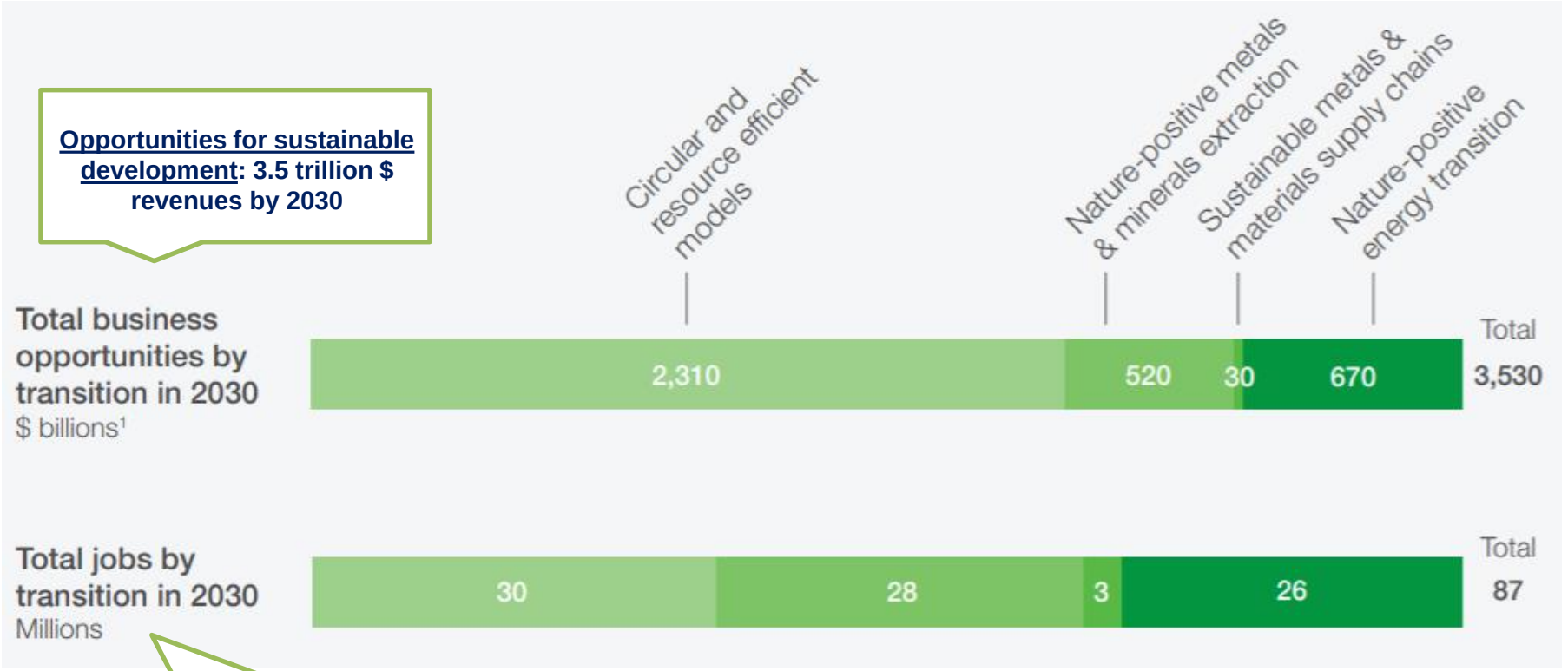
Source: World Economic Forum (2020), The Future of Nature and Business (New Nature Economy Report II)

Environmental and Socioeconomic Co-Benefits of a Circular Bioeconomy

The transition to a circular bioeconomy based on resource efficiency, sustainable supply chains and biomass with carbon capture and storage will provide new revenues and jobs by 2030.

- Circular and resource-efficient models for materials
- Nature-positive metals and minerals extraction
- Sustainable materials supply chains
- Nature-positive energy transition

Opportunities for sustainable development: 3.5 trillion $ revenues by 2030



Opportunities for sustainable development: 87 million job opportunities by 2030

Economic growth can be decoupled from environmental pressure with new solutions.

Source: World Economic Forum (2020), The Future of Nature and Business (New Nature Economy Report II)

We Can Shape the Solutions of the Future with Impact Oriented Processes

Researchers with an impact to future solutions

Examples

Advanced manufacturing

Sustainable environment

Composite aviation structures

New chemical conversion processes for **clean and safe energy**

New generation energy storage / double layer capacitors

Protein chemistry and protein engineering

Neuroscience and drivers of obesity

Industry 4.0 / predictive maintenance systems

Climate change and lake restoration

Software process of fuzzy logic and smart cities

Artificial intelligence, medical robots and capsule robots

Thermoelectric materials and modules

Automatic cardiac magnetic resonance quality

Machine learning and data analysis

Radiology and computer systems

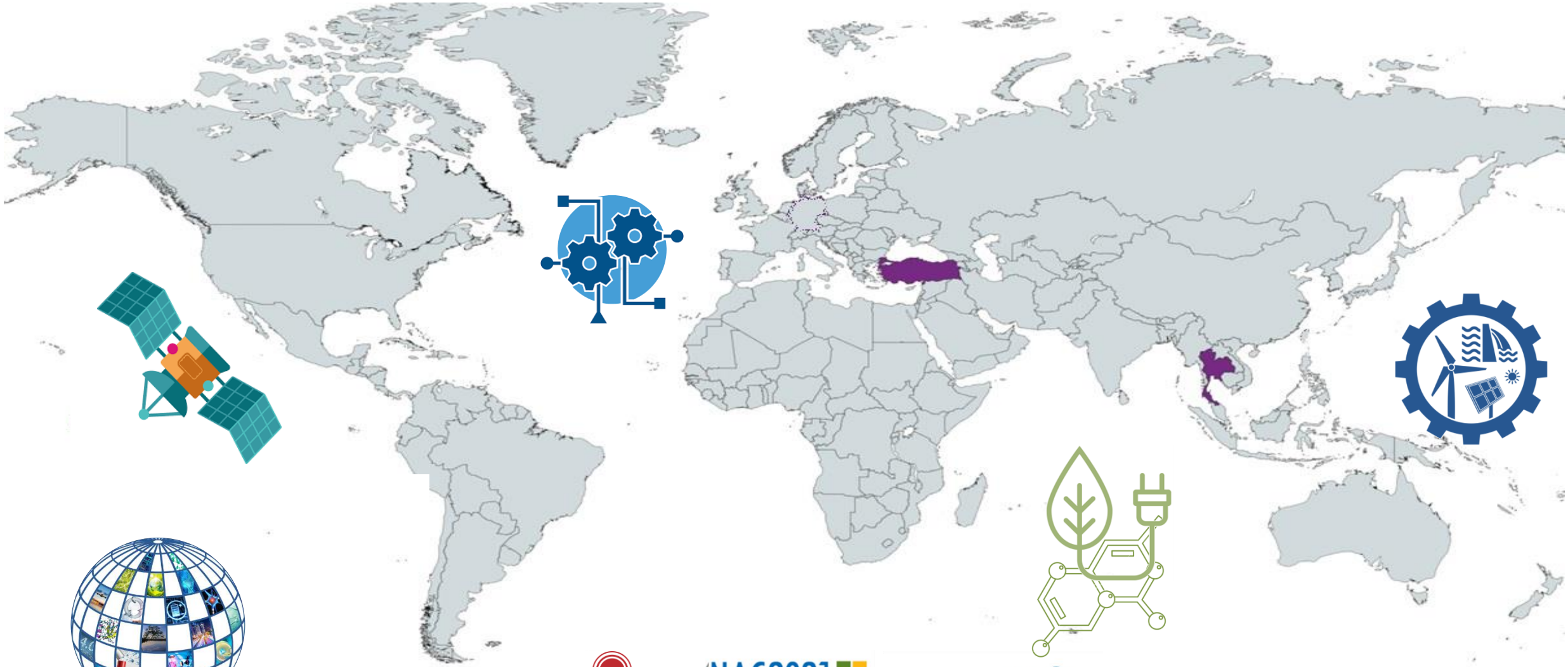
Cellular energy metabolism

Impact

Digital transformation

Health and well-being

We Need a Future of Co-Creation to Achieve a More Sustainable Future!



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