The Role of University for Promoting Circular Economy with a View to Quintuple Helix in the Socio-Ecological Transition Context. The Case Study of the University of Rome "Tor Vergata"

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Abstract. *The aim of the research is to analyze the role of University to promote sustainable strategies inside and outside the academic community. In particular, the focus is on projects promoted by the Academia that respond to the big problem regarding waste. After an analysis of the literature on circular economy and Third Mission of University, the research focuses on the analysis of the causes of the call "Mission Sustainability" promoted by University of Rome "Tor Vergata". By promoting sustainable action in the territory, in specific a project will involve the installation of incentivizing compactors in the Campus for PET collection. The research methodology applied to the case study, mainly qualitative, is based on the document analysis of: university report and strategy planning, the call and the specific project promoted by professor and researcher titled "GREENtosi for UniRecycling purpose between Third Mission and Sustainability. A virtuous experimental partnership with a view to quintuple helix in the socio-ecological transition context".*

Keywords: *Sustainability; third mission; university; circular economy; plastic free; mission sustainability.*

Introduction

In recent years, issues related to the environment and sustainability have significantly increased their thickness, due to the growing belief that our planet has limited borders and an uncontrolled use of its resources. This could lead to catastrophic effects for humanity. One of the major issues related to the environmental dimension concerns the production of waste, which has grown exponentially over the last decade due to the high industrialization and increase in population worldwide. Several plans and programs at National and European Level[1] have been promoted with the aim of promoting policies aimed at implementing the 4R principle in terms of waste: reduction (of the same and their danger); reuse; energy recovery; material recovery (Figure 1). Despite the good intentions, the results obtained by means of these tools are, at least for now, unsatisfactory. The management methods[2] of the same seem to be disappointing as they still see too high a use of landfill disposal. The effect of these inefficiencies on the waste problem generates a series of negative externalities, such as for example the high costs associated with the methods of disposal, much more expensive than the methods of recycling and recovery, both of energy and of matter. Diseconomies that take away huge public resources, which could, instead, be used to provide better

[1] In Italy, with regard to waste, the Legislative Decree 5 February 1997 n. 22, the c.d. Ronchi Decree, subsequently repealed by art. 264, c. 1, lett. i) of d. Lgs. N. 152 of 3 April 2006, to implement the implementation of directives 91/156 / EEC on waste, 91/689 / EEC on hazardous waste and 94/62 / EC on packaging and packaging waste.

[2] Art. 183, paragraph 1, lett. d) Legislative Decree 152/2006 provides the following definition of management: "The collection, transport, recovery and disposal of waste, including the control of these operations, as well as the control of landfills after closure".

services to citizens, with targeted interventions on sectors of primary importance such as: transport, assistance, health and school. Furthermore, the environmental and social significance of these issues should not be underestimated.

Figure 1. *The 4R principle in terms of waste (source: www.samworthbrothers.co.uk)*

Literature review

Italy has been given a sentence by the European Court of Justice, to pay a lump sum of 40 million euros for failure to comply with the EU legislation on waste and landfill, to which will be added further penalties for each semester passed from the sentence up to the final regularization of illegal landfills in the area. When the waste is not previously differentiated, it generates emissions with a high CH4 and CO2 content, two greenhouse gases carrying irreversible pollution; to avoid this the landfills must be equipped with efficient gas collection systems, in order to avoid their dispersion in the atmosphere. The basic problem is that in a system with obvious gaps, illegal dumps or disposal systems controlled by organized crime are proliferating, generating further environmental damage related to pollution of the soil, groundwater and surface water. This vicious circle is the author of a series of negative externalities, such as for example the pollution of the land, rendering them useless, as well as damage to the health of individuals mainly due to exposure to the harmful substances produced. It is necessary to review the management methods of the entire sector, trying to give concrete application to the objectives set by the regulations on waste. The starting point is to consider waste no longer as a problem, but as a resource capable of creating new job opportunities, encouraging the formation of a circular economy, is a type of economy capable of regenerating itself, in which the activities are organized in such a way that the waste produced by some becomes the basic resources of others (Kirchherr, Reike, & Hekkert, 2017; Murray, Skene, & Haynes, 2015). An economy designed to "self-regenerate" - given that the materials of technical origin are designed within a flow that foresees the least loss of quality - and that intentionally "reconstitutes" itself as it aims to rely on renewable energy sources, minimizing and the use of toxic chemicals. The plastics are constituted by macromolecules called "polymers" which in turn consist of chains of smaller molecules, called "monomers". The different types of plastic differ from each other in their appearance and intended use, but they have some very specific characteristics in common: they are light, washable, economical, easily malleable once heated, reproducible in series and particularly functional for the food storage. The most common plastic materials on the consumer product market (Table 1).

Table 1. *Different plastic on the consumer product market.*

CODE	DESCRIPTION
High-Density Polyethylene (HDPE) Low-Density Polyethylene (LDPE)	used for the production of bags, box, adhesive tapes, bottles, garbage bags, tubes, toys
Polypropylene (PP)	used for the production of furniture items, food containers, detergent bottles and personal hygiene products, carpets, garden furniture
Polyvinyl Chloride (PVC)	used for the production of egg trays, pipes and insulating films so that it can also be found between the walls of the house, in doors, in windows or in tiles and even as credit cards
Polyethylene Terephthalate (PETE or PET)	used especially for bottles of soft drinks and mineral water, but also for the production of synthetic fibers.
Polystyrene or Styrofoam (PS)	used to produce food trays, cutlery, plates, caps

Source: *Authors' elaboration.*

In this scenario, the University, as a public actor, plays a crucial role in the territory in which it threatens to be promoted in the wrong public policies and activator of virtuous circles. The University answers at the challenge of Agenda 2030, approving a new "mission" and "vision" to support the sustainability development in terms of education, research and relationship with the territory, with a view to third mission. On this matter several contributes and approaches are involved (Sanchez & Elena, 2006; Laredo, 2007; Spaapen et al., 2007; Molas & Gallart, 2002). The Third Mission has been studied and implemented as a means for transferring technology and economically exploiting the results of research activities carried out by universities, for example through the creation of spin-offs and incubators. The changing of socio-economic conditions has recently led to integrate this paradigm, as shown by the diffusion of the conceptual models of the Triple, Quadruple and Quintuple Helices (Etzkowitz & Leydesdorff, 2000) for national innovation ecosystems, which can be seen as an advanced mode of experimentation of the third mission approach. The Triple Helix innovation model focuses on university-industry-government relations; it underlines the importance of higher education for innovation and is compatible with the knowledge economy (Etzkowitz 2008; Etzkowitz & Leydesdorff, 1995; Etzkowitz, 1993). In the Quadruple Helix the territorial context and the civil society (Fourth Helix) are seen as key drivers in a democratic approach to innovation where government, business, academia and civil participants work together to co-create the future (Open Society model: from knowledge economy to knowledge society and democracy, (Ranga & Etzkowitz 2013). The Quintuple Helix Model (figure 2), adding the perspective/helix of the 'natural environments of society' supports the formation of a win-win situation between ecology, knowledge and innovation, creating synergies between economy, society and democracy (the "socio-ecological transition", European Commission in 2009) If the University is the principal actor in Quintuple Helix Model, it could be a promoter of circular economy' actions inside Academia and, in this context, sensitive other actors (political system, economic system, public administration and media) to involve a responsible behavior.

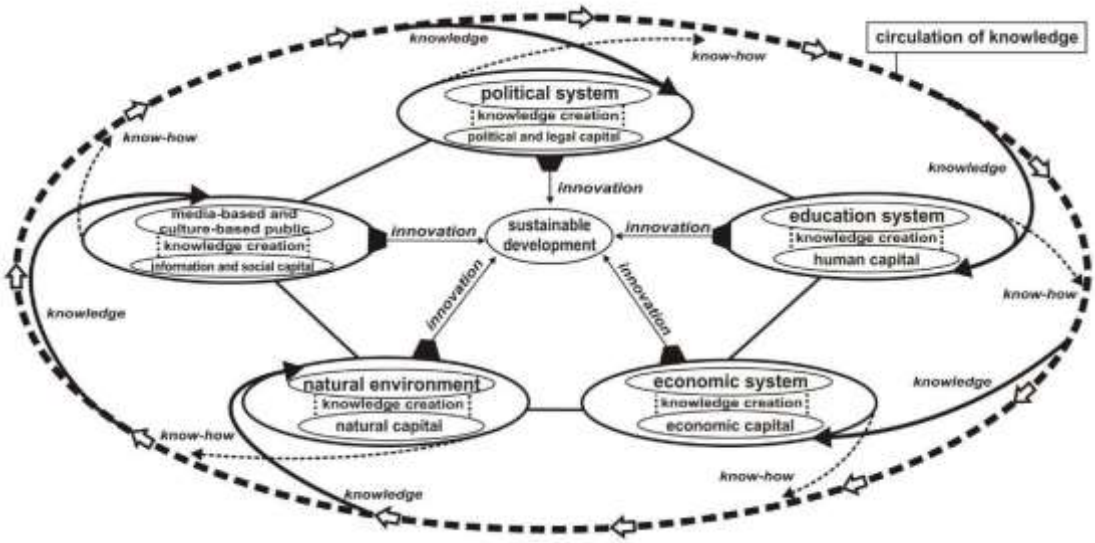

Figure 2: *Quintuple Helix Model*
(Source: Etzkowitz and Leydesdorff, 2000, on Carayannis & Campbell, 2006, 2009, 2010 and on Barth, 2011a)

In particular, the term "Third Mission" refers to all the activities with which the universities activate processes of direct interaction with civil society, companies, institutions and organizations (Quintuple Helix Model) with the aim of favoring the growth of the territory and civil society, offering services and structures. In this way knowledge becomes a tool to obtain productive results (Novelli & Talamo, 2014).

Brief-description of qualitative research method adopted

After a brief background of the importance of circular economy in waste sector, the first part introduce a framework of a shift of paradigm of University and a literature review of Third Mission of University (Sanchez & Elena, 2006; Laredo, 2007; Spaapen et al., 2007; Molas & Gallart, 2002) and The Evolution of

Helix Model to Quintuple Helix Model (Etzkowitz, 2008; Etzkowitz & Leydesdorff, 1995; Etzkowitz, 1993; Etzkowitz & Leydesdorff, 2000) and analysis has been applied to define plastic waste' characteristics.

The research focus is on the new role of University as a driver for sustainable development through social responsibility in an urban scenario. The research goals are: to develop a conceptual framework on the role of education at University level in promoting sustainability, according to the Third Mission approach and the role of High Education in Sustainability. The research is enriched by qualitative methodology as a case study analysis and documental analysis (Bowen, 2009) on a project titled "GREENtosi for UniRecycling purpose between Third Mission and Sustainability. A virtuous experimental partnership with a view to quintuple helix in the socio-ecological transition context", promoted by Department of Management and Law, Department of Biology, the Botanic Garden of the University of Rome "Tor Vergata" and the Government and Civil Society Research Group (GCS) and GREENTOSI student association, played a crucial role to build this project to involve an incentive compactor to improve recycling plastic waste in University. The case study is a specific example of stakeholder engagement, the importance of partnership, co-design and circular economy with a view of Sustainable Developments Goals.

Case Study: University of Rome "Tor Vergata"

The new mission and vision of the University of Rome Tor Vergata aims to contribute to education and training of people, scientific research and technological, organizational and social innovation necessary to reach the 17 SDGs (Agenda 2030), in view of the third mission. The university has more than 30,000 students and is ranked among the top 100 in the world in 2017 by THE (Times Higher Education) which considers only the best universities founded for less than 50 years and the University of "Tor Vergata" is the only Italian University in the "QS Top 50 Under 50", that is the ranking of the 50 best universities in the world created in the last 50 years. Tor Vergata aims to be a real promoter of territorial sustainability and for this reason it aims to increase collaboration with the public and private sectors, third sector organizations and investors, nationally and internationally. Starting in 2014, a "Sustainability Plan" was promoted, including the actions necessary to reduce long-term negative externalities - with particular reference to greenhouse gas emissions - generated by the University's activities. More recently, in February 2016, in collaboration with the Unipolis Foundation, the second Roman university proposed the creation of the Italian Alliance for Sustainable Development (ASviS) with the aim of raising awareness of the importance of the issues addressed in the Agenda of global sustainable development 2030. Furthermore, it is one of the promoting universities and an active member of the RUS, Sustainable University Network.

In 2016 the University of Rome "Tor Vergata" promoted the "Mission Sustainability" Call (section 3.1). The intent of University has been to support research through the funding of competitive research projects for the development of ideas with high scientific content and technology, for improving sustainability and achieving the 17 SDGs in Universities and territory where the academia is located.

Call "Mission Sustainability"

"The future of our environment depends on the intelligence with which we use the present one" this phase, reported in the "Sustainability Plan 2020" of the University of Rome "Tor Vergata", summarized one of the main issues facing today's society, that of environmental sustainability. The policies related to the efficiency of consumption and the recovery of materials, as widely confirmed by the numerous provisions in the EU and national sphere, represent today a primary need. The growing concern is a result of the obvious and dangerous climate changes, accompanied by the progressive reduction of available resources. It follows that in this context the University, as a key institution at the base of cultural and ideological change, must take an active role in the management of these problems. It must also represent a reference model, as well as an example for the entire community, through the adoption of prudent internal policies aimed at eliminating - or at least reducing - waste of materials and resources.

For this reason, the University or Rome "Tor Vergata" promote the public call "Mission Sustainability" to promote and financed sustainability project inside and outside the university' campus. This is selected on the basis of scientific excellence and innovative strength, aimed at achieving environmental, economic, social and institutional improvement objectives in the conceptual framework designed by the 2030 Agenda on sustainable development, both locally and globally, as well as fostering the use and dissemination of research results. The University has allocated a total of € 1,230,000.00 dividing for CUN areas (National

University Council), in order to enhance the role and responsibilities of the Departments, each Department has been assigned a fee of € 15,000.00 (Table 2).

Table 2. *Funding of the call "Mission Sustainability" for areas' CUN*

CUN AREA	BUDGET
01: Mathematics	€80.000,00
02: Physics	€120.000,00
03: Chemistry	€110.000,00
05: Biology	€170.000,00
06-07: Medicine - Agriculture and Veterinary	€200.000,00
08: Civil Engineering and Architecture	€80.000,00
09: Industrial Engineering and ICT	€145.000,00
10:Sciences of the philological-literary and historical-artistic anthology	€75.000,00
11:Historical, philosophical, pedagogical and psychological science	€75.000,00
12: Law	€75.000,00
13-14: Economics, Statistics and Political and Social Sciences	€100.000,00

The winning projects, which had to present in the written project application (in the English language) with reference to at least one of the 17 SDGs, are being implemented as they will have to finish within 18 months from the date of communication of the approval and financing. The evaluation criteria of the projects to which the auditors had to comply are: a) scientific and innovative nature of the project with respect to the state of the art (max 50 points); b) clarity, credibility, feasibility of the objectives and impact of the project, also considering its relevance for the realization of the University mission and vision (max 20 points); c) quality of the PI (Principal Investigator) and the entire research group (max 20 points); d) appropriateness and appropriateness of the costs (max 10 points). A careful analysis underlines not only scientific importance that the projects must have but also the connection with the trend-topic of sustainability in connection with the strategic planning of the University (mission and vision). The Board of Directors of the University of Rome "Tor Vergata" approved, on 25 June 2016, the ranking of the projects referred to in art. 3 of the Call "Mission: Sustainability" (DR 2817/2016), selected by the respective Departmental Councils with their own formal resolution, authorizing the Management III - Division 3 Accounting budget and treasury to the assignment of funding to the Departments of the Scientific Managers for the relative management. To the project titled: "GREENtosi for UniRecycling purpose between Third Mission and Sustainability. A virtuous experimental partnership with a view to quintuple helix in the socio-ecological transition context" (the PI is Gloria Fiorani), has been located €7.500,00 (start in: 1° July 2018; deadline: 31 December 2019).

"GREENtosi for UniRecycling purpose between Third Mission and Sustainability. A virtuous experimental partnership with a view to quintuple helix in the socio-ecological transition context"

The aim of the project is to encourage the recycling of plastic waste, in particular water bottles sold at refreshment points and at automatic vending machines located in university buildings, and to raise awareness among stakeholders of the problem of waste disposal and related pollution. The expected result will be to introduce an incentive compactor in the buildings of the University, useful for the collection of plastic waste and their compression to be resold and then donated or reused in terms of circular economy. The project also stems from the positive response of the academic community which, from a research conducted in 2016, expressed the will to collaborate for sustainable development and the interest in using incentive recyclers (98% of survey participants) to improve the separate collection system in the University, considered inadequate by 90% of the sample (Mititelu, Fiorani, & Litardi, 2017). The indirect expected result is to stimulate the stakeholders to virtuous and proactive behaviors. In fact, the pilot project is a specific interdisciplinary research-intervention that involves the academic community, the shops affiliated with the University, the local administrations and the territory and which provides for the installation of incentive compactors on the Campus for the collection of PET.

The research project is composed by 8 phases, in particular:

Phase 1: FormAction (Formation + Action). Main objectives of this phase will be: soft skills development, sensitization on sustainable development, SDGs deepening, encouragement of students' self-employment and promotion of participate planning (students, academic community, citizens, public and private –profit and no-profit – administrations) by extra-formative activities of New Economy Labs, operating from 4 years

and addressed to all young people of Lazio under 30 (university students or not). Partners: "Next-Nuova Economia per tutti" (association), University, Lazio Region. Every year, several research-action projects rises from Labs in order to answer Territory/University's needs and challenges: from close and self-referential place to open, dynamic and creative space (Mititelu, Fiorani, & Litardi, 2017)

Phase 2: Organizing student collaboration. Creation of green student association (GREENtosi) with the aim of promoting sustainability values and, possibly, managing both the incentivizing compactor and the relationship between partnership-companies, in cooperation with academic community.

Phase 3: Literature and best practices analyses. Analyses of national and international best practices of incentives recycle politics (i.e. German Government's Pfand, incentivizing compactors in Norway, Finland and Sweden, virtuous experiences in Italy, discounts on tickets or metro pass linked to PET recycle in China).

Phase 4: Market analysis and stakeholder management. Analyses of PET market, potential interested people in the project (stakeholder mapping and engagement), incentivizing recyclers' suppliers, possible machine's installation procedures (purchase, rental or partnership with dealers).

Phase 5: Realization. Installation of one or more incentivizing compactors in Athenaeum's strategic points, linked to approved retail outlets (starting from the already existing platform "Agevola.uniroma2.it"), which could grant: discounts and facilitations to citizens provided with incentivizing recycler's receipts, partnership/patronage institution with public local administrations (Municipio VI, Rome Municipality and Lazio Region) and prediction of rewarding/incentivizing systems inside or outside the University. For some machines the use of health insurance card should be require since it enables traceability of virtuous behaviors, so that they could be rewarded by companies with a relief on waste tax and also with services, like parking, transports, coupons etc.

Phase 6: Evaluation of the project's impact. Territorial network activated with the view to Third Mission. Data analysis about the attendance and use of the incentivizing recycler will be carried out. Evaluation of the academic response at the experimentation taking in accounts the types of incentives (monetary/of image/social recognition/extracurricular credits) will be performed by sending a questionnaire to the academic community and making interviews to privilege testimonies, as well as partner of the initiative. Consider eventual earnings coming from the PET's sale or the use of collected PET for the creation of nameplates, used from the Botanical Garden of the University of Rome "Tor Vergata" and produced by a 3D-printer (Attached 4). This phase will facilitate the expansion of green student associations.

Phase 7: Sharing results. The results of experimentation will be presented in national and international meeting and propagated also through scientific and educational publications at national and international level. Also, it will be possible a workshop at University of Rome Tor Vergata for presenting the results of the pilot project.

Phase 8: Repeatability of the experience. Considering the results obtained in the first 18 months of experimentation, the project could be replicated in all Faculties of the University, with the possibility of applying a competition system between faculties to achieve Athenaeum's founds on the base of the amount of collected PET.

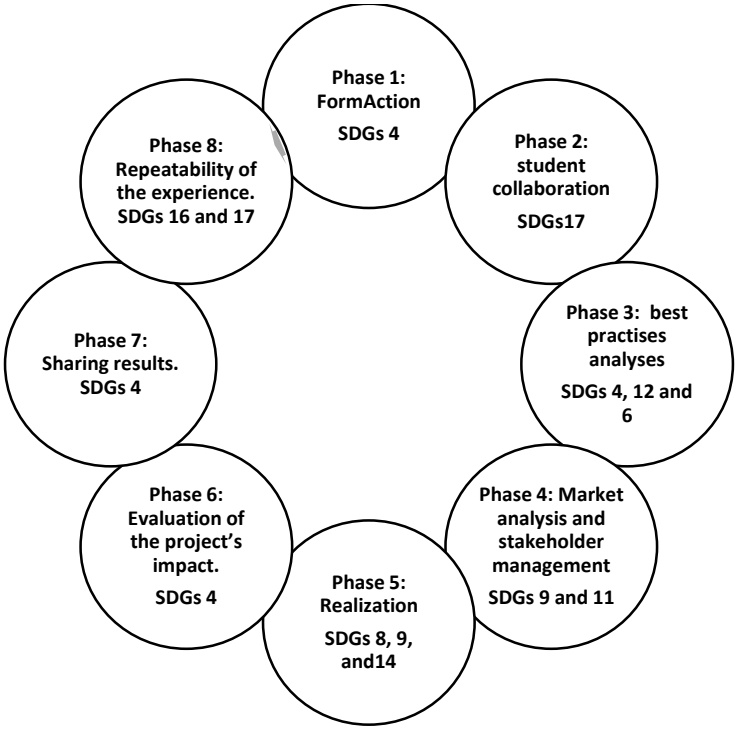

Figure 3. *Phases of the project as a virtuous circle connected with SDGs*

The specifics objectives of the research project are:
1. Sensitize academic community and target territory to the importance of circular economy and recycling materials;
2. Support the creation of a student association/green cooperative start up that opens up on the values of sustainability (as GREENtosi student association created and launched during a Conference "CSR and Social Innovation Conference" on 28 March 2019, Faculty of Economics, University of Rome "Tor Vergata");
3. Strengthen the internal relationship between teachers, administrative personal and students;
4. Strengthen the relationship with territory with a view to Third Mission, valorizing the existence connections (Agevola.it project) and starting new ones as the Outlet called "Le Torri", situated in a social-economic problematic neighborhood near University;
5. Investigate the inclination to recycling on the base of economic incentives (coupon, usable in all the retail outlets) and not-economical ones (reputational and relational image for example);
6. Strengthen the bonding between Departments and the role of COVISION, as interdepartmental center of research on Sustainability Development, Responsibility, Cost-Reporting and Social Innovation.
7. Using of the collected PET for the production, by a 3D-printer, of nameplates which will be used in the Botanical Gardens of the University of Rome "Tor Vergata";
8. Attract resources to reverse into sustainability projects;
9. Create awarding systems in the University on the quantity of collected PET from single Faculties;
10. Becoming a reference model for both administrations and citizen, spreading "the good practice of recycling" at national and international level.

Conclusions

The project is in line with the "mission" and "vision" of the University, because it converts sustainability into a Third Mission perspective, in terms of teaching, through the development of experimental extra-training that can make young people aware of the issue of sustainable development, to develop their soft skills and to stimulate youth creativity and self-entrepreneurship to respond to the challenges and needs of the territory. The research project is an intervention-research project and it proposes an innovative solution to minimize the impact on the environment, able to enhance the University's strengths in a transversal perspective (between teachers, researchers, administrative personal, technician, librarians and student' association GREENtosi) and interdisciplinary internal relations as (Department of Management and Law, Department of Biology, research Centre "COVISION", Government and Civil Society Research

Group). The strengthening of external relations constitutes a strong link with the territory, the company, SME and public administrations, able to carry out a continuous innovation process, seizing the opportunities that come from both the market and the strategic location of the University in the territory. The research project is an example of co-design for achievement of 17 SDGs and Sustainable Action Plan 2020 of University, that provides a promotion of a virtuous circuit of recycling PET, the current weak point of the University.

The main SDGs that the project answer are: 4 (quality education), 8 (decent work and economic growth), 9 (industry, innovation and infrastructure), 11 (sustainable cities and communities), 12 (responsible consumption and production), 14 (life below water), 16 (peace justice and strong Institution) and 17 (partnership for the goals) e related targets (Table 3).

Table 3. *SDGs connected with the project "GREENtosi for UniRecycling purpose between Third Mission and Sustainability. A virtuous experimental partnership with a view to quintuple helix in the socio-ecological transition context"*

SDGs	TARGET	DESCRIPTION
4 (quality education)	4.4	By 2030, substantially increase the number of young people and adults who have the necessary skills, including technical and professional skills, for employment, for decent jobs and for business skills.
	4.7	By 2030, ensure that all students acquire the knowledge and skills necessary to promote sustainable development through, among other things, education for sustainable development and sustainable lifestyles, human rights, gender equality , the promotion of a culture of peace and non-violence, global citizenship and the enhancement of cultural diversity and the contribution of culture to sustainable development.
8 (decent work and economic growth)	8.3	Promote development-oriented policies that support productive activities, the creation of decent work, entrepreneurship, creativity and innovation and encourage the formalization and growth of micro, small and medium-sized enterprises, including access to services financial.
	8.4	Progressively improve, until 2030, the efficiency of global resources in consumption and production in an attempt to separate economic growth from environmental degradation, in accordance with the ten-year framework of sustainable consumption and production programs, with developed countries taking the initiative.
	8.6	By 2020, substantially reduce the percentage of unemployed young people who do not follow a course of study or who do not attend training courses.
9 (industry, innovation and infrastructure)	9.b	Support the development of domestic technology, research and innovation in developing countries, also ensuring a favorable political environment, among other things, for industrial diversification and to give added value to raw materials.
11 (sustainable cities and communities)	11.6	By 2030, reduce the negative per capita environmental impact of cities, particularly with regard to air quality and waste management.
12 (responsible consumption and production)	12.4	By 2020, obtain the eco-compatible management of chemicals and all waste throughout their life cycle, in accordance with the agreed international frameworks, and significantly reduce their release into the air, water and soil, in order to minimize the their negative effects on human health and the environment.
	12.5	By 2030, to substantially reduce the production of waste through prevention, reduction, recycling and reuse.
	12.6	Encourage companies, especially large and transnational companies, to adopt sustainable practices and integrate sustainability information into their regular reports.
	12.8	By 2030, ensure that people have relevant information and awareness of sustainable development and lifestyles in harmony with nature all over the world.
14 (life below water)	14.1	By 2025, prevent and significantly reduce marine pollution of all kinds, particularly that from land-based activities, including marine litter and nutrient water pollution.
16 (peace justice and strong Institution)	16.7	Ensure a responsive, inclusive, participatory and representative decision-making process at all levels.

17 (partnership for the goals)	17.17	Encourage and promote effective partnerships between public, private-public and civil society subjects, based on the experience and strategies for accumulating resources of the partnerships.

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References

Bowen, G.A. (2009). Document Analysis as a Qualitative Research Method. *Qualitative Research Journal*, 9(2), 27-40. doi: 10.3316/QRJ0902027.

Direzione II - Divisione 1, Ripartizione 1: Ricerca di base, Rendicontazione e Audit (2016), Call "Mission Sustainability", University of Rome "Tor Vergata", Rome. Retrieved from http://web.uniroma2.it/module/name/Content/action/showpage/content_id/22793.

Etzkowitz, H., & Leydesdorff, L. (2000). The Dynamics of Innovation: from National Systems and "Mode 2" to a Triple Helix of University-Industry-Government Relations. *Research Policy*, 29, 109-123. doi PII: S0048-7333Ž99.00055-4.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions, *Resources, Conservation & Recycling,* 127, 221-232. doi: 10.1016/j.resconrec.2017.09.005.

Leydesdorff, L. (2012). The Triple Helix, Quadruple Helix, ...and an N-tuple of Helices: Explanatory Models for Analyzing the Knowledge-based Economy?, *Journal of Knowledge Economics,* 3:25–35. doi: 10.1007/s13132-011-0049-4.

Leroy, P. (1999). *Social and Political Sciences of the Environment. Three Decades of Research in The Netherlands*, Utrecht, NL: International Books.

Litardi, I., Fiorani, G., & Mititelu, C. (2015). Education and Sustainable Development: "Third Mission" of the University of "Tor Vergata". *Third Annual International Conference on Sustainable Development (ICSD)*, Columbia University, New York.

Mititelu, C., Fiorani, G., & Litardi, I. (2017). Fostering Sustainable Development and Entrepreneurship: The New Role of University. *Management Dynamics in the Knowledge Economy,* 5(3), 395-414. doi: 10.25019/MDKE/5.3.05.

Murray, A., Skene, K., & Haynes, K. (2015). The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context, *Journal of Business Ethics*, 140, 369–380. doi: 10.1007/s10551-015-2693-2.

Novelli, G., & Talamo, M. (2014). La Terza Missione dell'Università Italiana. Una nuova occasione per crescere?, *Quaderni delle Conferenze Permanenti di Medicina e Chirurgia,* 61, 2739-2746. doi: 10.4487/medchir2014-61-6.

Ranga, M., & Etzkowitz, H. (2013). Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society. *Industry and Higher Education*, 27(4), 237-262. doi: 10.5367/ihe.2013.0165.

United Nations, (2015). Transforming our world: the 2030 Agenda for Sustainable Development, Resolution adopted by the General Assembly on 25 September 2015. Retrieved from https://sustainabledevelopment.un.org/post2015/transformingourworld.