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KODECET
Knowledge Development for Circular Economy Transition

CIRCULAR ECONOMY EDUCATION IN INDIA AND THAILAND

STATUS QUO REPORT

December, 2024

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Document information	
Work Package	WP 3
Work Package leader	BAAC
Task leader	BAAC
Due date	31/12/24
Revision	1.0
Authors	BAAC, IMNU, PSU, PYU
Contributors	BAAC, IMNU, PSU, PYU, JYU

DELIVERABLE REVIEW HISTORY

Version	Partner	Status	Date	Summary of changes
1.0	All Partners	First Version	24/09/24	First Version of the Report
2.0	All Partners	Second Version	06/10/24	Second Version of the Report
3.0	BIMTECH	Third Version	10/10/24	Third Version of the Report
4.0	BIMTECH	Fourth Version	16/10/24	Fourth Version of the Report
5.0	BIMTECH	Fifth Version	06/11/24	Fifth Version of the Report
6.0	BIMTECH	Sixth Version	09/11/24	Sixth Version of the Report
7.0	BIMTECH	Seventh Version	18/11/24	Final Version Ready

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ACKNOWLEDGEMENT

The Status-quo report on Circular Economy Education represents the collective effort of the partners of Project KODECET. The consortium includes Jyväskylän Yliopisto (University of Jyväskylä), FH Joanneum Gesellschaft MBH (FH Joanneum University of Applied Sciences), Birla Institute of Management Technology (BIMTECH), Institute of Management, Nirma University (IMNU), Prince of Songkla University, and Payap University.

Gratitude is extended to the European Union, the co-founder and lead funder of the KODECET project through the European Education and Culture Executive Agency under the Capacity Building project ERASMUS-EDU-2023-CBHE-STRAND-2. Thanks also go to our project officer, Karolina Garbaliauskaite, whose unwavering support and guidance have been instrumental in making this initiative a reality.

Sincere thanks go to all members of the working groups from these partner institutions for their collaboration in preparing this report. Appreciation is also directed to the project coordinator, Jyväskylä School of Business and Economics, particularly Dean Hanna-Leena Pesonen, Associate Professor Tiina Onkila, and Dr. Bhavesh Sarna, the principal applicant of this project, for their invaluable contributions.

The steadfast support and contributions of the heads of participating institutions have been invaluable to the success of this project. Key contributors include Prof. Doris Kiendl (FH Joanneum University of Applied Sciences), Dr. Prabina Rajib (BIMTECH), Prof. Debasis Mallik (Nirma University), Mr. Apicha Insuwan (Payap University), Assistant Professor Dr. Niwat Keawpradub, Associate Professor Dr. Pun Thongchumnum, and Assistant Professor Dr. Thakerng Wongsirichot (Prince of Songkla University).We would also like to extend our heartfelt gratitude to Shri K. K. Patel (Vice President, Nirma University), Prof. Anup K. Singh (Director General, Nirma University), Shri G. R. Nair (Executive Registrar, Nirma University)for their constructive support and guidance. Their support, patronage, and invaluable guidance have been instrumental to this initiative.

Special recognition is extended to Prof. Rahul Singh (Director, Apeejay School of Management), Prof. Doris Kiendl, and Claudia Linditsch (FH Joanneum University of Applied Sciences) for their essential contributions to securing funding. Finally, deepest appreciation is expressed to all individuals and entities who contributed, directly or indirectly, to the successful completion of this report. The collaborative effort of the entire consortium has been crucial in addressing the goals of the KODECET project.

ACKNOWLEDGEMENT – FOCUS GROUP PARTICIPANTS

We extend our heartfelt gratitude to all the individuals and institutions who participated in the stakeholder meetings, both as contributors and participants. Your valuable insights and inputs have been instrumental in shaping the recommendations and actions outlined in this report.

We are particularly grateful to the esteemed panellists of the Focus Group Discussions conducted at the four Asian partner institutions. Your commitment to devoting time and sharing your expertise has significantly enriched this report. The perspectives you provided have helped us to understand the nuanced challenges and opportunities in advancing circular economy education across diverse contexts.

The names of the panellists, along with their respective organizations, are listed in the table below. We deeply appreciate their contributions and acknowledge their immense role in the formulation of this report. Your collaborative spirit and dedication to the mission of Project KODECET have been truly invaluable.

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EXECUTIVE SUMMARY

Shifting to a circular economy can generate significant benefit for both advanced and emerging economies. Responsible consumption and production is at the heart of the circular economy, which seeks to promote sustainable resource management, reduce waste creation, and promote material recycling and reuse. The Ellen MacArthur Foundation estimates that the circular economy might yield USD 4.5 trillion in global economic benefits. Nations must transition from a linear "cradle to the grave" model, which promotes the manufacturing, selling, consuming, and disposal of products in landfills, to the "cradle-to-cradle" concept as propagated by William McDonough and Michael Braungart in 2002. For successful implementation of transitioning to a circular economy, collaborative efforts among all stakeholders are key. It is essential to promote knowledge of the circular economy across a varied array of stakeholders, including government officials, policymakers, consumers, manufacturers, NGOs, advocacy groups, researchers, academics, and educational institutions.

Education, a crucial catalyst for societal transformation, can facilitate the transition from theory to practice in embedding circular economy (CE) ideas as a lifestyle for current and future generations. Integrating CE ideals from an early age can have enormous societal benefits. Thus, circular economy education (CEE) is essential for this transformation, since it provides individuals with the knowledge, skills, and competencies necessary to adopt sustainable practices in personal and professional settings. CEE seeks to cultivate a profound comprehension of sustainability, resource efficiency, and environmental stewardship, commencing with early education and extending through higher education, vocational training, and lifelong learning programs.This report offers a comprehensive analysis of circular economy education in Thailand and India, emphasising the distinctive approach of each nation as well as the similarities present. It provides a thorough examination of the policies, educational frameworks, and stakeholder engagement that influence the landscape of CEE in both India and Thailand. The comparative analysis emphasises critical issues like policy frameworks, curriculum integration, stakeholder engagement, and community involvement.

The report highlights that both countries have established strong governmental support for circular economy education; nevertheless, their implementation strategies vary according to socio-economic situations and cultural influences. India prioritises public-private partnerships and vocational training, whereas Thailand emphasises the convergence of higher education and community-based initiatives. It also highlights areas where both countries can benefit from each other's experiences, especially regarding curriculum development, industry partnership, and policy implementation. Last but not the least, it offers critical insights into potential pathways for cross-country partnerships, joint research initiatives, and knowledge exchange programs that can enhance the effectiveness of circular economy education in both nations.

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Full Form
AI	Artificial Intelligence
AOL	Assurance of Learning
AR	Augmented Reality
BCG	Bio-Circular-Green
BJP	Bharatiya Janata Party
CEO	Chief Executive Officer
CE	Circular Economy
CEE	Circular Economy Education
COP28	Conference of the Parties 28
CSR	Corporate Social Responsibility
CSCG	Cyber Security and Cyber Governance
EC	European Commission
ECE	Education for Circular Economy
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
ESG	Environmental, Social, and Governance
EU	European Union
GHG	Greenhouse Gases
GW	Gigawatt
HRM	Human Resource Management
ICT	Information and Communication Technology
ILO	International Labour Organization
IIM	Indian Institute of Management
IIMs	Indian Institutes of Management
IITs	Indian Institutes of Technology
IoT	Internet of Things
ISB	Indian School of Business
KASH	Knowledge, Attitude, Skills, and Habits
KODECET	Knowledge Development for Circular Economy Transition
KPIs	Knowledge Processing Indicators
LCA	Life Cycle Assessment
MBA	Master of Business Administration
NAPCC	National Action Plan on Climate Change
NEP 2020	National Education Policy 2020
NGOs	Non-Governmental Organizations
NITI Aayog	National Institution for Transforming India
NSTDA	National Science and Technology Development Agency
NREP	National Renewable Energy Policy
OCDE	Organisation for Economic Co-operation and Development
PET	Polyethylene Terephthalate
PPP	Public-Private Partnership
PETA	People for the Ethical Treatment of Animals
PESTEL Framework	Political, Economic, Social, Technological, Environmental, and Legal Framework
PMKVY	Pradhan Mantri Kaushal Vikas Yojana
R&D	Research and Development
SD	Sustainable Development
SDG	Sustainable Development Goals
SEP	Sufficiency Economy Philosophy
SMEs	Small and Medium-sized Enterprises
STEM	Science, Technology, Engineering, and Mathematics
SWAYAM	Study Webs of Active-Learning for Young Aspiring Minds
TEI	Thailand Environmental Institute
TISS	Tata Institute of Social Sciences
TRF	Thailand Research Fund
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNCTAD	United Nations Conference on Trade and Development
USD	United States Dollar
US	United States
VR	Virtual Reality

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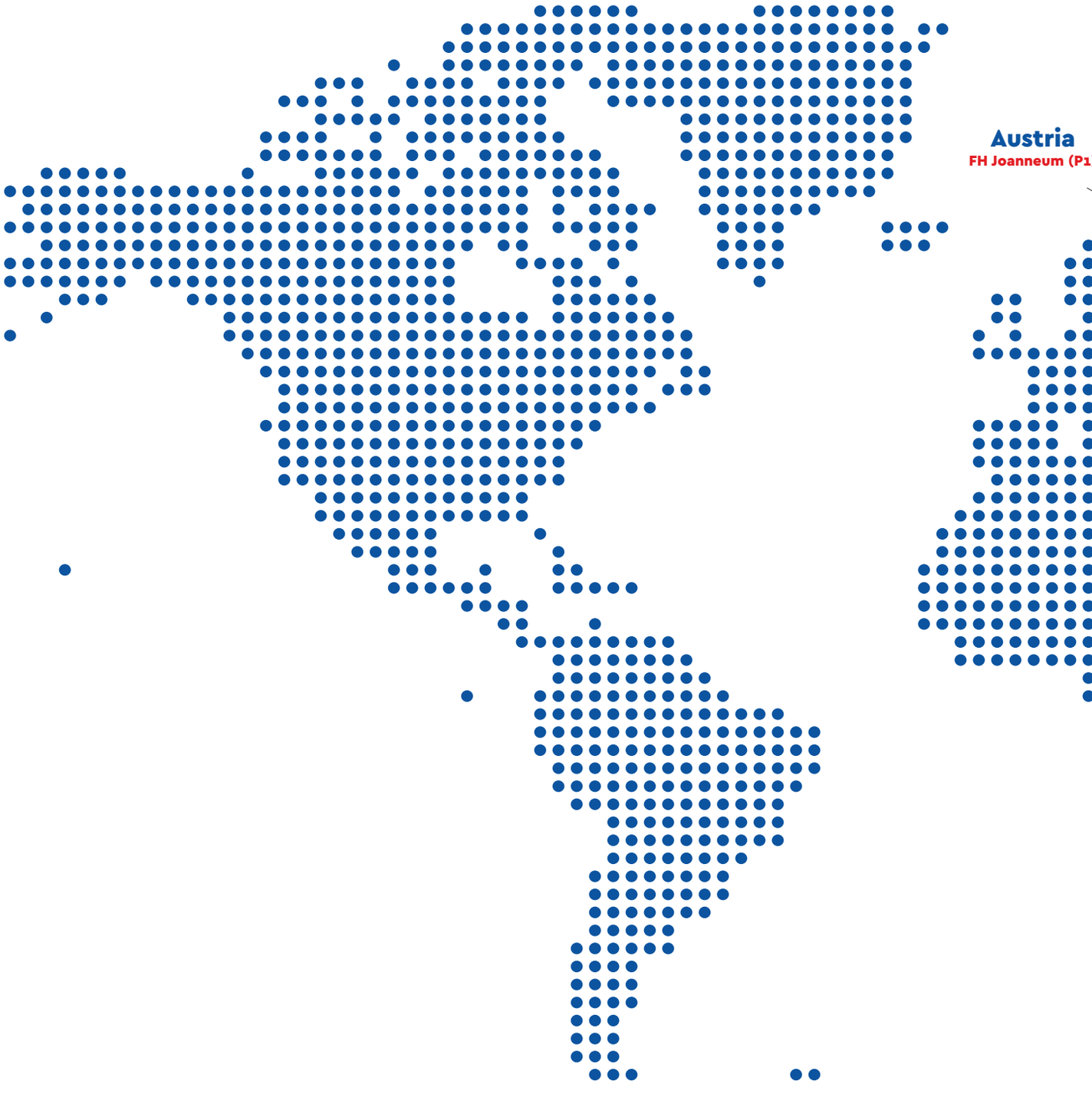

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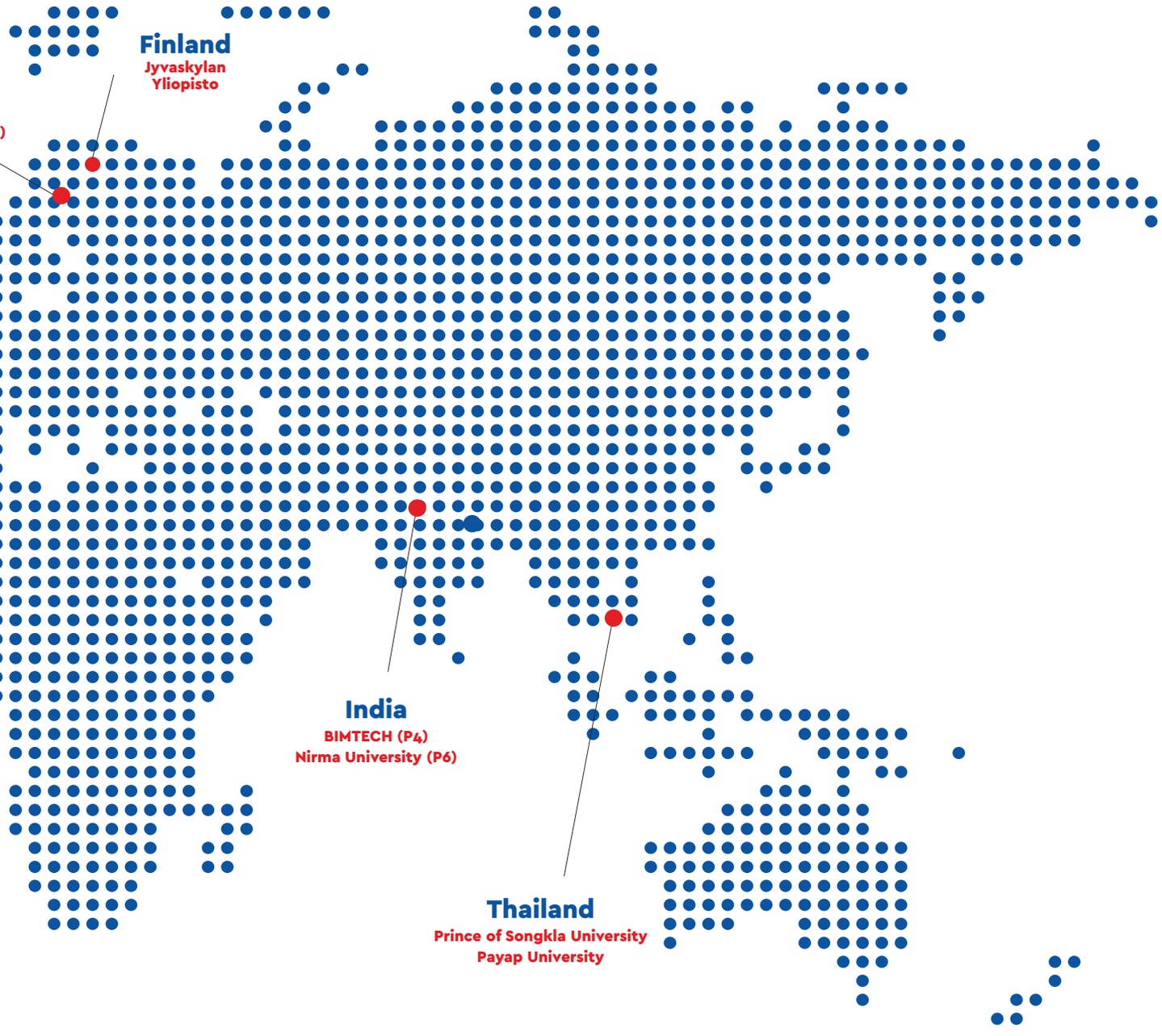

Contents

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CIRCULAR ECONOMY EDUCATION IN INDIA AND THAILAND

STATUS QUO REPORT

KODECET
Knowledge Development for Circular Economy Transition


Knowledge Development for
Circular Economy Transition

01
Overview of Report

1.1. Introduction to Circular Economy Education

The transition towards a circular economy (CE) represents a fundamental shift in how we manage resources, design products, and consider the lifecycle of goods and services. Unlike the traditional linear model of "take, make, dispose," a circular economy focuses on keeping products, materials, and resources in use for as long as possible through practices such as reuse, repair, remanufacturing, and recycling. The adoption of circular economy principles is seen as a key strategy for addressing pressing global challenges such as resource depletion, climate change, and waste management.

Circular economy education (CEE) plays a critical role in this transition, as it equips individuals with the knowledge, skills, and competencies needed to implement sustainable practices in both personal and professional contexts. CEE aims to foster a deeper understanding of sustainability, resource efficiency, and environmental stewardship, starting from early education and continuing through higher education, vocational training, and lifelong learning initiatives. As countries strive to meet the Sustainable Development Goals (SDGs), the integration of circular economy concepts into educational systems is becoming increasingly important.

This chapter provides an overview of the report, highlighting the comparative analysis of circular economy education in two Asian countries: India and Thailand. The goal is to offer a clear understanding of the status quo of CEE in these nations, including insights into policy frameworks, stakeholder involvement, curriculum development, and community engagement. By outlining the contents of each chapter, this introduction sets the stage for a comprehensive exploration of how India and Thailand are addressing the challenges and opportunities of circular economy education.

1.2 Structure of the Report: A Three-Part Overview

This report provides a detailed examination of circular economy education in India and Thailand, highlighting both the similarities and the unique approaches taken by each country. The analysis is divided into three main sections:

1. Part 1: Circular Economy Education in India
2. Part 2: Circular Economy Education in Thailand
3. Part 3: Comparative Analysis of India and Thailand's Circular Economy Education

This report is structured into 15 comprehensive chapters, providing an in-depth analysis of circular economy education (CEE) in two Asian countries, India and Thailand. The introductory chapter outlines the content and structure of the report, giving a roadmap of the report.

- Chapters 2 to 8 focus on the status quo of CEE in India, covering the country's policy framework, educational strategies, stakeholder engagement, and challenges in integrating circular economy principles into the educational system.

- Chapters 9 to 13 provide a detailed analysis of the status quo of CEE in Thailand, exploring the impact of government policies, the role of educational institutions, and the influence of traditional ecological knowledge in promoting sustainable practices.

- Chapters 14 to 16 present a comparative analysis of CEE between India and Thailand, synthesizing key insights, similarities, and differences in the approaches adopted by the two countries.

1.3. Part 1: Circular Economy Education in India

The first part of the report delves into the current state of circular economy education in India, offering a comprehensive overview of the policies, educational frameworks, and stakeholder involvement that shape the landscape of CEE in the country.

- **Overview of Circular Economy Education in India:** India's approach to circular economy education is rooted in its cultural heritage, which emphasizes sustainability, resource conservation, and environmental stewardship. It elaborates the traditional practices that have contributed to a mindset of circularity long before the term **"circular economy"** became widely recognized. The report explains how these cultural values are integrated into modern educational frameworks, creating a unique blend of traditional wisdom and contemporary pedagogical approaches.

- **Policy Frameworks and Government Initiatives:** The detailed analysis of the key policies that support circular economy education in India, with a focus on the National Education Policy (NEP) 2020 has been explained. The NEP 2020 marks a significant shift towards experiential learning and environmental education, emphasizing the integration of sustainability concepts across all levels of the curriculum. This part of the report highlights government initiatives like the Swachh Bharat Mission, the Plastic Waste Management Rules, and other regulatory frameworks aimed at promoting resource efficiency and waste reduction. The role of government agencies in funding and supporting educational institutions to adopt circular economy practices is also examined.

- **Role of Educational Institutions:** The report provides the insights into how Indian educational institutions are implementing circular economy principles, from primary and secondary schools to higher education and vocational training programs. It highlights the curriculum development process, the incorporation of circular economy concepts in environmental science subjects, and the involvement of universities in research and innovation. Leading institutions such as the Indian Institutes of Technology (IITs) and Indian Institutes of Management (IIMs) are profiled for their role in driving research on sustainable business models, resource optimization, and waste management.

- **Community Engagement and Industry Involvement:** The importance of community engagement and public-private partnerships in advancing circular economy education in India. Grassroots movements, local NGOs, and corporate social responsibility (CSR) initiatives play a crucial role in raising public awareness and providing practical learning experiences. Case studies from industry collaborations illustrate how businesses are partnering with educational institutions to offer internships, hands-on projects, and skill development programs focused on circular economy practices.

- **Challenges and Opportunities:** The first part of the report concludes by addressing the key challenges faced by India in scaling up circular economy education, including regional disparities in access to quality education, limited funding for sustainability programs, and the need for capacity building among educators. However, it also identifies significant opportunities, particularly through the use of digital learning platforms, vocational training initiatives, and international collaborations that can help bridge these gaps and enhance the impact of CEE in India.

1.4. Part 2: Circular Economy Education in Thailand

The second part of the report shifts its focus to Thailand, examining how the country has adopted and implemented circular economy principles within its educational system. Thailand's approach is influenced by its commitment to the Bio-Circular-Green (BCG) Economy Model, which serves as a guiding framework for sustainable development.

- **Overview of Circular Economy Education in Thailand:** This part of the report introduces with Thailand's strategic emphasis on integrating biological resources, circular economy practices, and green technologies. The BCG Economy Model has been central to Thailand's efforts to promote sustainability, and the report will provide how this model is reflected in the country's educational policies and practices.
- **Government Policies and Strategic Frameworks:** The detailed examination of the Thai government's initiatives supporting circular economy education, including the 13th National Economic and Social Development Plan, the 20-Year Master Plan for Waste Management, and the Roadmap for Plastic Waste Management (2018-2030) has been presented. These policies emphasize resource efficiency, waste reduction, and the incorporation of circular economy concepts into educational curricula. The role of the Ministry of Education and the Ministry of Natural Resources and Environment in driving these initiatives is also highlighted.
- **Integration into Educational Institutions:** The report will provide insights into how Thai universities and research institutions have integrated circular economy principles into their curricula. Leading universities, such as Chulalongkorn University and Thammasat University, are at the forefront of offering specialized courses on environmental management, sustainable development, and circular economy practices.
- **Community and Cultural Influences:** This part of the report also discusses the role of traditional ecological knowledge and local wisdom in shaping Thailand's approach to circular economy education. Community-based projects, particularly in rural areas, provide practical examples of circular practices, such as sustainable farming, local recycling initiatives, and collective waste management. The report

explains, how these culturally rooted practices align with modern circular economy principles, creating a unique educational experience that blends traditional and contemporary knowledge.

- **Challenges and Future Directions:** The section concludes with an analysis of the challenges Thailand faces in implementing circular economy education, including policy enforcement gaps, limited waste management infrastructure, and the need for greater public awareness. However, the emphasis on innovation, technology adoption, and international partnerships presents a promising outlook for the future. The report provides an understanding of how Thailand plans to leverage these opportunities to enhance its CEE framework.

1.5. Part 3: Comparative Analysis of Circular Economy Education in India and Thailand

The third and final part of the report provides a comparative analysis of the status quo of circular economy education in India and Thailand. It provides the insights from the previous chapters, highlighting both the similarities and differences in the approaches taken by the two countries.

Key Comparative Themes: The comparative analysis focuses on key themes such as policy frameworks, curriculum integration, stakeholder engagement, and community involvement. The report provides how both countries have developed robust policy support for circular economy education, yet their implementation strategies differ based on socio-

economic contexts and cultural influences. India's emphasis on public-private partnerships and vocational training contrasts with Thailand's focus on higher education integration and community-based projects.

Cross-Country Learning and Collaboration: The report identifies areas where India and Thailand can learn from each other's experiences, particularly in terms of curriculum development, industry collaboration, and policy implementation. The report will provide insights into potential pathways for cross-country partnerships, joint research initiatives, and knowledge exchange programs that can enhance the effectiveness of circular economy education in both nations.

This structured approach aims to guide the complexities of circular economy education, providing a balanced perspective on the progress made and the potential pathways for advancing CEE in India and Thailand.

India REPORT

Knowledge Development for Circular Economy Transition

02
Circular Economy Education in India

"The goods of today are the resources of tomorrow at yesterday's resource prices" (UNCTAD, 2024)

The circular economy significantly highlights topics such as sharing, leasing, reusing, repairing, refurbishing, and recycling, this symbolises an important shift in patterns of production and consumption. This strategy provides a sustainable path for economic prosperity by increasing the lifecycle of products and reducing their negative impacts on the environment.

In its simplest terms, a circular economy is a system of economic organisation where the means of production are designed with the reuse and recycling of inputs in mind. This reduces emissions into the atmosphere while also encouraging sustainable and ecologically modes of production.

Markets that promote product reuse rather than disposing of them and as a result extracting new resources are features of a circular economy. All waste products, including discarded clothing, scrap metal, and outdated electronics, are recycled or put to better use in such economies. This can offer ways of safeguarding the environment as well as making better use of the available natural resources leading to establishment of new industries, employment generation, and enhancing capacities

2.1 India's Progress and Potential

Some of the good examples of the Country's working is the Polyethylene Terephthalate (PET) plastic industry, India's recycled PET market is estimated to be around $400–550 million, it has a 90% recycling rate, which is higher than that of the US (31%), Europe (48%), and Japan (72%). This high recycling rate is consistent with worldwide trends supporting circular economic models showcasing India's leadership in sustainable plastic management.

Considering the fact that India's economy is anticipated to grow to be the third largest in the world by 2030, implementation of various concepts of the circular economy might have a significant positive impact on the country's economic and environmental sustainability.

According to reports, the estimated population of India in 2024 will reach 1.45 billion, with a population density of approximately 438.58 persons per square kilometer[1a]. In Contemporary times with the rapid evolution of the Indian Economy and changes in the environment leading to challenges such as global

[1]United Nations Conference on Trade and Development (UNCTAD). (n.d.). *The goods of today are the resources of tomorrow at yesterday's resource prices.* Retrieved September 16, 2024, from https://unctad.org/topic/trade-and-environment/circular-economy

[1a]Macrotrends, Retrieved September 15 2024, from https://www.macrotrends.net/global-metrics/countries/ind/india/population-density

warming, and climate change there is an evident contradiction between environmental conservation and economic expansion, especially in developing nations like India, whose population is expanding at a very high rate. India being a developing country through its policies and laws is trying to meet both ends of economic expansion and environment conservation to achieve the vision of Sustainable development for all stakeholders. The Indian Social fabric is highly stratified and fragmented based on caste, class, tribe, and gender norms. It is mostly observed that those who have the more 'privileged' often associate their identities more with economic consciousness while the 'less privileged' associate their identities more with environmental consciousness. The very ethos of circular economy values both economic consciousness while suggesting ways and methods such that there is economic progress without any environmental regress.

Comparing the existing growth environment in the Indian Context, India's circular economy has the potential generate an annual value of ₹14 lakh crore ($218 billion) in 2030 and ₹40 lakh crore ($624 billion) in 2050.

2.2 Circular Economy Practices in the Indian Context

The circular economy model has been guided by three principles of Reduce, Reuse, and Recycle. It has always been fortified in value and practiced as a principle since India's vedic era as a part of tradition , wisdom and customary eco-ethical practices.

Application of these ideas in the present day still holds a lot of essential value in creating a sustainable community.

India's bustling streets and marketplaces today stand as a testament to the country's thriving repair culture. The importance of recycling and mending is evident in many places, from the local shoe repair shop restoring worn-out items to electronics repair companies revitalising obsolete technology. These are not new habits; rather, they are ingrained practices that are motivated by a desire and a respect for continuing to recycle and use resources in a sustainable manner.

By absorbing the spirit of India naturally promotes a multi-sectoral circular economy through reuse. The following highlights several circular practices from a few different industries –

1. Water and Wastewater Management: India remains of the world's most water-stricken countries, with 18% of the world's population living in a country with 4% of its water resources. The many indigenous water harvesting and management techniques, such as the "johads" of Rajasthan and the "surangams" of Kerala, have traditionally helped to eliminate this situation. These traditional systems, which highly rely on upkeep and revival, may offer a long-term solution to India's water problems. There are high chances for the communities to become more drought-resistant, save money, and preserve water by repairing and maintaining these historic buildings.

2. Solid Waste Management, including Plastic Waste: Selling used newspapers, bottles and plastics to neighbourhood "kabadiwallas," or scrap merchants, is a regular home practice in India. Remarkably, 50% of India's plastic trash is recycled and co-processed; this is primarily due to division. This strategy not only promotes sustainability but also creates chances for ragpickers and other informal workers to make a living.

3. Textile Waste: There are numerous instances of repurposing in India's handloom and textile industries. For example, the skill of "raffu" stitching, which is a painstaking technique for repairing ripped fabrics, has helped many clothes last longer over time. India supports a sustainable

[2]Circular economy: definition, importance and benefits | Topics | European Parliament. (n.d.). Topics | European Parliament.https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular economy-definition-importance andbenefits#:~:text=What%20is%20the%20circular%20economy,cycle%20of%20products%20is%20extended

strategy that reduces waste and lessens the demand on virgin resources by promoting such traditions of reusing old fabrics into new and inventive products.

2.3 Synergies and Trade-Offs of a Circular Economy with the SDGs

Achievement of the Sustainable Development Goals (SDGs), especially those related to resource efficiency and sustainable consumption and production, is inevitably tied to the circular economy (CE). Optimisation of the use of resources in production and consumption while reducing waste and externalities is known as resource efficiency. Sustainable production and consumption prioritise the use of goods and services that improve quality of life, satisfy fundamental requirements, and consume less natural resources and emissions throughout the course of their lifetime.

Important SDGs that are especially in line with the circular economy's tenets include Goal 12 on "Ensuring Sustainable Consumption and Production Patterns." By increasing recycling and reuse, this goal seeks to close the loop on product lifecycles, directly supporting the circular economy's goals of reducing waste and improving efficiency of resources.

Similar to this, SDG 8.4 proposes to enhance global resource efficiency in process related to production and consumption. The Circular Economy aims to serve twin objectives of economic growth along with environment conservation.

The systems used by Corporation in operating their business in under criticism as to how far it is possible and practical to align SDGs in their businesses. Scholars criticise about lack of practical methods and techniques of incorporating SDG principles in business practices. By applying methods of "take - make- use-dispose" the circular economy framework can offer workable solutions such that core values of Social Justice, Economic growth and environmental sustainability can be an outcome of business operations along with end product developed for the customer.

Concluding the same there is convergence and divergence with SDGs and Circular Economy. An example to cite here would be about SDG 13 i.e Climate Change , in contemporary times a lot of Corporations want to work on this agenda and also want to be in the Public eye, however there is still a need to study its practical implementation and come about with solutions as to how the SDG can be aligned and bridge the gap between SDG goals and Corporate strategies.

2.4 Principles of the Circular Economy

The Circular Economy Framework is built upon four fundamental principles: energy recovery, recycling, upcycling, and prevention.

- **Prevention:** Waste is intended to be avoided by waste is intended by creating items that are robust, repairable, and modular.
- Upcycling is the transformation process of converting waste into new, higher-value products. Some Significant examples include composting food waste and repurposing plastic waste into new products.

In order to minimise resource extraction and landfill usage, recycling concentrates on transforming waste materials into new goods. Energy recovery, on the other hand, uses trash that is not suitable for recycling or upcycling to produce energy through processes like incineration or biogas production.

Energy recovery can still result in pollution, therefore while it aids in waste management, it cannot take the place of prevention, reuse, and upcycling. Achieving zero waste by following these guidelines is the ultimate goal of the circular economy. The emphasis must be shifted from waste management to prevention and minimisation in order to make the change from the three Rs of reduce, reuse, and recycle to the 10 Rs of circular economy.

4. Basu, A. (2023, October 14). *India's repair Culture: Pioneering the Circular Economy movement.* https://www.linkedin.com/pulse/indias-repair-culture-pioneering-circular-economy-movement-basu/

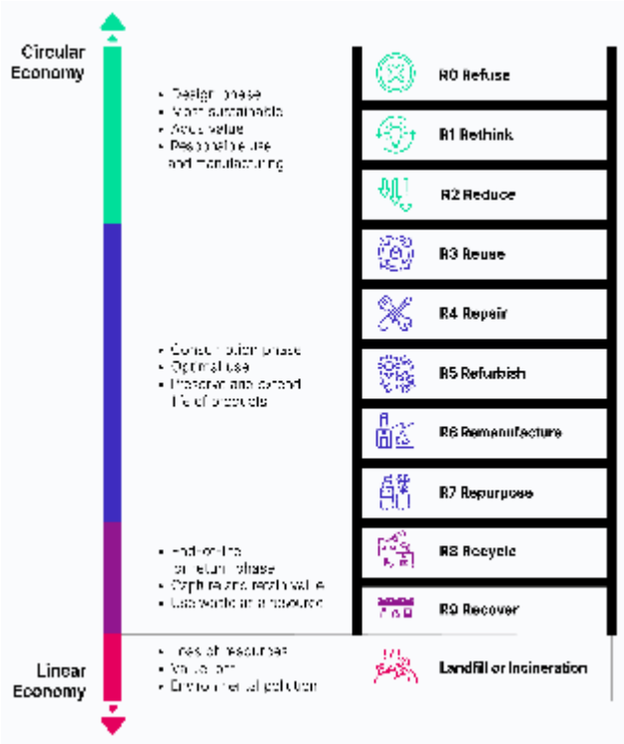


Fig 1: The 10Rs of Circular Economy[7]

- **Refuse:** To reduce waste and increase the usefulness of fewer items, stay away from needless purchases.
- **Rethink:** To lessen the influence that systems and goods have on the environment, rethink, re - evaluate, and innovate.
- **Reduce:** Adopt a circular economy by using and producing goods in a more effective manner.
- **Reuse:** Encourage the sharing and selling of goods instead of perpetuating a disposable culture.
- **Repair:** Encourage repairability to prolong product lifespans and fend against scheduled obsolescence.
- **Refurbish:** To cut down on waste and lower carbon emissions, restore and modernise outdated products.
- **Remanufacture:** Creating new, useful goods by reusing parts from discarded ones.
- **Repurpose:** Convert used objects into applications that encourage upcycling.
- **Recycle:** To save resources and cut waste, raise recycling rates over 9%.
- **Recover:** To reduce the negative effects on the environment, turn waste into energy through procedures like anaerobic digestion.

From the Lens of Social, Economic and Environment the global industrial ecosystem has not succeeded in incorporating the components of a circular economy, despite all the attempts to satisfy the objectives of sustainable development.

The rise in resource extraction and consumption to meet the higher aggregate demand is a major contributing factor to this. There is an important need to recognise that increased private consumption is quintessential to improving the quality of living of billions of lives, particularly in developing nations, it's also important to make sure that this doesn't come at the cost of our environmental objectives. As per Municipal sources about 50 million tonnes of solid trash is generated annually.

By 2025, it is predicted that this would rise to 150 million tonnes. Furthermore, because value losses are inevitable, waste treatment is accountable for 6.7% of India's total annual GHG emissions are produced by 124 million tonnes of emissions. Huge volumes of unprocessed trash also wind up in open-air dumpsites, typically those which are close to cities, these pose serious risks to the environment and public health.

A circular economy ecosystem aims to reduce waste generation by prioritizing the usage of renewable resources, encouraging recycling practices and reusing products and materials, and ensuring the efficient use of resources. By reducing waste generation, a circular economy can mitigate the environmental impact of waste disposal and decrease the strain on India's already overburdened waste management infrastructure.

[4]Midha, A. (2023, May). Promoting circular economy through Education: Empowering India's sustainable future. Horasis. *https://horasis.org/promoting-circular-economy-through-education-empowering-indias-sustainable-future/*

[5]*Kukreja , D. C. (2023, January 12). Circular economy for Sustainable Development in India: IBEF. India Brand Equity Foundation. https://www.ibef.org/blogs/circular-economy-for-sustainable-development-in-india*

2.5 Integrating Circular Economy Principles in Education

Education, by encouraging social justice and responsible consumption, is essential to the advancement of the circular economy. By including the concepts of the circular economy into curriculum, educators may provide guidance and teaching to students through a thorough awareness of how their decisions affect the environment and society. Circular Economy Education can create a great impact on students decision making related to social and Environmental consequences of using resources. This will provide them with avenues to learn about the scarcity of natural resources and how one can judicially utilise them. With the right knowledge and thought process they can opt for more sustainable options and can increase the demand for goods and services associated to circular economy.

Thus, it is highly important that India's Curriculum system should include circular economy as a subject and make students aware about its benefits for Economy and Environment.

India's curriculum system should include instruction on the circular economy and highlight the benefits that adopting a circular economy model offers for the environment and ecology.

An extensive plan for developing workforce development in the context of the circular economy calls for expanding technical training in waste management, for example. Professionals need to improve their knowledge of sustainability and circularity principles, especially those in procurement roles.

Incorporating circular economy principles into subject domains such as science, social studies, economics, and environmental studies is instrumental for enabling students to understand the interdependence of environmental, social, and economic features in sustainable development. Students are given the tools and equipments to take charge of their education and develop a feeling of responsibility through experiential learning, a major part of which includes field excursions to recycling centres, waste management facilities, and sustainable enterprises in addition to hands-on activities like waste segregation and recycling programs in schools.

Project-based learning is encouraged by giving students tasks that push them to come up with creative solutions for resource conservation, waste management, and sustainable product creation. These tasks also improve creativity, critical thinking, and problem-solving skills. It is important to run teacher training programs so that teachers have the skills and pedagogical resources they need to teach circular economy principles to their students. Promoting collaboration and professional development among educators facilitates the exchange of resources and best practices.

It is important to provide avenues for exchanging experiences, success stories, and best practices with an aim of promoting Circular Economy Education. Sharing knowledge and working together is further improved by taking part in knowledge exchange events such as conferences, workshops, and competitions that support sustainable practices and circular economy projects.

2.6 Effective strategies for embedding circular economy concepts into education include:

- Interdisciplinary Learning: Introducing circular economy principles across various subjects to provide a holistic understanding.
- Hands-on Experiences Engaging students in practical projects and activities that illustrate real-world applications of circular economy concepts.
- Teacher Training: Training of Teachers should take place in a manner which ensures their skills and knowledge to impart education.

7 Confederation of Indian Industries. (1 C.E.). National Circular Economy Framework. In https://www.ciiwaste2worth.com/pdf/national-circular-economy-framework-compressed.pdf (First Edition). Retrieved November 1, 2023, from https://www.ciiwaste2worth.com/pdf/national-circular-economy-framework-compressed.pdf

[7]R-Strategies for a Circular Economy. (n.d.). https://www.circularise.com/blogs/r-strategies-for-a-circular-economy

- Technology Integration: Different digital tools should be leveraged to enhance educational experiences.

2.7 Global Policies and Research Trends

Several Policies on Circular Economy like the European Commission's Action Plan for the Circular Economy and China's Circular Economy Promotion Law have played an instrumental role in promoting the concept of circular economy and made it an important and well-known term worldwide.

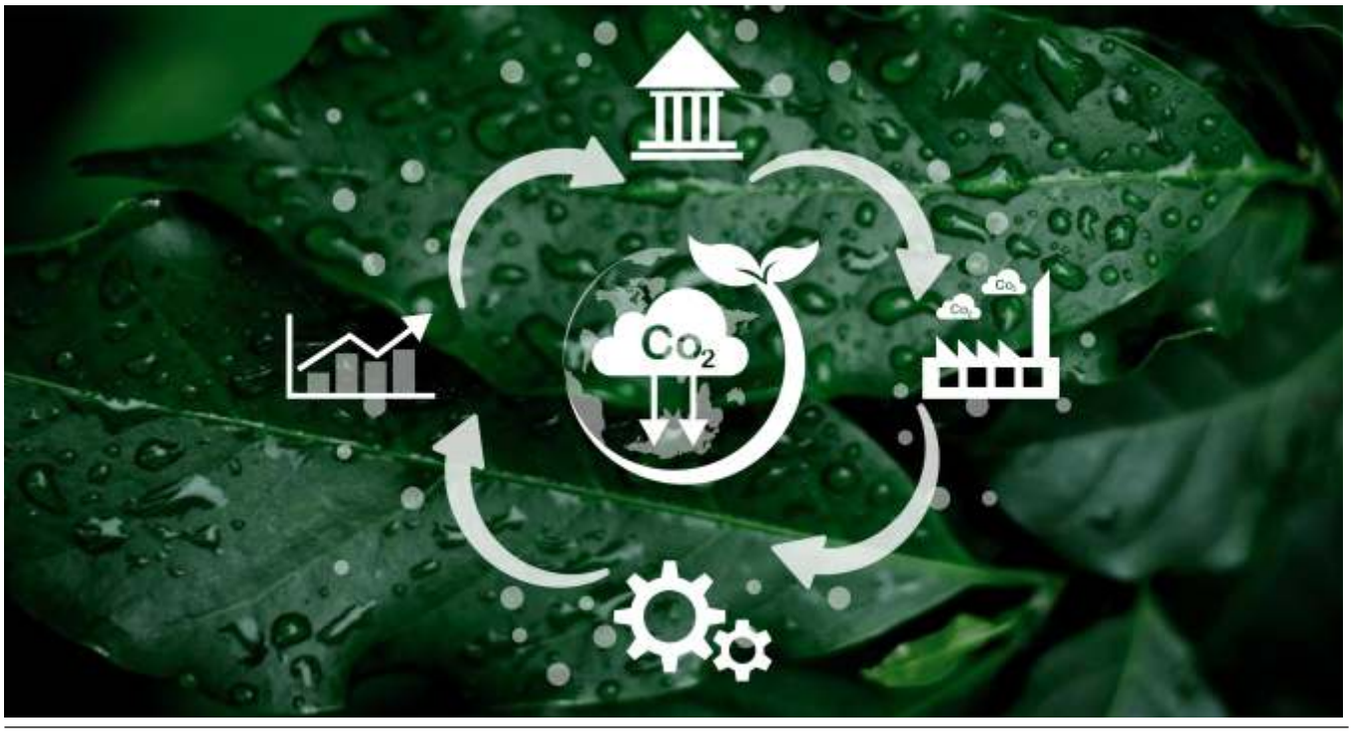
Countries such as Finland, China , India and England are some of the countries which have seen immense growth in the field of Circular Economy Education. As per Research conducted it was found that curriculum development was crucial for addressing various systemic and multidisciplinary aspects of Circular Economy through integrated teaching strategies.

According to recent research, comprehensive curriculum development is crucial for addressing the systemic and multidisciplinary aspects of the circular economy through integrated teaching strategies.

Competency-Based Education: It is very important to acquire useful skills related to Circular Economy to equip the population with the right kind of Knowledge and Skillset.

Collaborative Practices: Improving student outcomes by forming alliances between higher education and business.

In conclusion, the significance of incorporating these ideas into education is shown by India's progress in recycling and its potential for expansion in sectors of the circular economy. A focus on comprehensive, competency-based educational approaches will be crucial for easing the transition to a more resilient and sustainable circular economy as research and regulations change[12].



[10]Qu, Dongxu & Shevchenko, Tetiana & Xia, Yuanyuan & Yan, Xiumin. (2022). Education and Instruction for Circular Economy: A Review on Drivers and Barriers in Circular Economy Implementation in China. International Journal of Instruction. 15. 1-22. 10.29333/iji.2022.1531a.

[11]Andersson, J., François-Ferrière, M. F.-F., & Hoskova, K. (2023, December 14). Circular Solutions, Community *Revolutions: The Social Impact of Circularity. World Economic Forum.*

[12]Renfors, Sanna-Mari. (2024). Education for the circular economy in higher education: an overview of the current state. International Journal of Sustainability in Higher Education. 25. 111-127. 10.1108/IJSHE-07-2023-0270.

03

Policy Framework and Government Initiatives in India

3.1 Circular Economy Education in India

Circular economy (CE) is a new industrial paradigm designed to overcome the linear "take, make, disposal" model, which "relies on large quantities of easily accessible resources and energy, and as such is increasingly unfit to the reality in which it operates" . The concept of circular economy has become extremely popular since policymakers have heavily promoted it as a solution to reduce harm to the environment.

With a promise to significantly reduce the environmental and social impact of current production and consumption activities, CE is fully integrated into the broader sustainability paradigm and, simultaneously, can provide companies with economic and ecological benefits . All organizational functions-including engineering, procurement, marketing and sales, supply chain, design, production, and logistics-are being impacted by CE transformation and, as a consequence, new and updated skills and competencies aligned with the CE principles are required for all these areas. The shift to a circular economy necessitates action from multiple stakeholders worldwide. In particular, managers of all business departments should align their skills and competencies to the increasing complexity of this new context. Thus, circular economy has also started to gain traction in higher education. Keeping in mind the dearth of knowledge in this area, educating people and creating an awareness of the benefits of a circular economy can be considered a crucial way to start transitioning from a linear economy towards a circular economy. Thus higher educational institutions are increasingly seen as strategic agents and main drivers that can and should support circular economy transition.

3.1.1 Develop the National Level Context in Circular Economy Education

Circular Economy (CE) has the potential to understand and implement new forms of business operations and consumption behaviours and patterns that can help society become more sustainable at low or no energy, material, and environmental costs (Table 1). From this perspective, moving to a CE plays a vital role in addressing the Sustainable Development Goals (SDGs) of the Agenda 2030, such as SDG 12 (Dantas et al., 2021) on responsible consumption and production, SDG 9 on industrial development, or SDG 13 on climate action, amongst others (EMF, 2021). The implementation of the CE requires systemic

[13]Ellen MacArthur Foundation. Delivering the CE. A Toolkit for Policymakers; Ellen MacArthur Foundation: Cowes, UK, 2015.
[14]Kirchherr, J.; Reike, D.; Hekkert, M. Conceptualizing the Circular Economy: An Analysis of 114 Definitions. Resour. Conserv. Recycl. 2017, 127, 221–232.
[15]Ghisellini, P.; Cialani, C.; Ulgiati, S. A Review on Circular Economy: The Expected Transition to a Balanced Interplay of Environmental and Economic Systems. J. Clean. Prod. 2016, 114, 11–32.

Table 1: Evolution of Circular Economy Education in India

Time	Key Developments	Focus Area	Stakeholders
Ancient and Traditional Practices	Utilization of natural resources and implementation of recycling methods in conventional crafts and agriculture	Examples of circular activities include agricultural rotation, water conservation, and the reuse of materials in handicrafts and textiles.	Traditional communities, artisans, agricultural sectors
Pre-Industrial India (before 1947)	Indigenous waste management and repair-based economy	Practices like composting, biogas production, and the reuse of organic waste were common in villages	Local communities, farmers, craft industries
Post-Independence (1947-1990)	Initial industrialization with growing focus on sustainability in academic research	Resource management, environmental conservation in agriculture and forestry education	Indian universities (e.g., Agricultural universities), government agricultural bodies
Globalization Era (1990-2000)	Emergence of environmental education in Indian curricula	Environmental studies introduced in school curriculums focusing on pollution, waste management, and resource efficiency	Ministry of Environment, Educational Boards, NGOs
Sustainability Focus (2000-2010)	Emphasis on sustainable development in higher education programs	Environmental science programs emphasizing sustainable resource management and waste reduction	Universities, UGC (University Grants Commission), policy-makers
Circular Economy Integration (2010-2020)	Introduction of circular economy concepts in technical and higher education	Courses in waste management, resource efficiency, sustainable business models, and renewable energy	IITs, IIMs, technical institutes, industry collaborations, government ministries
National Policy Alignment (2020-Present)	NEP 2020 and Skill India initiatives encouraging CE education	National policies integrating circular economy in education with focus on industry collaboration and skill development	NITI Aayog, Ministry of Education, industry partners, skill development programs
Future Prospects (Post 2023)	Full integration of circular economy principles across educational disciplines	Interdisciplinary programs, vocational training for green jobs, policy-oriented research on circular practices	Higher education institutions, vocational institutes, government agencies, industries

Source: Authors' Compilation

innovation and adjustment amongst all the relevant stakeholders, for example companies, policymakers, and higher education institutions (HEIs) (Bertassini et al., 2021; Pieroni et al., 2021).

India, a country facing significant challenges in waste management and environmental degradation, has a unique opportunity to promote sustainable development by embracing the principles of a circular economy. This approach not only addresses waste and resource management but also encourages economic growth, social equity, and environmental conservation.

Role of Stakeholders:

In the context of Circular Economy (CE) education in India, various stakeholders play a crucial role in shaping its development and implementation. These stakeholders, ranging from government bodies to educational institutions, private sector players, NGOs, international organizations, and local communities, are instrumental in driving awareness, formulating policies, and providing practical training in CE principles (Table 2). Each entity contributes to sustainability in a unique way through the efficient utilisation of resources and the reduction of waste. By

Table 2: Role of stakeholders in Indian Context

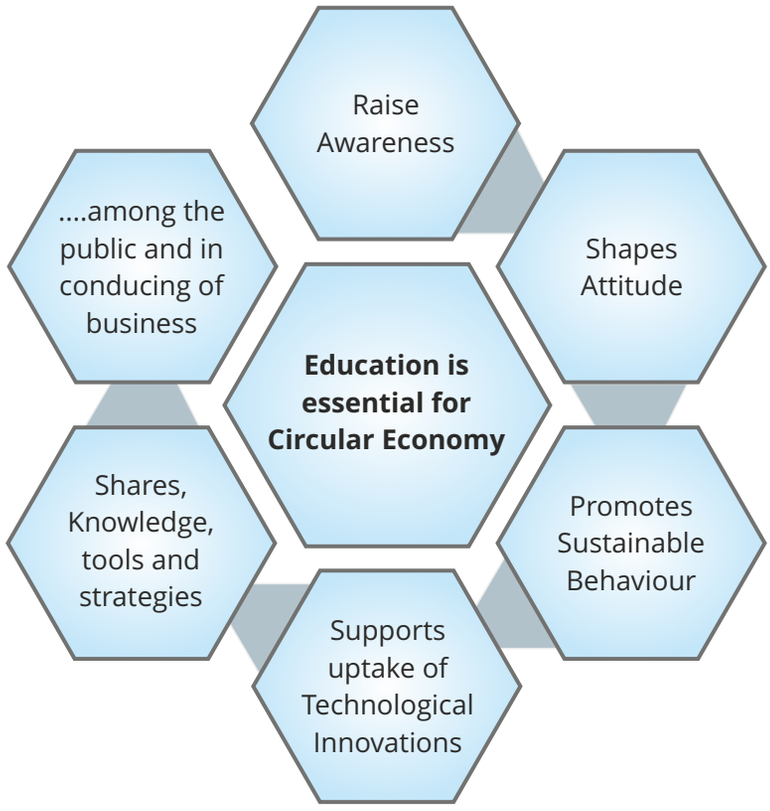
Stakeholder	Entities	Role in CE
Government	- Ministry of Education - Ministry of Environment, Forest and Climate Change - NITI Aayog	- Develop policies and curricula - Ensures environmental sustainability and promotes green skills - Aligns economic strategies with circular economy principles
Educational Institutions	- Universities - Technical Institutes	- Design and offer circular economy-focused programs - Collaborative research with industry
Industry	- Manufacturing Companies - Technology Firms - Start-ups	- Collaboration with Industry - Lead Innovation - Funding - Research
NGOs and Non Profit	- Skill development NGOs - Environmental Organisations	- Provide Training - Advocate for Policies - Grassroot connect - Feedback - Execution of Programmes
International Organisations	- United Nations - EU Collaboration	- Offer Framework - Promote Global Good Practices
Local Communities	- Small businesses	- Implementation at the Grassroots level - Engagement in Sustainable Practice.

Source: Authors' Compilation

working together, these stakeholders can establish a system that optimises the longevity of resources, materials, and products, thereby benefiting both the economy and the environment.

The potential to generate substantial value for both developed and developing economies is present in the transition to a circular economy. At its core (Figure 1), education fosters awareness, shapes attitudes, and promotes sustainable behaviour. It supports the

Figure 2: Education embraces the Circular Economy



Source: Authors' Compilation

uptake of technological innovations and facilitates the sharing of knowledge, tools, and strategies. These elements collectively contribute to building a more sustainable and resource-efficient economy.

By promoting education, community engagement, technological innovation, and supportive legislation, we can fully realize the promise of the circular economy, to make our living conditions less polluted, create a more environmentally friendly and resilient society, and provide opportunities now and forever to current and future generations.

3.1.2 Identifies the Stakeholders and System

Circular economy education in India involves a diverse range of stakeholders, each playing a crucial role in shaping the educational ecosystem to promote sustainability and resource efficiency . These actors include government bodies, educational institutions, private sector companies, and non-governmental organizations (NGOs), all working to integrate circular economy principles into formal and informal education. The process involves developing policies,

curricula, and training programs that align with circular economy goals while addressing the needs of industries and communities. This collaborative effort not only enhances the technical skills and awareness of individuals but also fosters sustainable practices at a systemic level, contributing to long-term environmental and economic benefits. The following table outlines the key stakeholders, their roles, and the input-output mapping of circular economy education, highlighting how these efforts lead to broader societal change (Table 3).

Table 3: Input-Output mapping of stakeholders and process

Stakeholder		System	Input	Output	Long-term Effects
Government	Government Agencies	Policy Formulation	Policies, Funding, Regulations, and Program Initiatives	Circular economy principles integrated into national education policies	- Rise of awareness among future professionals - Adoption of CE Principles - Long-term resource Efficiency
	Ministry of Education	Integrating CE in education	Guidelines for education policy	Updated Curricula	- National Sustainability Culture
	Ministry of environment	Provides environmental standards and guidelines for education	Framework for integrating sustainability into educational policies	Alignment of educational outcomes with SDGs	- Adoption of Sustainable Practices
	NITI Aayog	Developing Strategy	National Strategies	Promotion of Circular economy research and innovation	- Enhancing Research Output
Education	Educational Institutions	Developing Curriculum	Research Initiatives	Skilled Graduates	- Creation of industry-specific CE solutions
	Universities	Research Centres	Academic expertise	Graduates with circular economy knowledge	- Increased adoption of CE practices by industries - Growth in green
Industry	Private Sector Companies	Curriculum Support and Training	Internships	Corporate partnerships	- More sustainable business practices
	Corporate Training Programs	Upskilling and re-skilling	Partnerships with educational institutions	Skilled professionals, adoption of circular business models	- Reduced environmental footprint
NGOs	Environmental NGOs	Advocacy for CE education	Educational materials, workshops, awareness campaigns	Enhanced community participation and CE knowledge	- Behavioral changes in communities

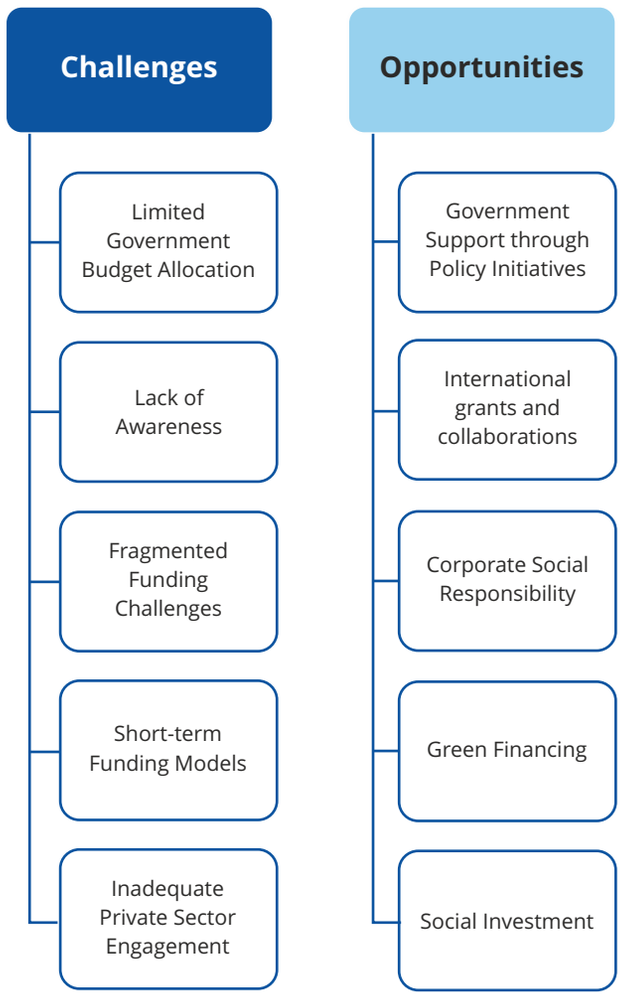
Source: Authors' Compilation

3.1.3 Need Gap Analysis

Teaching circular economy is challenging because of the systemic complexity and the involvement and contribution of a variety of different stakeholders. Due to these features, purely theoretical teaching does not allow the development of competencies and adequate learning for circular economy . Therefore, a versatile learning environment is required that allows the development of professionals with competencies to apply and manage circular economy.

Funding circular economy education in India faces several challenges. Government budget allocation is limited, as sustainability competes with other priorities. Additionally, a lack of awareness among donors, both in the private sector and philanthropic organizations, restricts funding opportunities. However, there are significant opportunities for growth. Government policies such as NEP 2020 and sustainable development initiatives can provide support through increased funding. International grants and collaborations with bodies like the UN and EU present avenues for financial support. The rise of Corporate Social Responsibility (CSR) in India also offers opportunities for companies to invest in circular economy education. Addressing these challenges and leveraging these opportunities can significantly expand circular economy education in India.

Figure 3: Funding challenges and opportunities for circular economy education in India



Source: Authors' Compilation

3.1.4 Mapping of the Influence Factors and Performance

Mapping the influence factors and performance of circular economy education in India involves identifying key elements that shape its development and impact. Policy frameworks like the National Education Policy (NEP) 2020 and sustainability guidelines provide foundational support, encouraging institutions to integrate CE into curricula. Some policies, strategies, and approaches that can support the growth and impact of circular economy education:

- Encouraging research and Development
- Establishing composite centers
- Encouraging emergence of innovation CE solutions
- Transdisciplinary thinking
- Embedding CE principles into teaching
- Driving circular solutions
- Supporting applied research

Its performance can be measured by analysing enrolment in CE-related courses, curriculum development, and industry partnerships that promote hands-on experience. Innovative teaching methodologies such as experiential learning, partnerships with industries, and internships in green sectors can help students develop practical skills in circular economy practices.

3.2 Developing the Process

Education for the Circular Economy

Education for Circular Economy (ECE) as a field of research is still in its infancy. The concept was introduced by Kirchherr and Piscicelli in 2019 when describing a course designed to present undergraduates with the circular economy concept. ECE deals with the role of higher education teaching in supporting the circular economy transition by examining how its principles are integrated across disciplines and their curricula as well as what teaching and learning approaches are the most suitable to its contents. Higher education undoubtedly plays a crucial part in the worldwide shift towards a circular economy. There is increasing movement within the industry, globally, to transition from teaching and learning to research and student action in the realm of the circular economy9.

Thus, the existing literature on ECE has explored how circular economy can be approached and integrated into higher education. The literature has mainly focused on the issues of developing single circular economy courses and examining the characteristics of the teaching and learning approaches best fitting to develop circular economy competencies in these courses. As circular economy is a systemic transformation and complex interaction between economic, environmental and social systems, the system's focus is the key issue in ECE. Thus, students should understand how the environment, economy, society and culture interrelate. Students must gain extensive knowledge and comprehend the processes related to Circular Economy, enabling them to find, create, and assess innovative circular business models. Systems thinking also supports the students to consider interdependencies, multiple stakeholder perspectives, causes and effects of system changes, causalities and environmental influences. As Marouli stated in 2016 , ECE is integrative, which means different bodies of knowledge and different viewpoints should be integrated into teaching and learning. Due to the systemic nature of the circular economy, changes must occur, not only at the individual but also at the social structural level. This means that students should be able to get involved in these issues and understand the elemental connection between individual actions and social problems. They should acquire skills for developing circular techniques, resources and business models.
The status quo report on Circular Economy (CE) education in India has been meticulously developed following an extensive review of existing literature, policies, and practices. This thorough examination (Table 4) aimed to build a robust framework for understanding the current landscape of CE education. Key stakeholders, including government agencies, educational institutions, private sector organizations, and NGOs, were identified to map their roles and contributions in fostering circular economy principles.

Table 4: Input-Output mapping of stakeholders and process

Resource	Focus	Identified Gaps
Research Papers	- Emerging Concepts in CE - CE curriculum development - Skills development for green jobs - Experiential learning in CE - Circular economy models for India - Role of technology in CE education	- Limited institutional focus on CE - Gaps in industry-academic partnerships - Lack of awareness in vocational training - Inconsistent integration of CE in primary education - Absence of CE metrics - Underrepresentation of CE in rural areas.
News Articles	- Government initiatives for CE - Role of CSR in promoting CE - Educational reforms towards CE - Market demand for CE professionals - Industry contributions to CE education.	- Lack of public understanding of CE - Insufficient promotion of CE success stories - Limited dialogue between policymakers and educators - Industry's inconsistent engagement in media debates - Absence of policy critiques - Lack of focus on CE's economic impact
Government reports	- National policy on CE - NEP 2020 and CE integration - Government incentives for CE education - Public-private partnerships for CE education - State-level CE education policies - CE workforce development strategies - Green skill enhancement programs	- Gaps in implementation of CE policies - Inadequate funding for CE education - Limited support for CE in vocational education - Gaps in public sector collaboration with private entities - Limited focus on teacher training in CE - Need for better regulatory mechanisms

Source: Authors' Compilation

[16]Malik, A., Sharma, P., Vinu, A., Karakoti, A., Kaur, K., Gujral, H. S., ... & Laker, B. (2022). Circular economy adoption by SMEs in emerging markets: Towards a multilevel conceptual framework. Journal of business research, 142, 605-619.

[17]de las Mercedes, M. and Alvarez-Risco, A. (2022), "Better students, better companies, better life: Circular learning", in Alvarez-Risco, A., Muthu, S.S. and Del-Aguila-Arcentales, S. (Eds), Circular Economy: Impact on Carbon and Water Footprint, Springer, Singapore, pp. 19-40.

[18]https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf

Understanding the Ecosystem and Communities

Circular economy (CE) education in India has the potential to create significant transformations across various sectors and communities . India, the fastest growing major economies also houses 1/3 of the world's extreme poor with the highest demographics of children suffering from malnutrition. With more than 1.4 billion people, India accounts for around 18 percent of the world population and is ranked third in global carbon emissions. Regarding the implementation of circular economy initiatives, the country has made some progress; yet, it still has much distance to travel, particularly in comparison to European nations that are actively enhancing resource efficiency and implementing circular economy practices. India's present material efficiency is approximately 25% compared to European nations, which have material recycling rates above 45%.

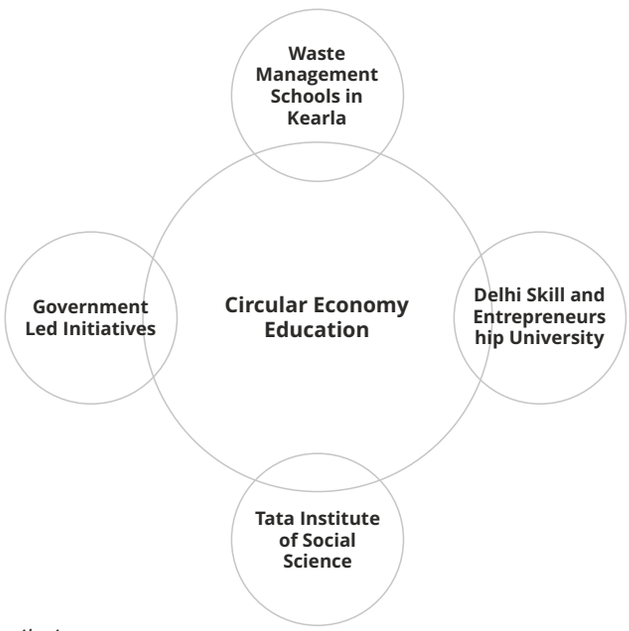
Any positive or negative change in the country's development path could have a tremendous impact both at a social and an environmental level globally. By instilling the principles of reusing, reducing, and recycling materials, CE education can reduce environmental degradation and promote sustainable development. As per the Chief Executive Officer of the National Institution for Transforming India (NitiAyog), policy think-tank of the Government of India, the country's current per capita income is $1,652. If India continues to grow at the current rate of 7 per cent per annum, by 2032 per capita income will be $4,000 in real terms. Moreover, if the economy grew by 10 percent annually, the per capita income would reach $6,800 and India would be largely free from poverty by 2030. It is important that India embarks quickly on a positive model of development, uses its resources efficiently and becomes more inclusive, while harnessing the growing potential of the small and medium-sized sectors, which includes the informal economy. At a broader level, CE education can influence policy-making, ensuring that sustainability goals are met at local, state, and national levels. By equipping future leaders and policymakers with CE knowledge, India's transition towards a more

[19]Kirchherr, J., & Piscicelli, L. (2019). Towards an education for the circular economy (ECE): five teaching principles and a case study. Resources, Conservation and Recycling, 150, 104406.

[9]https://www.ellenmacarthurfoundation.org/articles/driving-the-circular-economy-on-a-university-campus.

sustainable and resource-efficient economy can be accelerated. There are several good practices in CE in India (Figure 3). Kerala's waste management programs in schools integrate CE principles by teaching students about waste segregation, composting, and recycling. Delhi Skill and Entrepreneurship University (DSEU) offers vocational training programs focusing on green jobs and CE principles. Tata Institute of Social Sciences (TISS) runs programs that engage communities in sustainability through circular economy models. The Indian government's "Swachh Bharat Abhiyan" and "Smart Cities Mission" have incorporated CE elements like waste reduction and resource optimization. Initiatives like the Plastic Waste Management Rules (2016) and the prohibition of single-use plastics have enabled the nation to successfully recycle approximately 60% of its plastic trash, in contrast to the global average of 9%. Concerning the energy sector, the nation aims to attain its ambitious goal of 500GW of renewable energy by 2030 through augmented investments in renewable sources, including solar energy and waste-to-energy initiatives. Thus, in the Indian context, progress will be found not via a trickle down sector-specific approach, but rather circular economy principles should be followed as a way of life from business, to homes, farms, schools. The effort has to be made both from the bottom as well as from the top of the pyramid.

Figure 4: Good Practices



Source: Authors' Compilation

3.3 Developing the Framework

To determine whether the current policy framework supports the long-term sustainability of circular economy (CE) education in India, it is essential to review key government policies, educational reforms, and international commitments that influence this space. The concept of circular economy has become extremely popular since it has been heavily promoted by policymakers as a solution to reduce harm to the environment.

[22]Korhonen, J., Honkasalo, A. and Seppälä, J. (2018), "Circular economy: the concept and its limitations", Ecological Economics, Vol. 143, pp. 37-46, doi: 10.1016/j.ecolecon.2017.06.041.

National Education Policy (NEP)

The National Education Policy (NEP) 2020 represents a transformative reform of India's education system, emphasizing a multidisciplinary and holistic approach to learning. Although it doesn't explicitly mention circular economy (CE) education, the NEP's focus on environmental sustainability, critical thinking, skill development, and experiential learning lays a strong foundation for the integration of circular economy principles into the national curriculum(Table 5).

Table 5: Explanation on Challenges, Opportunities& Provisions for NEP

Challenges	Opportunities	Provisions
Lack of Direct Reference to CE Education	Curriculum Development	Multidisciplinary and Holistic Education
Decentralized nature of education	Vocational and Technical Education	Experiential Learning and Critical Thinking
Teacher Training Gaps	Sustainable Schools and Campuses	Integration with Sustainable Development Goals
	Public-Private Partnerships	Higher Education and Research

Source: Authors' Compilation

NEP 2020 offers a promising framework for incorporating circular economy principles into India's education system by promoting multidisciplinary learning, sustainability, and skill development. While there are significant opportunities to align NEP's goals with CE education, a more explicit focus on the circular economy in policy implementation and curriculum design would strengthen India's long-term sustainability goals.

Skill India Mission

Skill India Mission aims to provide training in various sectors, including green jobs, by creating a skilled workforce ready for new-age industries. Skill India offers vocational courses that include elements of circular economy practices, such as waste management, sustainable product design, and eco-friendly technologies. As the nation moves towards sustainable development, integrating Circular Economy (CE) education within the Skill India framework is increasingly essential to address pressing environmental challenges and promote resource efficiency(Table 6) .

Table 6: Challenges and Opportunities under Skill India Mission for CEE.

Challenges	Opportunities	Areas of Integration Between Skill India and CEE
Lack of Awareness and Standardization	Public-Private Partnerships	Green Jobs and Vocational Training
Regional Disparities in Access	Online learning platforms under Skill India like **SWAYAM** and **e-Skill India**	Industry Collaborations and Practical Exposure
Limited Industry Engagement	Policy Alignment	Skill Development for Informal Economy
Funding and Infrastructure Gaps		Entrepreneurship and Innovation

Source: Authors' Compilation

Circular Economy (CE) education in India is an evolving field, shaped by a combination of national policies, industry demand, and educational reforms. The literature reviewed on the subject highlights the growing importance of CE in addressing environmental sustainability, resource management, and economic resilience.

The current status of circular economy education in India, as reviewed in the existing literature, shows that while there has been progress, there are significant gaps in policy implementation, curriculum standardization, and industry collaboration. However, the opportunities for advancing CE education, through policy alignment, industry partnerships, and digital learning platforms, are vast. By developing a structured action plan that addresses these challenges and capitalizes on these opportunities, India can build a strong foundation for circular economy education that not only contributes to sustainability but also prepares the workforce for the green jobs of the future.

04

Role of Educational Institutions in India

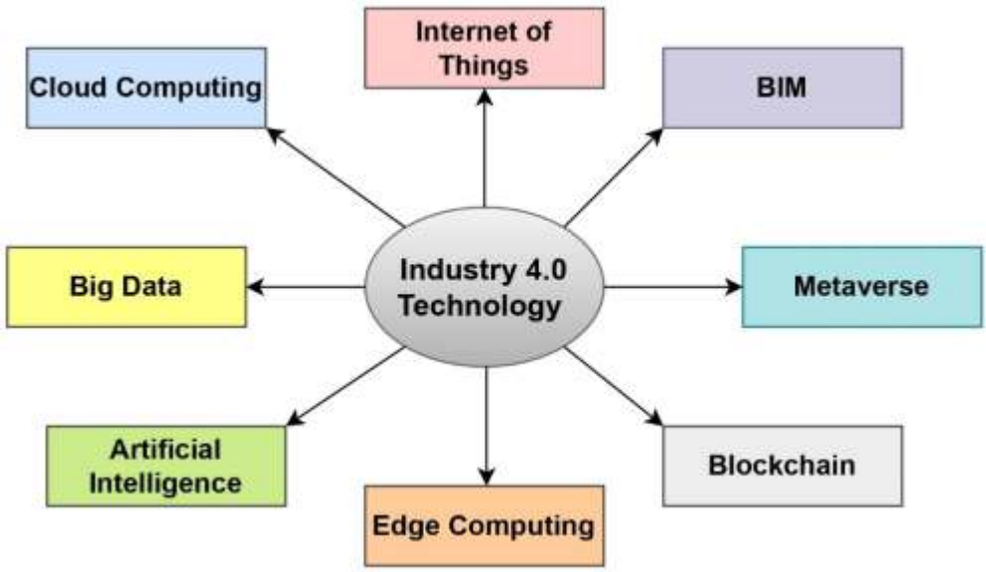
4.1. Circular Economy & Sustainable Development Goals

Circular economy exhibits great potential for attaining several Sustainable Development Goals (SDGs), such as SDG 6 on energy, SDG 8 on economic growth, SDG11 on sustainable cities, SDG 12 on sustainable consumption and production, SDG 13 on climate change, SDG 14 on oceans, and SDG 15 on life on land. Circular Economy also has in-direct linkages with SDGs. For example, SDG 9, which focusses on fostering innovation. The transition of enterprises towards sustainable production methods gives rise to fresh prospects in industries associated with recycling, refurbishment, and product-service systems.

These prospects not only enhance economic growth but also stimulate innovation as firms allocate resources to research & development in order to foster the creation of sustainable solutions. Similarly, by assigning value to resources at each phase of their life cycle, circular economy can greatly diminish the environmental consequences of enterprises, therefore promoting the survival of life in aquatic environments (SDG 14) and on terrestrial substrates (SDG 15). For instance, by the reduction of plastic trash, we can alleviate its detrimental impacts on marine life and ecosystems. Furthermore, by restraining the clearing of forests for the purpose of extracting resources, we can guarantee the preservation of various terrestrial ecosystems and the species that reside inside them.

4.2. Synergies between Circular Economy and SDGs

Figure 5: Industry 4.0 Technology



Source: Authors' Compilation

4.3. Identification of Issues in Circular Economy

Some of the issues which can slow down the growth of circular economy can be listed as below:

(i) Lack of the required Infrastructure to support Circular Economy
(ii) Increase in Cost of Production
(iii) Lack of appropriate Technology
(iv) Customers' low willingness to pay extra
(v) Design and Production constraints
(vi) Loose Regulatory framework by Govt.
(vii) Requirement of higher investments in the value chain
(viii) Presence of Institutional Voids

Circular economy, like any novel paradigm, is subject to several constraints and difficulties. Certain Nations are adapting their functioning to align with the principles of the circular economy, while others are encountering challenges in doing so. In underdeveloped Nations, the primary barriers impeding the implementation of a circular economy are financial and governmental laws.

Furthermore, emerging and developing Nations also face significant challenges in advancing towards circular economy because of their limited understanding of circular economy principles, consumer attitudes, and technology limitations.
The adoption of new circular systems of provision is subject to significant costs and risks due to a scarcity of providers, insufficient competence, inadequate regulatory frameworks, higher costs and lack of political will. Customers' limited willingness to pay extra for circular economy based products is also a big challenge. It is seen that, despite their assertions of promoting sustainability, the majority of consumers are reluctant to pay the required additional cost for circular economy-aligned alternatives. Another factor to consider is the challenge of reconciling the value chain with the provision of circular economy solutions. The cost and availability of circular economy raw materials pose a challenge in the value chain for business and Industry.

4.4. Assessment of the Situation and Identification of Needs

Few steps which can facilitate the implementation of circular economy principles can be:

(a) Designing sustainable products, Eg. Ecodesign
(b) Right to Repair
(c) Consumer Education and Awareness
(d) Eliminate unfair Green practices, Eg. Greenwashing
(e) Efficient Waste Management
(f) Stringent Legislation
(g) Empowered Institutions
(h) Customer Awareness
(i) Promotion of Research and Development (R&D) in this Area

By facilitating effective partnerships and collaborations among various stakeholders, well planned circular business processes have the potential to decrease the overall cost and increase the profit for circular economy products, thereby yielding substantial long-term benefits.

To get the best possible results, it is necessary to minimise resource usage, as well as restructure both the forward and reverse production processes. In order to enhance sustainable performance, reverse processes need to be both effective and efficient, meaning they must be scalable, practical, and profitable. Implementing reverse processes such as recovery, reuse, recycling, redesign, and reduction will enhance circularity and prolong the inclusion of materials in value-creation loops. The adoption of cutting-edge technologies such as Industry 4.0, IoT, AI, and blockchain to implement circular economy principles has to be promoted and development of novel operational frameworks has to be undertaken.

Caselet

Mini Caselet - Phool

Phool is a social enterprise turning flower waste into opportunity, which is popularly known as Kanpur Flower cycling Private Limited. Phool has revolutionized the way people think about waste, particularly flower waste. This company recycles temple flower waste into eco-friendly products, thereby addressing the dual challenges of environmental pollution and value generation from waste. Phool transforms discarded flowers into valuable items, including incense sticks, vermicompost, and biodegradable packaging. These products offer a sustainable substitute for detrimental materials while simultaneously generating revenue for the company and its employees, establishing a self-sustaining business model that benefits both the environment and society. Using floral cycling technology, Phool has developed 'Fleather'. Leather has been recognised by PETA and considered one of the finest innovations in the vegan sector, serving as a substitute for animal leather. This technology converts the waste material into alternative materials for Styrofoam (Expanded Polystyrene), which is often considered a raw material for packaging and insulation.

This alternative approach to Styrofoam has the capacity to lessen plastic and pollution. In terms of managing the labour force, Phool comprises women from underprivileged communities, and it also offers a conducive working environment, justifiable compensation, and training. Phool is providing livelihood opportunities to these women, and with this offer, they are sustaining their families. Thus, Phool is also generating possibilities for economic empowerment and social agility for the ostracized sections of society.

References:

Serrano-Bedia, A. M., & Perez-Perez, M. (2022). Transition towards a circular economy: A review of the role of higher education as a key supporting stakeholder in Web of Science, Sustainable Production and Consumption, vol. 31.

https://www.bharateconomicforum.org/post/phool-co-a-social-enterprise-turning-flower-waste-into-opportunity

https://www.iitk.ac.in/new/d2c-start-up-phool-co

05
Building Value Chain

The value chain of circular economy education involves thoroughly examining the interconnected processes required to design and implement educational programs. It describes the full range of activities, stages, and processes, from content development to stakeholders' engagement and continuous improvement stages to the design and delivery of a course to the target audience. At each stage, qualitative and quantitative data from various dimensions need to be collected to improve the next cycle of implementation and ensure the assurance of learning (AOL). Before proposing the value-chain framework, it is important to deliberate on the phases of the circular economy education (CEE) process in an educational ecosystem through planning, development and operations.

5.1. Planning

Shifting from a linear to a circular economy is vital for a sustainable future. The circular economy fosters closed-loop systems that minimize waste and maximize resource use. Achieving this requires systemic technical and behavioural changes, driven primarily through education. Educating people on circular economy principles and their integration into business and society is essential to addressing global environmental, economic, and social challenges.

5.1.1. Curriculum Design

When developing a curriculum on the Circular Economy (CE), it's important to cover a range of topics reflecting the core principles and practical applications of CE. Table 8 covers the main aspects and issues that can be included in teaching curricula.

5.1.2. Stakeholder Collaboration

Effective CE education requires close collaboration with various stakeholders, ensuring comprehensive and practical outcomes of learning.

- **Educational Institutions:** Schools and universities are pivotal in delivering CE education. Faculty and curriculum designers must work together to embed CE concepts across subjects and educational levels.

  Role: Curriculum co-creation, teacher training, and CE integration into existing subjects (e.g., science, business, engineering).

[24]Circular Economy: A Credit Point Course-AICTE Model Curriculum developed in collaboration with International Council for Circular Economy https://www.aicteindia.org/sites/default/files/Model_Curriculum/Open%20elective%20Circular%20Economy.pdf
[25]Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions *Resources, Conservation and Recycling, 127, 221-232*
[26]OECD (2024), "Circular business models for small and medium-sized enterprises", in A Roadmap towards Circular Economy of Albania, OECD Publishing, Paris. DOI: https://doi.org/10.1787/d5296bfd-en

- **Business & Industry Partners:** Engaging businesses ensures that students gain practical exposure to CE applications. Industry players can offer internships, field visits, and mentorships.

  Role: Provide case studies, internships, funding, and research opportunities.

- **Government Bodies:** Governments can drive CE integration by offering policy support, setting sustainability goals, and providing funding incentives for educational institutions.

  Role: Curriculum support, policy development, funding, and access to national CE initiatives.

- **Non-governmental organisations (NGOs):** NGOs focused on sustainability can provide teaching resources, training, and community-based CE projects to enhance practical learning.

  Role: Assist in community engagement programs, share best practices, and offer educational content.

- **Media Houses:** The media plays a critical role in shaping public opinion and raising awareness about environmental issues and circular economy (CE).

  Role: Reporting success stories, case studies, and challenges can inspire educational institutions and policymakers to adopt sustainable practices and CE principles.

- **Trade Associations and Chambers of Commerce:** These chambers can advocate for CE education in business and commerce sectors.

  Role: Trade associations can help in providing a platform for the collaboration between corporate houses, businesses and higher educational institutes to promote circular economy education.

5.2 Development:

To design a comprehensive framework for developing and imparting CE curriculum in the Indian educational system, an approach which can integrate important stakeholders' perspectives is required. In the development phase, the focus should be on making the curriculum comprehensive and practice-oriented which can bring change in the mindset, behaviour and

skill sets of students to deal with circular economy models.

5.2.1. Multi-Disciplinary Approach for CE Curriculum Design

The application of CE is widespread in every walk of life. Therefore, the CE curriculum should be incorporated into various subject domains like Business, Engineering and Environmental Studies. In addition, the committee to develop the CE curriculum must involve academicians for the relevant domain and industry professionals along with representatives of Governments and NGOs.

5.2.2. Incorporate Global and Local CE practices

The CE curriculum should be benchmarked against the global best practices in CE and focus on worldwide issues like resource optimization, waste reduction, and environmental sustainability etc. The curriculum should integrate the global CE framework with India-specific CE challenges, such as resource management, waste reduction, and sustainable agriculture.

5.2.3. Emphasizing Hands-On Experience and Industry Partnerships

The CE education aims at changing the behaviour of citizens towards circularity concept and implementation. Therefore, the delivery of the CE education curriculum should ensure hands-on experience and practical training with industries. The curriculum delivery should include an optimum mix of theory classes, real-world projects and industry internship to impart CE education.

5.2.4. Faculty Training and Development

To successfully impart CE education to the students, training of trainers and academicians regarding integrating CE principles in their delivery and pedagogy is required. Faculty can be developed through various efforts like (1) a Dedicated Faculty Development program which covers a range of topics like circular business models, sustainable supply chain management, sharing economy, P2P lending and borrowing, waste management, and (2) In addition, Industry Engagement Programs in CE driven companies can help the faculty members to have a real-world exposure of implementing CE philosophy in a different process.

5.3. Operation

The CE education can be imparted through various modes as per the need of the subject. It can be delivered through a Dedicated CE program or can be incorporated into the curriculum of the existing courses to introduce specific CE dimensions in the subject area.

5.3.1. Dedicated CE Programs

Higher education institutions should introduce specialized degree programs and minors dedicated to Circular Economy (CE). Programs such as Bachelor's and Master's degrees in Circular Economy, Sustainable Development, and related fields can provide focused education. For example, XIM University offers an MBA in Sustainability Management through its School of Sustainability.

5.3.2. Embedding Circular Economy Concepts into Current Curricula

The circular economy dimension can be incorporated into the variety of existing courses in business management and Engineering courses. Courses like Supply chain management can incorporate sustainable supply chains in its syllabus. Similarly, courses on Business models can include topics like circular business models, P2P lending, sharing economy models etc. Nirma University also integrates sustainable supply chain management and circular business models into its MBA curriculum.

5.3.3. CE-specific Modules and Courses

Short-term certification courses can be developed to cover key aspects of CE, offering focused and flexible learning opportunities.

- Earth5R, a UNESCO-recognized organization,

offers a Certification Course in Sustainable Fashion Design that includes circular fashion concepts.

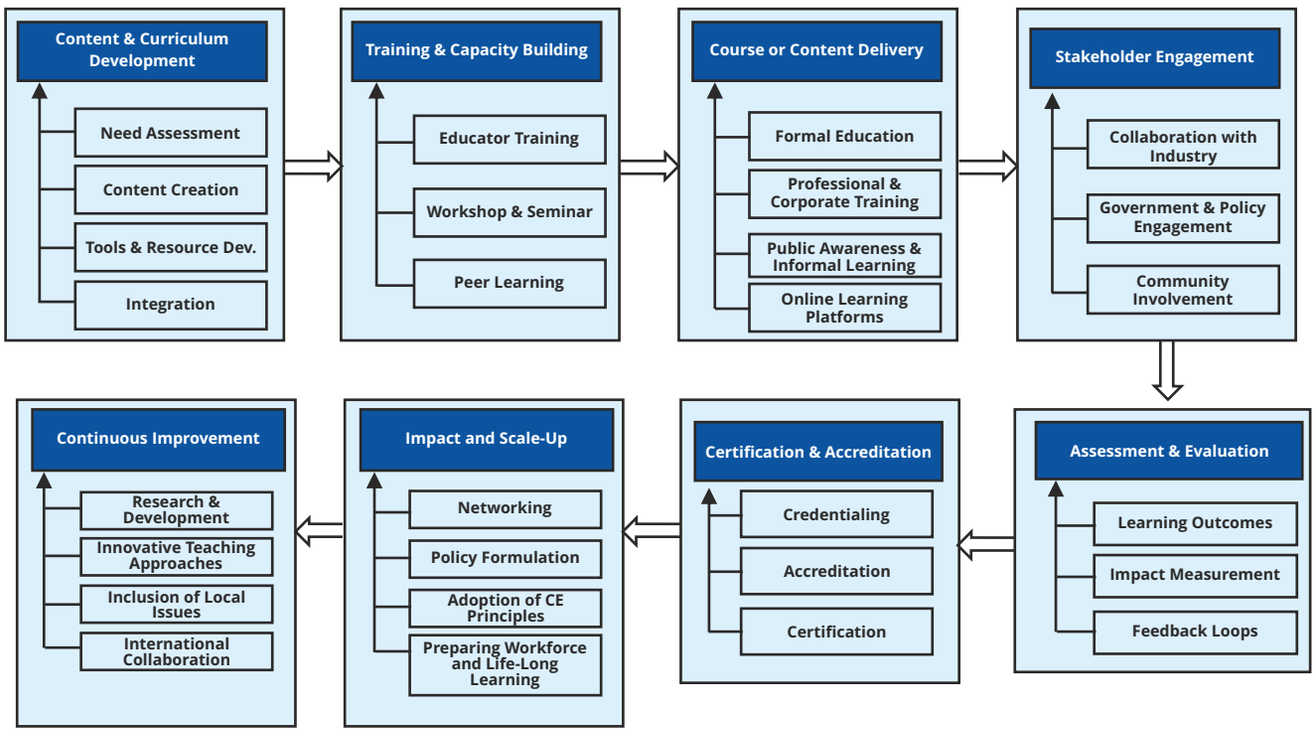
- Swayam, an initiative by India's Ministry of Education, provides an online course on transitioning from a linear to a circular economy.

5.3.4. Workshops, seminars, and guest lectures

Regular workshops, seminars, and guest lectures by industry experts, CE-focused organizations, and NGOs are essential for deepening understanding and sharing real-world insights. Organizations like the Centre for Science and Environment regularly conduct workshops on topics such as industrial waste circularity.

- Practical Learning and Industry Collaboration
- Hands-on experience is critical for applying CE concepts in real-world contexts. Institutions can

Figure 6: Value Chain of Circular Economy Education



Source: Authors' Compilation

[27]Ellen MacArthur Foundation, Artificial intelligence and the circular economy - AI as a tool to accelerate the transition (2019). http://www.ellenmacarthurfoundation.org/publications

[28]https://www.grantthornton.in/insights/thought-leadership/envisioning-future-of-circular-economy-in-india/ accessed on August 27, 2024.

[29]https://jaljeevanmission.gov.in/media/jal-jeevan-and-swachh-bharat-missions-are-combining-improve-peoples-well-being accessed on August 29, 2024.

achieve this through robust industry collaborations.

- **Internships:** Universities should partner with industries practicing CE to offer internships that tackle real-world challenges such as waste reduction and circular supply chain management.
- **Research Projects:** Engage students in collaborative research with industries, government agencies, and NGOs on challenges like circular product innovation for sustainable urban planning. These partnerships can lead to innovative solutions with practical applications.

5.4 Circular Economy Education Value Chain for India

In order to promote sustainable practices, optimising resource usage, minimising waste, and evaluating their impact on the environment and society, it is very important to have an effective CE education across the globe. However, there is no uniformity globally and efforts and interventions for CEE look sporadic and fragmented. The proposed comprehensive framework given in Figure 6 outlines the significant stages of CEE value chain.

The subsequent section thoroughly elucidates the comprehensive process of the value chain of circular economy education.

5.4.1. Content & Curriculum Development

(i) Needs Assessment: Identification of gaps in the current education systems and the need for circular economy education.

(ii) Content Creation: Developing educational materials, case studies, and practical examples illustrating circular economy principles.

(iii) Tool & Resource Development: Creation of teaching aids, simulation tools, online platforms, and other resources to facilitate learning.

(iv) Integration: Embedding circular economy concepts into existing curricula or creating specialised courses.

India's rapid economic growth and urbanisation have brought multiple challenges, including resource depletion, environmental degradation, and rising waste levels . To tackle these urgent issues, India needs to develop relevant Circular Economy content, such as case studies and projects, to provide education . Some initiatives taken by the Indian government, such as the Swachh Bharat Mission, Jal Jeevan Mission, and Vehicle Scrapping Policy, can be used for content creation and should be integrated into the curriculum .

5.4.2. Training and Capacity Building

(i) Educator Training: Preparing teachers, trainers, and facilitators to effectively understand and deliver the curriculum. This includes providing them with the necessary knowledge, tools, and teaching strategies.

(ii) Workshops and Seminars: Organizing events and training sessions to build capacity among educators, industry professionals, and other stakeholders in the circular economy.

(iii) Peer Learning: Encourage knowledge exchange among educators through networks and communities of practice.

Educational institutions can establish partnerships with the different ministries to implement their effective capacity-building framework for training educators using various methods . For instance, the National e-Governance division has designed a capacity-building program aimed at improving the competencies of public sector employees, enabling them to contribute to digital transformation and effective governance.

[30]https://morth.nic.in/vehicle-scrapping-policy-overview accessed on September 2, 2024.
[31]https://negd.gov.in/capacity-building/#:~:text=Importance%20and%20Relevance,to%20training%20and%20development%20opportunities accessed on September 5, 2024.
[32]https://iitbmonash.org/smartMaterials accessed on September 5, 2024.
[33]https://www.niti.gov.in/circular-economy-cell on September 7, 2024.

5.4.3. Course / Content Delivery

(i) **Formal Education:** Schools, colleges, and universities should incorporate circular economy concepts into their programs or create dedicated courses.

(ii) **Professional Training:** Vocational schools, training centres, and online platforms should be developed to offer certifications and courses targeted at professionals.

(iii) **Corporate Training:** Companies and industry bodies should collaborate and provide training programs for employees to foster circular practices within their operations.

(iv) **Public Awareness & Informal Learning:** NGOs, government bodies, and media should engage the public through workshops, campaigns, and informal educational programs to promote circular economy principles.

(v) **Online Learning Platforms:** Offering courses through online platforms that allow for broader access, flexible learning schedules, and potentially lower costs.

Indian Institute of Technology, Bombay, created courses on circular economy in areas such as clean energy, high-performance computing, medical technologies and infrastructure, etc. The courses focus on cutting-edge nanotechnology, composite materials and research in nano-bio hybrid materials in close partnership with industry to develop innovative solutions .

5.4.4. Stakeholders Engagement

(i) **Collaboration with Industry:** Educational institutions should partner with businesses to provide students with internships, apprenticeships, and real-world project opportunities.

(ii) **Government & Policy Engagement:** Policymakers should be involved in shaping educational standards and supporting programs that promote circular economy education.

(iii) **Community Involvement:** Local communities should participate in circular economy initiatives and projects, creating a feedback loop for practical learning.

In India, Niti Aayog, through its Circular Economy Cell, coordinate with stakeholders' state government, other ministries and departments, academic institutions, industries, etc., to develop a strategy for a circular economy plan and its implementation .

5.4.5. Assessment & Evaluation

(i) **Learning Outcomes:** Assess the effectiveness of circular economy education through student performance and understanding.

(ii) **Impact Measurement:** Evaluate the real-world impact of education on students' behaviour and the adoption of circular practices.

(iii) **Feedback Loops:** Incorporate feedback from students, educators, and industry to continuously improve the curriculum.

5.4.6. Certification & Accreditation

(i) **Credentialing:** Develop certification programs that validate expertise in circular economy principles.

(ii) **Accreditation:** Ensure that circular economy programs meet national and international standards.

(iii) **Certification:** Awarded the certificate from the recognized institute will help the candidate in job market.

In India, now a days several online and offline courses offered by well recognized institutes in the area of circular economy education and sustainable future. For example, several certificate programmes in waste management, resource efficiency, sustainability, and circular economy are offered by the Centre for Science and Environment, New Delhi.

5.4.7. Impact and Scale-Up

(i) **Networking:** Developing a network among students and experts in the area of circular economy and sustainability will help to influence and promote others in the society for creating a behavioural change about utilization of resources and waste management.

(ii) **Policy formulation:** Based on the insights and data obtained from various certification programs, the institutions and government bodies can design their policy related to environmental issues and sustainability.

(iii) **Adoption of circular economy principles:** In line with the circular economy education, its impact can be measured across the various sectors.

(iv) **Preparing workforce:** It is important to measure the level of preparedness among the individuals who completed circulate economy education so that they can positively contribute to the society.

(v) **Life-long learning:** Assess the long-term effects of circular economy education on the environment and society.

5.4.8. Continuous Improvement

(i) **Research & Development:** There is a need to invest in R&D to make sure that content created for circular economy is at par with the latest developments.

(ii) **Innovative Teaching Approaches:** In order to make effective and engaging circular economy education, there is a need to come out with new teaching pedagogies including use of technology and modern interactive techniques.

(iii) **Inclusion of local issues:** While preparing the curriculum for the circular economy, it is important to customize it based on the local needs including the societal, business, and environmental contexts.

(iv) **International Collaboration:** Connecting with global institution and bodies is required to bring out the international context for circular economy education.

The proposed value-chain describes various stages that can be used for developing the cutting-edge curriculum and preparing the skilled workforce in the area of circular economy and sustainability.

5.5 Conclusion

The process of developing a CE education curriculum needs to take into consideration the perspective of all the stakeholders like higher educational institutions, NGOs, Industries and trade associations. Also, to change the mindset of people towards circularity, CE education should be integrated at every level of education starting from school education to higher education. As the CE education is in the nascent stage in India, these educational institutes lack resources in terms of trainers, infrastructure and teaching aids to deliver CE education effectively. A significant gap exists in materials that align with India's unique socio-economic and industrial landscape. There is a need for teaching resources that address country-specific issues such as sustainable agriculture, waste management, and circular manufacturing practices. Without localized and contextualized content, students may not fully grasp how CE principles can be applied to India's industries and resource challenges. Hence, scaling up CEE in India requires focused efforts in curriculum development, targeted funding, and the creation of contextually relevant teaching materials, along with a systematic approach to faculty training and industry collaboration.


Knowledge Development for
Circular Economy Transition

06

Future Prospects in Circular Economy Education

6.1 Introduction

Sensitisation for protection of mother earth and its scarce natural resources has existed since many decades under different names i.e., Environment Education, Nature and Society, Sustainability Education etc. Society and family nurture the children for the conservation and growth of environmental assets in an informal manner.

However, in a formal setup, schools and colleges impart structured knowledge on this vital subject along with aptitude building for the same. In the last few decades, its scope has expanded significantly in the form of circular economy education (CEE) with emphasis on various R's like reduce, reuse, recycle, rethink, refuse, repair etc.

While the fundamentals remain the same, content and pedagogy of circular economy education is witnessing a paradigm shift. This change is inevitable due to various macroeconomic factors. With urbanisation and globalisation, the nature of waste has changed with the menace of plastic, glass, electronic waste, bio-waste to name a few. Societal shifts in demography (age, income…) and psychography (perception, attitude, self-concept towards climate change, biodiversity) also affect this domain.

6.2 PESTEL Framework

This report analyses the changing contours or trends in circular economy education through the PESTEL (except ecology as it is core of the report!!) framework as given below:

Politics: Politics shapes the policies, programmes and products in a particular country. Political parties' ideology and thought process determine the socio-economic progress of any country. In this context, it is encouraging to witness the inclusion of environment protection and related aspects in the political manifesto.

In recent lok sabha (lower house of parliament) elections of India conducted in 2024, two major political parties of the country - BJP and Congress, dedicated three pages (titles as 'Modi Ki Guarantee for Sustainable Bharat') and two pages respectively to environment, climate change aspects. A 2022 study by the Centre for Policy Research noted that the

[34]https://economictimes.indiatimes.com/news/elections/lok-sabha/india/lok-sabha-2024-environment-climate-change-gain-prominence-in-party-manifestos-but-experts-question-follow-through/articleshow/109366697.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst, , accessed on September 19, 2024.

[35]89% Bengaluru voters more concerned about environmental issues: Survey | Bangalore News - The Indian Express, accessed on September 19, 2024.

Congress party has consistently emphasized climate change and environmental sustainability over the last three elections. BJP dedicates about 11 per cent of its manifesto to environmental issues, left-leaning parties generally highlight water conservation, dedicating around 12 per cent of their content to environmental protection and and sustainability . Globally, many political parties have included climate issues as their core agenda as shown in following hyperlink - The Four Pillars | Australian Greens.

Government's policy and budgetary focus, global collaborations, SDG commitments should also be seen in this direction and requires utmost attention while teaching circular economy education. In this context, it is noteworthy to mention that even citizens have been demanding green commitments from their political candidates during elections in India.

Few years ago, citizens of Bangalore city had issued a green manifesto having demands from political parties and candidates. In same city, during local elections held in 2022, a survey showed that 89 per cent of the voters were worried about the environmental issues and climate change of the city, however, only 25 per cent felt the elected representatives were giving due importance to environmental issues. Geo-Political Influences and their impact on climate specific discussions must also be part of CEE curriculum.

Economic: Economic growth of an individual, society, country, industries and companies are necessary, however, it should not be at the cost of environment. Therefore, it is heartening to see the growing realisation about balancing three pillars i.e., people (social pillar), planet (environment pillar) and profit (economic pillar) for sustained growth.

This people-planet-profit triad is getting covered in circular economy education but needs to be further emphasised in the curriculum with examples, cases, illustrations, videos of successful and failed implementations.

For business leaders, climate change is one of the major concerns posing both challenges as well as opportunities. More than 100 CEOs from Alliance of CEO Climate Leaders (with USD 4 trillion in revenues) shared an open letter to world leaders ahead of COP28. These issues require reflection in the curriculum. Indian School of Business (ISB) offers an elective Climate Change and Business .

It introduces the students to the salience of climate change on business in three dimensions i.e., physical risks and hazards as a consequence of climate change; institutional dimensions, with a focus on regulatory mandates and new opportunities - both technological and financial - for business that are intended to usher in the new low-carbon economy.

Similarly, the Centre for Sustainability and Corporate Governance Research (CSCG) at Indian Institute of Management (IIM) Ahmedabad has been set up to contribute to the development of the nascent ESG ecosystem in India and help Indian enterprises and organizations integrate ESG into their core business and investment decisions. Students should also be taught contemporary concepts like green bonds, sustainable bonds, green economy, green lending, sustainability accounting, sustainability audit as part of ESG goals.

[36]Regional rare-earth element supply and demand balanced with circular economy strategies | Nature Geoscience, accessed on August 27, 2024.
[37]Full article: Rethinking Energy Geopolitics: Towards a Geopolitical Economy of Global Energy Transformation (tandfonline.com) accessed on August 17, 2024.
[38]Alliance of CEO Climate Leaders: Open letter for world leaders at COP28 | World Economic Forum (weforum.org) accessed on August 12, 2024.

Social: Societal mindset, culture, rituals, habits, family values etc. play a catalytic role in shaping young minds towards nature. In all capacity building sessions, social aspects should be duly emphasised with enabling role of civil society, NGOs, religious leaders , media and educational institutes.

If students are taught these softer aspects along with the harder aspects (principles, frameworks, conventions, laws, technologies etc), learning outcomes will be more effective.

Technology: Contemporary information and communication technologies (ICT) including artificial intelligence, machine learning (AIML) for forecasting , virtual and augmented reality for prototype making and immersive learning, blockchain for immutable and decentralised records, gamification , 3D printing customised designs and less wastage, Internet of things and other technologies like Gen AI have changed the discourse in all disciplines. These should be leveraged to a great extent for faster dissemination of content, better connect and effective learning .

Legal: Students must also learn the laws, governance framework and regulations (global, national and local) associated with environment. Judicial interventions and outreach are leading to climate justice across the globe and must be included in courses appropriately.

6.3 Future Prospects:

In addition to the above discussion, future prospects of circular economy education have been summarised below:

- For 360-degree awareness, sensitisation and actions, circular economy education is needed across disciplines i.e., Medical – (biomedical waste management), Management (waste management, functional perspectives - product design, Green HRM etc), Chartered Accountancy (ESG goals and accounting), Social Sciences – psychology, Economics (resources, Environment Economics).

- Generally, in CEE, limited industries examples like electronics, agriculture, textiles etc are given. It's desirable to include examples and cases from

[39]PGP Specialization (isb.edu) accessed on September 18, 2024.
40Centre for Sustainability and Corporate Governance Research (iima.ac.in) accessed on August 16, 2024.
[41]Bishnoi: Not Just a Community, a Belief System that Supports an Environmental Commitment | URI accessed on August 17, 2024.
[42]Worshipped by Millions: The Sacred River Ganges | Ancient Origins (ancient-origins.net) accessed on August 18, 2024.

other industries like Space (reusable components), Mega Events too.

- CEE education may be offered in an inter-disciplinary mode with active involvement of engineering (techniques, technologies, design), law (legal framework), management (HR, consumer behaviour and financial dimensions) for holistic education.
- Inter-Country collaboration is the need of the hour for Circular Economy Education Ex. KODECET Project.
- Collaborative efforts from Industry (best practices) – Government (policies) - Academia (frameworks, theories) for Circular Economy Education – Triple Helix model.
- Circular Economy Education in form of workshops for corporates and other professionals (Judges, Doctors, media professionals) at regular intervals by industry bodies, associations.
- Focus on early education (catch them young) for building a strong foundation of children with effective blend of knowledge, attitude, skills and habits (KASH). This will be important as the child acts as an influencer role of their parents. As future citizens also, this will be crucial.

[43]On World Environment Day, Morari Bapu calls for protecting the five elements by planting trees | Loktej Business News - Loktej English accessed on September 17, 2024.
[44]Save Soil (sadhguru.org) accessed on August 28, 2024.
[45]Save Our Tigers Campaign - Wildlife Conservation Trust accessed on September 18, 2024.
[46]Artificial intelligence and the circular economy: AI as a tool to accelerate the transition | McKinsey accessed on August 19, 2024.
[47]Gamification in Communicating the Concept of Circular Economy - A Design Approach | SpringerLink accessed on August 22, 2024.
[48]Linking circular economy and digitalisation technologies: A systematic literature review of past achievements and future promises - ScienceDirect accessed on September 2, 2024.
[49]Unleashing the Power of Education and Machine Learning for a Circular Economy | by economic donut | Medium accessed on September 12, 2024.
[50]Reusable rocket: SpaceX and Rocket Lab are getting a huge competitor (inverse.com) accessed on September 9, 2024.
[51]How Paris Olympics 2024 could be the 'greenest-ever' games | World Economic Forum (weforum.org) accessed on September 18,2024.

07

Opportunities for Growth in Circular Economy Education in india

Circular economy is an appropriate way that has a sustainable approach to maintaining the environment. The term 'circular economy education' describes the various educational projects, activities, and methods that are meant to provide people, organisations, and communities the information, abilities, and frame of mind needed to comprehend, use, and promote the concepts of the circular economy. Its focus has broadened considerably over the past few decades with the introduction of circular economy education (CEE), which places a strong emphasis on the many R's: reduce, reuse, recycle, rethink, refuse, repair, etc.

The circular economy and sustainability in India are experiencing severe environmental and economic difficulties, which is why education is becoming more and more crucial. Keeping in mind the current environmental issues and their importance, India has initiated to revamp its education system by

integrating sustainability into its curricula.The discussion in the above segment offers an inclusive approach to integrating Circular Economy (CE) values into higher education in India, as it is a need of the hour. This initiative will envisage bringing systemic changes towards sustainability. As we know, education plays an imperative role in bringing about change; therefore, it is important to factor in some key apparatuses such as curriculum components, stakeholder obligations, and project-based learning while marrying the concepts of circular economy and sustainability. The suggested core curriculum deals with central issues such as waste management, circular business models, and technological integration.

However, the effective execution of CE instruction encounters several obstructions. Insufficient finance, paucity of skilled instructors, and absence of teaching material restrict the growth. Likewise, the existing infrastructure hinders the support system of CE projects, which further indicates the lacuna between theoretical understanding and application in a real life context. To maximise the effectiveness and its relevance, it is important to curate and customise educational content keeping in mind India's distinct socio-economic and industrial context.

The road to success is not tranquil, therefore, India must give precedence to resource allocation, promote collaboration between academic institutions, industries, and government bodies, and curate some educational training programs. This will facilitate and expedite the smooth transition to a circular economy. It is crucial to emphasise hands-on learning experiences so that the upcoming generation will understand the multifariousness of sustainable development within the circular economy framework.

The dialogue explains the well-designed structure to implement CE education, wherein it talks about the eight important stages with a value chain model. To ensure the comprehensive cognition of CE principles, it is essential to focus on the elements like developing a curriculum to continuous evaluation. CEE's future is dependent on how academia and society are responding to a systemic change. It is imperative to nurture knowledgeable citizens who can contribute to conserving natural resources.

This will help the academia to promote the circular economy principles and society to bring sustainability culture.

Thailand REPORT


Knowledge Development for
Circular Economy Transition

08

Circular Economy Education in Thailand

8.1. Introduction

The circular economy (CE) has gradually become a central focus in Thailand's national development plans, primarily within the framework of sustainable development (SD). The government's explicit inclusion of the CE in its policies in 2019 marked a significant milestone in this journey. Thailand's longstanding commitment to sustainable development, rooted in the Sufficiency Economy Philosophy (SEP) by the late King Bhumibol, has been integrated into national plans since 2002 . The SEP, along with the UN Sustainable Development Goals (SDGs), forms the cornerstone of Thailand's long-term strategy, emphasizing resource efficiency and waste management.

In 2020, the government aimed to achieve a delicate balance between resource utilization for national development and conservation for long-term sustainability. To accomplish this, a development agenda centered on the circular economy was outlined in government policy, focusing on enhancing Thailand's economic competitiveness. This agenda encompasses promoting industries in the bio-economy, circular economy, and green economy (Bio-Circular-Green Economy: BCG Economy), leveraging technology to increase resource value and promote renewable energy, and managing industrial and cluster-based waste. Additionally, it prioritizes infrastructure development in science, technology, research, and innovation, supporting prototype facilities to meet economic needs. Finally, the policy drives the development of environmental systems supporting the circular economy while revising laws to foster new-era entrepreneurs.

8.1. Circular economy education

Thailand is recognizing the importance of sustainability and circular economy education to transition towards a more environmentally friendly and resource-efficient society. There is a growing recognition of the need to create a knowledge base and spread awareness about circular economy principles. The government, private sector, local communities, and higher education institutions are collaborating to develop educational resources and programs related to the circular economy.

Moreover, universities offer specialized sustainability courses across a range of disciplines, including environmental science, engineering, business, and management. Research in higher education focuses on circular economy strategies, waste reduction, and the development of sustainable technologies. However, education in Thailand also requires diversity in accessing circular economy information at all levels of education, including the general public, to promote knowledge and deep understanding of the circular economy and its applicability to daily life.

[52] วันที่ปรับปรุงข้อมูล 5 Jan 2024, SEP for SDGs, https://unmissionnewyork.thaiembassy.org/en/content/38134-sep-for-sdgs


Knowledge Development for
Circular Economy Transition

09

Policy Framework and Government Initiatives in Thailand

9.1. Aim of the Report

Developing a report with the aim to:

- Provide an update on the status quo of the circular economy education in the country.
- In specific the country-level gap analysis, report to include the following broad areas:

9.1.1. Develops the national level context in circular economy education

Background and context, the relevant stakeholders, the ecosystem in the domain, policy and practice, social aims and programs at the national level and commitment to international agendas, performance of the industry and social impact.

The Evolution of Circular Economy Understanding in Thailand

Thailand's journey towards embracing the principles of a circular economy (CE) has been marked by significant shifts in awareness, government policies, and business strategies over the last few decades. As a developing economy with a strong reliance on natural resources and industrial production, Thailand's understanding of the circular economy has evolved from initial environmental concerns to a more holistic approach that links environmental sustainability with economic growth .

- **Early Stages (2000): Being aware of environmental impacts.**
  The 1990s marked a critical period of environmental awareness in Thailand. Rapid economic growth, urbanization, and industrialization during this period led to increased environmental degradation, prompting widespread concerns about pollution, waste management, and resource depletion. Several factors contributed to this early stage of circular economy understanding:

- **Public Campaigns and Media Attention:** Public campaigns initiated by environmental groups, along with increasing media coverage, raised awareness about the environmental damage caused by industrial waste, deforestation, and water pollution.

- **Emergence of Environmental NGOs:** Non-governmental organizations (NGOs) began advocating for environmental protection, influencing both public opinion and government policies. NGOs like Greenpeace Thailand and Thailand Environmental Institute (TEI) played pivotal roles in driving early sustainability movements.

- **Corporate Social Responsibility (CSR):** As Thailand's economy globalized, multinational

[53]Khajuria, A., Atienza, V. A., Chavanich, S., Henning, W., Islam, I., Kral, U., ... & Li, J. (2022). Accelerating circular economy solutions to achieve the 2030 agenda for sustainable development goals. Circular Economy, 1(1), 100001.
[54]NOVEMBER 2019, THAILAND INVESTMENT REVIEW, https://www.boi.go.th/upload/content/TIR5_2019_5e2e95134a76b.pdf
[55]Juan Allan, (September, 2024), Thailand's Journey Towards a Circular Economy, https://www.thailand-business-news.com/environment/158804-thailands-journey-towards-a-circular-economy
[56]Serrano-Bedia, A. M., & Perez-Perez, M. (2022). Transition towards a circular economy: A review of the role of higher education as a key

corporations operating in the country began recognizing the importance of CSR. Initially, CSR efforts were limited to charitable donations and philanthropic activities, but over time, businesses began considering the environmental impacts of their operations. International CSR standards and investor pressure also pushed Thai companies to adopt more responsible business practices, which laid the groundwork for future circular economy initiatives.

Despite the rise in environmental awareness, translating this concern into effective policies or significant behavior change remained a challenge during this phase. Many early environmental initiatives were voluntary or piecemeal, and a lack of enforcement hampered the impact of these efforts. Consumer awareness and the push to change consumption habits were still in the early stages.

Shifting Towards a Holistic Approach (Present)

In the last decade, Thailand's understanding of the circular economy has shifted towards a more integrated and holistic approach. This shift has been driven by the recognition that environmental well-being is closely tied to economic prosperity. The concept of the circular economy has gained traction, emphasizing the need to design out waste, extend the lifespan of products, and keep resources in use for as long as possible.

- **Government Initiatives and Public-Private Partnerships:**
  One of the driving forces behind this shift has been the Thai government's active role in promoting circular economy principles through national policies and public-private partnerships. Several key initiatives and strategies have been developed to encourage resource efficiency and innovation across various sectors:

- **The Bio-Circular-Green (BCG) Economy Model:** Launched by the Thai government, the BCG model integrates bioeconomy, circular economy, and green economy principles. It promotes sustainable growth by encouraging resource-efficient practices in agriculture, manufacturing, and energy. This policy framework has become the cornerstone of Thailand's circular economy strategy, providing a clear roadmap for businesses and industries to adopt circular practices.

- **Government Support for Research and Development (R&D):** The Thai government has also provided funding and incentives for R&D in circular economy practices. Institutions such as Thailand Research Fund (TRF) and the National Science and Technology Development Agency (NSTDA) have been instrumental in driving innovation and supporting industries in their transition to circular models.

- **Public-Private Partnerships (PPPs):** Collaboration between government agencies, businesses, and educational institutions has been essential for implementing circular economy initiatives. Businesses, especially in sectors like manufacturing and agriculture, are increasingly aware of the economic benefits of adopting circular practices. Many companies are now focusing on extending product lifespans, redesigning products for easy repair and reuse, and developing new business models based on circular principles.

Growth and Innovation:

As Thailand continues to adopt circular economy principles, growth and innovation are expected to play key roles in driving the transition to sustainability . The circular economy is becoming a significant driver of economic growth, particularly as businesses adopt green technologies and new business models:

- **New Business Models:** Circular business models such as product-as-a-service, sharing economy platforms, and remanufacturing are emerging in Thailand. These models offer companies the opportunity to reduce material use, cut costs, and generate additional revenue streams.

- **Green Technologies:** The development of green technologies, such as renewable energy systems, biotechnology, and smart waste management, is expected to create jobs and boost Thailand's

innovation capacity. The integration of IoT and Industry 4.0 technologies also offers opportunities to monitor resource use more efficiently and enhance circular practices.

- **Government Incentives:** The government's role in providing policies and incentives for businesses to adopt circular economy practices will continue to accelerate this growth. Tax incentives, grants, and investment in R&D will help promote green technologies and sustainability across industries.

Local Wisdom:

Thailand's circular economy is not only driven by modern innovation but also deeply rooted in its local wisdom and traditional ecological knowledge. Many Thai communities, particularly in rural areas, have long practiced sustainable resource management through practices such as:

- **Collective Resource Management:** Thai communities have traditionally relied on collective decision-making to manage natural resources such as water, forests, and fisheries.

Table 7: Evolution from CSR to Circular Economy in Thailand

Period	Key developments
1990s	Surge in environmental awareness, emergence of NGOs, and the introduction of CSR practices.
Early 2000s	Growth of CSR beyond philanthropy, focus on brand reputation and compliance with international standards.
2010s	Shift towards circular economy principles, government support through policies like the BCG Model.
Present (2020s)	Holistic approach to CE, growth in public-private partnerships, increased adoption of circular business models.
Future (2030s and beyond)	Expansion of green technologies, enhanced resource efficiency, and consumer behavior change driving CE growth.

Source: Authors' Compilation

Thailand's circular economy journey has evolved from an early focus on environmental awareness and CSR to a more integrated approach that emphasizes resource efficiency, innovation, and collaboration across stakeholders.

9.1.2. Identifies the Stakeholders and System

Key Stakeholders in Thailand's Circular Economy

The successful implementation of the circular economy (CE) in Thailand requires collaboration across multiple stakeholders. Each actor plays a critical role in promoting awareness, building knowledge, and fostering skills related to circular economy principles. This multi-faceted approach includes contributions from the government, educational institutions, businesses, non-governmental organizations (NGOs), community organizations, and Thai households. The detailed analysis of these stakeholders and their responsibilities, alongside measurements of their influence on the development of circular economy education (CEE) in Thailand is mentioned below:

- **Government and Policy Makers**
  Responsibility: Governments can significantly influence the direction of education by integrating circular economy principles into curricula and providing funding for research and development. This pivotal role allows governments to shape the educational landscape and foster a more sustainable future.

Key Policies Related to Circular Economy:

- **13th National Economic and Social Development Plan:** A strategic document that incorporates sustainability and circular economy principles to promote resource efficiency across sectors.
- **20-Year Pollution Management Strategy (2017-2036):** Focuses on reducing pollution and promoting environmentally-friendly practices, including circular economy strategies in waste management.
- **20-Year Master Plan for Waste Management (2018-2037):** A comprehensive framework aimed at reducing waste generation and promoting recycling and reuse.
- **Roadmap for Plastic Waste Management (2018-2030):** A plan to reduce the use of single-use plastics and promote alternatives, contributing to the circular economy.
- **Bio-Circular-Green Economy (BCG) Policy:** A holistic approach promoting the integration of biological resources, circular production models, and green technologies.

Measurement of Influence: Government influence can be measured through policy adoption, budget allocation, and the inclusion of circular economy concepts in national educational standards (Table 10).

- **Policy Adoption:** The extent to which CE concepts are included in national strategies and educational standards.
- **Budget Allocation:** Government funding dedicated to CE education, research, and development initiatives.
- **Curriculum Integration:** The inclusion of CE principles in national curricula across all levels of education, from primary to higher education.

Table 8: Policy Frameworks and Focus Areas

Policy Framework	Focus Area	Timeline
13th National Economic and Social Plan	Resource efficiency and sustainability	Ongoing
20-Year Pollution Management Strategy	Pollution reduction and circular practices	2017-2036
20-Year Master Plan for Waste Management	Waste reduction, recycling, and reuse	2018-2037
Roadmap for Plastic Waste Management	Phasing out single-use plastics, promoting recycling	2018-2030
Bio-Circular-Green Economy (BCG) Policy	Circular economy integration across industries	Current

Source: Authors' Compilation

- **Educational and Research Institutions**

Responsibility: Educational institutions play a critical role in promoting circular economy education. Their responsibilities include:

- **Curriculum Development:** Designing and implementing curricula that incorporate circular economy principles across various disciplines, such as business, engineering, and environmental studies.
- **Knowledge Dissemination:** Delivering educational content through lectures, workshops, and other activities to foster understanding of circular economy concepts.
- **Research and Analysis:** Conducting research to advance knowledge and provide evidence-based insights on circular economy practices and policies.

- **Skill Development:** Equipping students with the skills and competencies needed to contribute to a circular economy, including problem-solving, critical thinking, and innovation.

By fulfilling these responsibilities, educational institutions can empower students to become active participants in the transition to a more sustainable future.

Measurement of Influence: The influence of educational institutions can be measured by course offerings, student engagement, research output, and industry partnerships. Research institutions can be evaluated by the quality and impact of their research, citations, and collaborations(Table 11).

Table 9: Role of Educational Institutes in Offering Knowledge Resources related to Circular Economy

Institution Type	Role in Circular Economy Education	Example
Universities	Curriculum development, research, and skills training	Chulalongkorn University, Thammasat University
Technical Colleges	Practical skills development in CE practices	King Mongkut's Institute of Technology
Research Institutes	CE-related research, technological innovations	Thailand Research Fund (TRF), NSTDA

Source: Authors' Compilation

- **Industry and Businesses**

Responsibility: Businesses can contribute to circular economy education by providing real-world examples, internships, and funding. They can also integrate circular economy principles into their operations.

- **Internships and Training:** Offering students hands-on learning experiences through internships and apprenticeships focused on CE practices.
- **Funding Research and Development:** Supporting academic research in circular economy innovations through collaborations and grants.
- **Circular Integration:** Adopting circular practices in business operations, such as sustainable manufacturing, product lifecycle management, and waste minimization.

Measurement of Influence: The influence of businesses can be measured by their adoption of circular practices, participation in educational programs, investment in research, and integration of circular economy criteria in procurement (Table 12)

Table 10: Role of Businesses and Industry in investment towards circular economy practices.

Business Sector	CE Focus Area	Example
Manufacturing	Sustainable production, waste minimization	Siam Cement Group (SCG)
Agriculture	Resource-efficient farming practices	Charoen Pokphand (CP Group)
Technology	Green innovation and recycling technologies	PTT Global Chemical

Source: Authors' Compilation

- **Non-Governmental Organizations (NGOs)**
  Responsibility: NGOs play a vital role in advocacy, awareness-raising, and providing educational resources. They can contribute to building a supportive environment for circular economy education.
- **Advocacy:** Promoting the importance of sustainability and circular economy practices to both the public and private sectors.
- **Awareness-Raising:** Educating communities about the benefits of adopting circular practices through media campaigns and educational materials.
- **Resource Provision:** Developing toolkits and resources to aid in the understanding and implementation of circular economy principles.

Measurement of Influence: The influence of NGOs can be measured by the reach of their initiatives, stakeholder engagement, advocacy efforts, and partnerships (Table 13)

Table 11: Role of NGOs in promoting circular economy practices

NGO	Area of Influence	Key Initiative
Greenpeace Thailand	Advocacy and public awareness	Plastic reduction campaigns
Thailand Environment Institute (TEI)	Sustainability education and research	Circular economy advocacy
EcoThailand	Grassroots initiatives	Community-driven CE programs

Source: Authors' Compilation

- **Community and Civil Society Organizations**
  Responsibility: Community organizations play a crucial role in promoting circular economy principles at the grassroots level. They are often responsible for organizing local campaigns, engaging citizens in sustainability efforts, and advocating for the adoption of circular practices within households and communities.

Measurement of Influence: The influence of community organizations can be measured by community engagement, advocacy success, and visibility in local media(Table 14)

Table 12: Role of community organizations in advocating for circular economy practices

Community Role	Area of Focus	Example Initiative
Grassroots Movements	Waste reduction, recycling, and local sustainability	Local recycling initiatives
Community Cooperatives	Sustainable farming and resource sharing	Community farming cooperatives

Source: Authors' Compilation

- **Thai Residence**
  Responsibility: In Thailand, family-based education plays an important role in fostering awareness and understanding of circular economy principles. Parents and elders often impart sustainable practices to younger generations, such as reducing waste, recycling, and conserving natural resources.

Measurement of Influence:

- **Household Practices:** The extent to which circular economy practices are adopted at the household level, such as composting, waste segregation, and resource conservation.
- **Intergenerational Learning:** The transfer of knowledge about sustainability practices from generation to generation, ensuring continuity in environmentally responsible behaviour.

A collaborative effort involving governments, educational institutions, businesses, NGOs, and communities is essential to promote circular economy education in Thailand. By measuring the influence of these actors, policymakers can identify areas for improvement and strengthen efforts to build a more sustainable and circular future.

- **Input-Output Mapping in Thailand's Circular Economy**
  Like any other region, Thailand's circular economy operates on a continuous cycle of resource utilization, which can be visualized using input-output mapping.

- **Inputs:**
  Raw Materials: Thailand's economy relies on a variety of raw materials, including agricultural products (rice, rubber, sugar), minerals (tin, tungsten), and natural resources (timber, marine products).

  Energy: The country primarily sources energy from fossil fuels (natural gas, coal), but it's also transitioning towards renewable sources like solar and hydropower.

  Labor: Thailand's workforce, both skilled and unskilled, is a crucial input into its economy.

- **Outputs:**
  Products: A diverse range of products are manufactured in Thailand, including textiles, electronics, automotive parts, and agricultural goods.

  Services: Thailand is a significant exporter of services, particularly tourism, healthcare, and education.

  Waste:
  Industrial Waste: Manufacturing processes generate various forms of waste, such as scraps, chemicals, and wastewater.Consumer Waste: Households and businesses produce a significant amount of waste, including food scraps, packaging materials, and electronics.

  Recycling and Reuse:
  Waste Management: Thailand has been improving its waste management infrastructure, including recycling facilities and composting programs.

  Circular Initiatives: Businesses and communities are implementing circular practices, such as product reuse, recycling, and industrial symbiosis.

Thailand's Unique Context

Thailand's input-output mapping is influenced by its geographic location, natural resources, and economic development . The country's agricultural sector, for example, generates significant amounts of waste, while its manufacturing industries produce a variety of industrial byproducts.

Challenges and Opportunities

While Thailand has made progress in implementing circular economy practices, challenges remain, such as inadequate waste management infrastructure and limited awareness of circular principles. However, the country's growing focus on sustainability and its potential for innovation present significant opportunities for a more circular future.

Key Circular Economy Practices in Thailand

- **Waste Management:** Thailand has been focusing on improving its waste management systems. This includes promoting recycling, composting, and waste-to-energy projects to divert waste from landfills and recover valuable resources.
- **Product Design:** Companies are adopting a more sustainable approach to product design. By creating products with longer lifespans, reusability, and recyclability, businesses can reduce waste and extend the useful life of materials
- **Industrial Symbiosis:** Thailand has been encouraging industrial symbiosis, where businesses collaborate to share resources and byproducts. This practice helps reduce waste, improve resource efficiency, and create new economic opportunities.
- **Renewable Energy:** The country has been promoting the adoption of renewable energy sources, such as solar and wind power, to reduce its reliance on fossil fuels and decrease greenhouse gas emissions.

Circular Agriculture: Thailand is encouraging sustainable agricultural practices, including organic farming, agroforestry, and closed-loop agriculture. These practices help to improve soil health, reduce environmental impacts, and promote biodiversity.

Positive Outcomes of Circular Economy Initiatives

The implementation of circular economy practices in Thailand has led to several positive outcomes:

- **Environmental Benefits:** Reduced waste generation, decreased pollution, and improved resource conservation.
- **Economic Benefits:** Job creation, increased competitiveness, and reduced costs associated with waste disposal.
- **Social Benefits:** Improved public health, enhanced quality of life, and increased community engagement.

- **Challenges and Future Directions**
- While significant progress has been made, Thailand still faces challenges in fully transitioning to a circular economy. Key areas for further development include.
- **Strengthening Infrastructure:** Investing in improved waste management facilities, recycling infrastructure, and renewable energy systems.
- Promoting Circular Business Models: Encouraging businesses to adopt circular practices and providing incentives for innovation.
- Fostering Public Awareness: Raising awareness about the benefits of a circular economy and promoting sustainable consumption habits.

Despite these challenges, Thailand's commitment to sustainable development and the growing momentum behind circular economy initiatives provide a promising outlook for its future. By continuing to implement effective policies and practices, Thailand can position itself as a leader in the global transition to a more sustainable and circular economy.

9.1.3. Need gap analysis

Thailand, with its growing economy and increasing population, faces significant environmental challenges. Transitioning to a circular economy can help address these issues by minimizing waste and maximizing resource efficiency. However, there are several gaps that need to be addressed to ensure a successful implementation.

- **Business Models:**
  Gap: While some Thai businesses have begun to explore circular economy principles, many still operate within traditional linear models.

Recommendations:

- **Promote Education and Training:** Offer targeted training programs for entrepreneurs and business leaders on circular business models, their benefits, and case studies of successful implementations.
- **Provide Financial Incentives:** Introduce tax breaks, subsidies, or low-interest loans to encourage businesses to adopt circular practices and invest in circular infrastructure.
- **Support Pilot Projects:** Fund and support pilot projects that demonstrate the feasibility and benefits of circular business models in various sectors, such as manufacturing, agriculture, and tourism.

- **Sustainability Factors:**
  Gap: Measuring the sustainability impact of circular business models is crucial for understanding their effectiveness. However, the lack of standardized frameworks and tools presents a challenge.

Recommendations:

- **Develop Tailored Frameworks:** Create sustainability measurement frameworks that are specifically designed for Thai businesses and consider the country's unique context and priorities.
- **Support Research and Development:** Invest in research to develop innovative tools and methodologies for assessing the environmental, economic, and social impacts of circular initiatives.
- **Facilitate Knowledge Sharing:** Establish platforms for businesses to share best practices and lessons learned regarding sustainability measurement and reporting.

- **Collaboration:**
  Gap: Effective collaboration among stakeholders is essential for the successful implementation of a circular economy. However, Lack of coordination and collaboration among stakeholders involved in the circular economy in Thailand.

Recommendations:

- **Create Collaborative Platforms:** Establish platforms for information exchange, networking, and partnership building among businesses, government agencies, NGOs, and academic institutions.
- **Support Collaborative Initiatives:** Encourage and support collaborative projects that involve multiple stakeholders, such as industrial symbiosis partnerships or circular economy hubs.
- **Promote Multi-Stakeholder Engagement:** Ensure that all relevant stakeholders are involved

in decision-making processes related to the circular economy, including policy development, strategy implementation, and resource allocation.

- **Education and Skills:**
  Gap: A skilled workforce is essential for driving the transition to a circular economy. Shortage of skilled personnel with the expertise and knowledge required to drive the circular economy in Thailand.

Recommendations:

- **Develop Educational Curricula:** Integrate circular economy principles into educational programs at all levels, from primary schools to universities.
- **Support Workforce Training:** Provide training and upskilling programs for existing workers to equip them with the knowledge and skills needed for circular economy jobs.
- **Promote Lifelong Learning:** Encourage a culture of lifelong learning to ensure that workers can adapt to the evolving needs of the circular economy.

- **Additional Considerations**
- **Cultural and Social Factors:** Consider cultural and social factors that may influence the adoption of circular economy practices, such as attitudes towards waste, consumption patterns, and traditional lifestyles.
- **Infrastructure and Technology:** Assess the availability and accessibility of necessary infrastructure and technology for circular economy initiatives, such as waste management facilities, recycling technologies, and renewable energy sources.
- **Policy and Regulatory Environment:** Evaluate the existing policy and regulatory framework and identify areas for improvement to create a supportive environment for circular economy businesses.
- By addressing these challenges and implementing the recommended actions, Thailand can foster a more sustainable and circular economy that benefits both the environment and the economy.

9.1.4 Mapping of the influence factors and performance

Framework for Assessing the Circular Economy in Thailand

To effectively evaluate the performance and impact of the circular economy in Thailand, a comprehensive framework should be adopted. This framework should include:

- Goal setting and KPIs: Establish clear objectives and measurable indicators.
- Policy analysis and implementation: Assess existing policies and ensure effective implementation.
- Stakeholder engagement: Foster collaboration and knowledge sharing.
- Economic, environmental, and social impact assessment: Measure the benefits of circular economy initiatives.
- Case studies and best practices: Learn from successful examples.
- Monitoring and evaluation: Track progress and identify areas for improvement.
- Reporting and communication: Disseminate findings to relevant stakeholders.
- Continuous improvement: Use assessment results to inform policy adjustments and program improvements.

By following this framework, Thailand can gain valuable insights into the effectiveness of its circular economy efforts and make informed decisions to drive sustainable development.

Supporting Mechanisms (Policies, Strategies, and Approaches):

1. **Policy Frameworks:** Governments can promote circularity by implementing policy frameworks that include extended producer responsibility, tax incentives, and sustainable procurement policies. These policies can create a favorable environment for businesses to adopt circular practices, reduce waste, and foster sustainable economic development. By incentivizing circularity, governments can contribute to a more resource-efficient and environmentally friendly future.

2. **Capacity Building and Training:** Educational programs, workshops, and training initiatives can help stakeholders develop the knowledge and skills necessary for implementing circular practices effectively.
3. **Innovation Support:** Governments and industry associations can provide funding, grants, and incentives for research and development of circular technologies, as well as support for technology transfer and commercialization.
4. **Market-Based Instruments:** Market-based instruments such as carbon pricing, resource taxes, and green procurement criteria can create economic incentives for businesses to adopt circular practices and invest in sustainable innovation.
5. **Public-Private Partnerships:** Collaborative initiatives between governments, businesses, and civil society organizations can facilitate knowledge sharing, capacity building, and resource mobilization for circular economy projects and initiatives.

9.2. Developing The Process

Ecosystem and Communities for Circular Economy Education

Circular economy education in Thailand has the potential to significantly impact the country's ecosystem and communities. By promoting awareness of sustainable practices and resource conservation, it can:

- **Reduce waste and pollution:** Educate residents about proper waste management, recycling, and composting to minimize environmental harm.
- **Conserve natural resources:** Teach people about the importance of water, energy, and land conservation, and encourage sustainable use of these resources.
- **Promote local economic development:** Support the development of circular economy businesses and industries, creating jobs and boosting the local economy.
- **Strengthen community resilience:** Empower communities to adapt to climate change and other environmental challenges.

Importance and Benefits of Good Practices in Thailand

Good practices in the circular economy are essential for Thailand's sustainable development. They can:

- **Improve environmental quality:** Reduce pollution, conserve natural resources, and mitigate climate change.
- **Enhance economic competitiveness:** Create new business opportunities, reduce costs, and increase efficiency.
- **Promote social equity:** Ensure equitable access to resources and benefits, and improve quality of life for all citizens.
- **Strengthen Thailand's international reputation:** Position Thailand as a leader in sustainable development and attract foreign investment.

By implementing good practices in the circular economy, Thailand can create a more sustainable, resilient, and equitable future for its people and environment.

Challenges and Recommendations for Circular Economy Education and Implementation

Key Challenges:

- **Lack of knowledge and awareness:** Many people are unfamiliar with the concept of a circular economy.
- **Societal inequality:** Businesses prioritize profit over sustainability, and there are limited incentives for circular practices.
- **Limited practical experience:** Academics and educators often lack hands-on experience with circular economy initiatives.
- **Lack of cooperation:** Communities and network partners may not collaborate effectively for circular economy implementation.
- **Insufficient awareness and leadership:** Community leaders may not fully understand the importance of a circular economy.
- **Limited funding:** Government budgets may not adequately support circular economy initiatives.
- **Inefficient budget management:** Government spending on circular economy projects may lack transparency and accountability.

Recommendations:

- **Integrate CE into all levels of education:** Incorporate circular economy principles into school curricula through interactive and practical activities.
- **Enhance public awareness and engagement:** Conduct campaigns to educate the public about the benefits of CE and encourage community involvement in waste management and recycling.
- **Strengthen legal and policy frameworks:** Implement supportive legislation and regulatory reforms to promote CE practices and remove barriers.
- **Foster collaboration among stakeholders:** Encourage partnerships between government, educational institutions, the private sector, and NGOs to drive CE initiatives.
- **Address implementation gaps:** Allocate sufficient funding, provide resources and training for educators, and establish monitoring and evaluation systems.

By promoting a circular economy requires a multifaceted approach that addresses knowledge gaps, societal challenges, and institutional barriers . By integrating CE into education, raising public awareness, strengthening policies, and fostering collaboration, it is possible to create a more sustainable and resilient future.

9.3. Developing the framework

Assessing and Strengthening Circular Economy Education and Management in Thailand

Assessment Phase

1. Review of Existing Policies and Regulations:

- Identify relevant policy documents, regulations, and guidelines at national, provincial, and local levels in Thailand.
- Analyze the extent to which these documents support circular economy principles and education.
- Assess the effectiveness of existing policies in facilitating the implementation of circular economy initiatives.

Specific Areas of Focus:

- **National Sustainable Development Plan:** Examine how the circular economy is integrated into this plan.
- **Environmental Impact Assessment (EIA) Regulations:** Evaluate the extent to which EIAs consider circular economy principles.
- **Waste Management Laws:** Assess the adequacy of regulations governing waste disposal, recycling, and reuse.
- **Industrial Promotion Policies:** Analyze incentives provided for businesses adopting circular economy practices.

2. Field Mission and Stakeholder Interviews:

- Conduct interviews and focus group discussions with key stakeholders in Thailand, including government officials, educators, businesses, NGOs, and community representatives.
- Gather insights on the current state of circular economy education, challenges faced, and perceived needs.
- Identify gaps in existing policies and practices.

Specific Areas of Inquiry:

- **Awareness and Understanding:** Assess the level of awareness and understanding of the circular economy among key stakeholders.
- **Educational Integration:** Explore the extent to which circular economy principles are integrated into school curricula.
- **Business Adoption:** Investigate the barriers and incentives for businesses to adopt circular economy practices.
- **Community Engagement:** Assess the level of community involvement in circular economy initiatives.

Action Planning Phase

1. **Develop a Tailored Action Plan for Thailand:**

- Based on the assessment findings, create a comprehensive action plan for strengthening circular economy education and management in Thailand.
- Define specific objectives, activities, timelines, and responsible parties for each component of the plan.

Consider the following areas for potential action:

- Curriculum development and integration of circular economy principles into Thai education systems.
- Teacher training and capacity building programs.
- Public awareness campaigns and community engagement initiatives.
- Policy reforms to support circular economy practices in Thailand.
- Incentives for businesses and individuals adopting circular economy approaches.
- Partnerships and collaborations among stakeholders in Thailand.
- Monitoring and evaluation mechanisms to track progress and measure impact.

Specific Considerations for Thailand:

- **Cultural and Social Factors:** Consider the unique cultural and social context of Thailand when designing the action plan.
- **Economic Development:** Align the plan with Thailand's economic development goals and priorities.
- **Natural Resources:** Take into account Thailand's natural resource endowments and vulnerabilities.

Capacity Building Workshop

1. **Workshop Objectives:**

- Provide a platform for key stakeholders in Thailand to discuss and exchange ideas on circular economy education.
- Facilitate collaboration among stakeholders to identify common goals and priorities.
- Equip participants with practical tools and examples to implement the proposed action plan.

2. **Workshop Content:**

- Presentation of the assessment findings and action plan for Thailand.
- Discussion of options and scenarios for circular economy education, considering the specific context of Thailand.
- Interactive exercises to explore potential interventions and their implications.
- Case studies of successful circular economy initiatives in Thailand and other countries.
- Practical guidance on curriculum development, teacher training, public engagement, and policy advocacy tailored to the Thai context.

By following this framework, Thailand can develop a comprehensive and effective strategy for strengthening circular economy education and management, leading to a more sustainable and resilient future.

9.3. Developing the framework

Assessing and Strengthening Circular Economy Education and Management in Thailand

Assessment Phase

1. **Review of Existing Policies and Regulations:**

- Identify relevant policy documents, regulations, and guidelines at national, provincial, and local levels in Thailand.
- Analyze the extent to which these documents support circular economy principles and education.
- Assess the effectiveness of existing policies in facilitating the implementation of circular economy initiatives.

Specific Areas of Focus:

- National Sustainable Development Plan: Examine how the circular economy is integrated into this plan.
- Environmental Impact Assessment (EIA) Regulations: Evaluate the extent to which EIAs consider circular economy principles.
- Waste Management Laws: Assess the adequacy of regulations governing waste disposal, recycling, and reuse.
- Industrial Promotion Policies: Analyze incentives provided for businesses adopting circular economy practices.

2. **Field Mission and Stakeholder Interviews:**

- Conduct interviews and focus group discussions with key stakeholders in Thailand, including government officials, educators, businesses, NGOs, and community representatives.
- Gather insights on the current state of circular economy education, challenges faced, and perceived needs.
- Identify gaps in existing policies and practices.

Specific Areas of Inquiry:

- **Awareness and Understanding:** Assess the level of awareness and understanding of the circular economy among key stakeholders.
- Educational Integration: Explore the extent to which circular economy principles are integrated into school curricula.
- **Business Adoption:** Investigate the barriers and incentives for businesses to adopt circular economy practices.
- **Community Engagement:** Assess the level of community involvement in circular economy initiatives.

Action Planning Phase

1. **Develop a Tailored Action Plan for Thailand:**

- Based on the assessment findings, create a comprehensive action plan for strengthening circular economy education and management in Thailand.
- Define specific objectives, activities, timelines, and responsible parties for each component of the plan.
- Consider the following areas for potential action:
- Curriculum development and integration of circular economy principles into Thai education systems.
- Teacher training and capacity building programs.
- Public awareness campaigns and community engagement initiatives.
- Policy reforms to support circular economy practices in Thailand.
- Incentives for businesses and individuals adopting circular economy approaches.
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Knowledge Development for Circular Economy Transition

10 Role of Educational Institutions in Thailand

10.1. Principles of Circular Economy and Sustainability

The principles of a Circular Economy (CE) center around resource efficiency, environmental conservation, economic innovation, and social impact. Resource Efficiency focuses on extending the lifespan of materials and products by promoting reuse, recycling, and resource recovery to reduce waste and consumption.

Environmental Conservation is a priority, emphasizing the reduction of pollution and conservation of resources. This approach contributes to environmental sustainability by prioritizing renewable energy, efficient waste management, and pollution reduction. Additionally, CE fosters Economic Innovation by encouraging the redesign of products, processes, and business models that promote sustainability, which in turn drives economic growth and job creation. Finally, Social Impact and Inclusion are integral to CE, aiming to create opportunities that benefit all stakeholders, foster community resilience, and incorporate local wisdom, ensuring that sustainability becomes a shared responsibility across society.

Requirements for the Circular Economy Education Sector

For the effective integration of circular economy principles into the education sector, Collaboration and Partnerships are essential. This involves engaging stakeholders from the government, private sector, NGOs, educational institutions, and communities to facilitate knowledge sharing, research, and the implementation of CE initiatives. Additionally, Supportive Policy Frameworks are crucial, as governments must implement supportive laws, incentives, and regulations to enable the adoption and integration of CE principles within educational systems.

There is also a need for Research and Innovation; investing in research and development for CE practices and sustainable technologies is vital, as well as promoting interdisciplinary studies and innovation within educational institutions. Another key requirement is Addressing Gaps by identifying weaknesses, such as the limited emphasis on CE in primary education, and addressing them by integrating CE principles at all educational levels.

10.2. Aims for Circular Economy Education:

The aims of circular economy education focus on integration, awareness, and capacity building. Integration in Education is fundamental, involving the embedding of CE principles into primary, secondary, and higher education curricula through hands-on learning, project-based initiatives, and research. Additionally, there is a strong focus on Raising Awareness; education should promote awareness of CE principles among the public, encouraging sustainable consumption patterns and waste reduction.

Lastly, Capacity Building is essential to provide training for educators, students, and professionals to ensure they possess the knowledge and skills necessary to drive the transition to a circular economy.

10.2.1. Stakeholders and their Roles

Table 13: Stakeholders involved in promotion of circular economy practices

Stakeholder type	Role in delivering circular economy education
1. Government and Policy	Governments play a crucial role in shaping education policies and curricula to integrate circular economy principles at all levels of education from primary schools to universities. They also provide funding and support for research and development in circular economy education.
2. Educational and Research Institutions	Educational institutions are responsible for designing and delivering curricula that incorporate circular economy principles across various disciplines. They conduct research and provide training for educators, and they can offer interdisciplinary courses that cover circular economy practices and technologies.
3. Industry and Businesses	Businesses have a responsibility to incorporate circular economy principles into their operations, products, and supply chains. They contribute to circular economy education by providing real-world examples, internship opportunities, and funding for educational initiatives.
4. Non-Governmental Organizations (NGOs)	NGOs advocate for and raise awareness about the importance of the circular economy. They provide educational resources, training programs, and networking opportunities for educators, students, and other stakeholders to foster a better understanding of CE principles.
5. Community and Civil Society Organizations	Community and civil society organizations engage in mobilizing grassroots support for circular economy education and awareness-raising activities. They organize events, campaigns, and community-based projects to promote circular economy principles and practices at the local level.

Source: Authors' Compilation

10.3. Identification of Issues in Circular Economy

A methodological framework for circular economy education should encompass comprehensive strategies and actions that align with the aims of promoting resource efficiency, sustainability, and the principles of a circular economy (CE). Here's a structured framework built around these aims:

1. **Establish Clear Learning Objectives and Outcomes:**
- **Objective Setting:** Define specific objectives for CE education, such as fostering understanding of CE principles, sustainability, waste management, and resource efficiency.
- **Outcome Orientation:** Align these objectives with measurable outcomes, such as students demonstrating knowledge of CE concepts, applying them to real-world scenarios, and developing sustainable solutions.

2. **Integrate Circular Economy Principles into Curriculum Design:**
- **Early Education:** Introduce CE principles through play-based and hands-on activities in primary and secondary education, such as waste sorting, recycling projects, and seed planting.
- **Higher Education:** Develop multidisciplinary courses that combine CE with traditional subjects, such as business, engineering, environmental science, and social studies. Include project-based learning, case studies, and research projects on CE strategies and sustainable technologies.
- **Practical Experience:** Incorporate internships, field trips, and partnerships with businesses practicing CE to provide practical experience for students.

3. **Promote Awareness and Engagement:**
- **Awareness Campaigns:** Conduct campaigns to educate the public, students, and educators about the benefits of CE, using social media, workshops, and community events.

- **Community Involvement:** Encourage local communities to participate in waste management and recycling programs, fostering grassroots engagement in CE practices.

4. **Collaborate with Stakeholders:**
- **Government and Policy Makers:** Collaborate with the government to integrate CE into national education policies and provide funding for CE education programs.
- **Private Sector:** Engage businesses to offer internships, case studies, and guest lectures that provide real-world examples of CE in practice.
- **NGOs and Civil Society:** Partner with NGOs to develop training programs, educational resources, and workshops that raise awareness about CE practices.

5. **Develop Teaching and Learning Materials:**
- **Educational Resources:** Create textbooks, online courses, videos, and interactive modules that cover CE concepts, sustainability, and real-life applications.

- **Best Practices and Case Studies:** Include best practices from local and global businesses, communities, and governments that have successfully implemented CE models.

6. **Encourage Research and Innovation:**
- Research Initiatives: Promote research on CE strategies, sustainable technologies, and waste reduction, particularly in higher education institutions.
- Innovation Hubs: Establish innovation centers where students, researchers, and entrepreneurs can develop and test new ideas, technologies, and business models related to CE.

7. **Incorporate Skills Development and Lifelong Learning:**
- Skills Training: Offer training programs for educators, professionals, and students to develop skills in CE-related fields such as waste management, product design, and sustainable supply chain management.
- Lifelong Learning: Provide opportunities for continuous education through workshops, seminars, and online courses to keep up with the latest CE trends and practices.

8. **Monitor and Evaluate Progress:**
- Assessment Tools: Develop assessment tools to measure the effectiveness of CE education, including knowledge tests, project evaluations, and surveys.
- Impact Evaluation: Regularly evaluate the impact of CE education on students' understanding, behavior, and ability to implement sustainable practices. Use this data to adjust and improve the educational framework.

9. **Align with Sustainable Development Goals (SDGs):**
- Policy Alignment: Ensure that the CE education framework aligns with SDGs, particularly those related to responsible consumption and production, climate action, and sustainable communities.
- Incorporate Global Perspectives: Introduce students to the role of CE in achieving global sustainability goals, fostering a sense of responsibility and global citizenship.

10. **Foster an Inclusive and Equitable Approach:**
- Social Inclusion: Ensure that CE education is accessible to all, including marginalized communities, by providing resources, training, and opportunities for participation.
- Cultural Integration: Integrate local wisdom, traditions, and practices into CE education to make learning more relatable and to promote the use of locally sourced materials and sustainable practices.

This methodological framework provides a structured approach to building CE education around aims that focus on knowledge, skills, awareness, and practical application. By integrating CE principles into all levels of education, fostering collaboration, and aligning with SDGs, this framework aims to create a robust educational ecosystem that prepares future generations to lead the transition toward a sustainable and circular economy .

10.4. Assessment of the Situation and Identification of Needs

1. **Current Understanding and Gaps in Circular Economy (CE) Education:**
- Limited Awareness and Understanding: There is a lack of awareness and understanding of CE principles among students, educators, businesses, and the general public.
- Insufficient Integration in Education: CE concepts are not consistently integrated across all levels of education, with primary education, in particular, lacking focus on CE principles.
- Inadequate Waste Management Practices: There is a need for better waste management education and practices to ensure proper waste disposal, recycling, and resource conservation.
- Shortage of Skilled Personnel: There is a shortage of trained educators, professionals, and workers with expertise in CE-related fields.

[60]Alka, T.A., Raman, R. & Suresh, M. Research trends in innovation ecosystem and circular economy. Discov Sustain 5, 323 (2024). https://doi.org/10.1007/s43621-024-00535-5

2. **Policy and Regulatory Gaps:**
- Inconsistent Policies: Although supportive CE policies exist, their implementation is inconsistent, and there is a lack of comprehensive legal frameworks that support CE practices.
- Need for Incentives: There is a need for financial and policy incentives to encourage businesses and educational institutions to adopt and promote CE practices.

3. **Infrastructure and Resource Gaps:**
- Lack of Access to CE Resources: Educational institutions, businesses, and communities lack access to resources, materials, and infrastructure necessary for implementing CE practices.
- Limited Research and Innovation: More research and innovation are needed to develop sustainable technologies and business models that align with CE principles.

Formulation of Interventions and Actions:

1. **Educational Interventions:**
- Integrate CE into Curricula: Embed CE concepts into the curriculum at all levels of education, from primary to higher education. Include project-based learning, case studies, and hands-on activities related to waste management, recycling, and sustainable practices.
- Develop Training Programs: Offer training programs for educators to equip them with the knowledge and skills to teach CE effectively.
- Promote Lifelong Learning: Provide opportunities for lifelong learning through online courses, workshops, and seminars on CE principles and practices.

2. **Policy Interventions:**
- Implement Supportive Policies: Establish supportive policies that promote CE practices, such as tax incentives, grants, and subsidies for businesses and institutions that adopt sustainable models.
- Legal Reforms: Update existing regulations to remove barriers to CE implementation and to create a legal framework that encourages innovation and sustainable practices.

3. **Research and Innovation Interventions:**
- Promote Research Initiatives: Encourage research in CE-related fields such as waste management, renewable energy, and sustainable product design.
- Create Innovation Hubs: Establish innovation centers to support the development of new technologies, business models, and solutions related to CE

4. **Public Awareness and Community Engagement:**
- Conduct Awareness Campaigns: Launch nationwide campaigns to raise awareness about the benefits of CE among the public, businesses, and policymakers.
- Encourage Community Participation: Involve local communities in waste management, recycling programs, and CE-related projects to foster grassroots engagement.

5. **Collaboration and Partnerships:**
- Multi-Stakeholder Collaboration: Foster collaboration among government agencies, educational institutions, businesses, NGOs, and communities to create an ecosystem conducive to implementing CE practices.

Implementation and Action Plan (The Way Forward):

In the short term (0-1 year), several foundational actions can be taken to advance circular economy (CE) education and practices. First, awareness campaigns should be launched to emphasize the importance of CE at the community, educational, and business levels. Simultaneously, training programs need to be developed to equip educators and professionals with CE concepts and practices. Integrating CE principles into existing curricula across primary, secondary, and higher education institutions is also essential to build foundational knowledge from an early age. Additionally, collaborative platforms should be established to facilitate knowledge sharing, collaboration, and information exchange among stakeholders.

In the medium term (1-3 years), efforts should focus on implementing supportive policies by collaborating with government agencies to establish financial incentives, regulatory reforms, and other supportive CE policies. Encouraging universities and research institutions to engage in research projects centered on CE strategies, waste reduction, and sustainable technologies will further promote innovation. Establishing innovation hubs to connect researchers, students, and entrepreneurs can accelerate the development of CE-related projects. To support these initiatives, comprehensive educational resources such as textbooks, digital content, and case studies on CE principles and practices should be created.

In the long term (3-5 years and beyond), a monitoring and evaluation system should be established to assess the impact of CE education, policies, and initiatives on sustainability outcomes. Fostering lifelong learning by providing continuous opportunities for skill development in CE practices is essential to keep up with evolving needs. Scaling up CE practices across all sectors—including businesses, communities, and educational institutions—will ensure that CE is embedded in society and contributes to the achievement of the Sustainable Development Goals (SDGs). Finally, achieving full policy integration by embedding CE principles into national policies will support the transition toward a sustainable and circular economy that aligns with SDG objectives.

11 Building Value Chain

11.1 Introduction

In the context of Thailand's evolving understanding and implementation of circular economy principles, the value chain of circular economy education can be conceptualized through three interconnected phases: planning, development, and operations

11.1.1. Planning

The planning phase is critical in establishing the foundation for effective circular economy education. Key elements include:

- **Environmental Scanning:** Assessing the current state of circular economy awareness and practices in Thailand, including government initiatives like the Bio-Circular-Green (BCG) Economy Model .
- **Stakeholder Analysis:** Identifying and engaging key stakeholders, including government agencies, educational institutions, businesses, NGOs, and community organizations .
- **Resource Allocation:** Determining the necessary financial, human, and technological resources required for implementing circular economy education initiatives.
- **Strategy Formulation:** Developing comprehensive strategies that align with national policies and address identified gaps in circular economy understanding and implementation.

11.1.2. Development

The development phase focuses on creating and refining educational content and delivery mechanisms. Key activities include:

- **Curriculum Design:** Developing educational materials that integrate circular economy principles across various disciplines, from primary education to higher learning institutions.
- **Capacity Building:** Training educators and facilitators to effectively teach circular economy concepts and practices.
- **Pilot Programs:** Implementing and evaluating small-scale educational initiatives to refine approaches before broader implementation.
- **Collaborative Partnerships:** Fostering partnerships between educational institutions, businesses, and community organizations to create practical learning opportunities and real-world applications of circular economy principles.

11.1.3.Operations

The operations phase involves the ongoing implementation and management of circular economy education initiatives. Key elements include (Table 17)

- **Program Delivery:** Executing educational programs across various levels and sectors, including formal education, professional development, and community outreach.
- **Monitoring and Evaluation:** Continuously

[61] Howard, M., Yan, X., Mustafee, N., Charnley, F., Böhm, S., & Pascucci, S. (2022). Going beyond waste reduction: Exploring tools and methods for circular economy adoption in small-medium enterprises. Resources, Conservation and Recycling, 182, 106345.

assessing the effectiveness of educational initiatives through metrics such as participant engagement, knowledge retention, and practical application of circular economy principles.

- **Adaptive Management:** Refining and updating educational content and delivery methods based on feedback, emerging trends, and new research in circular economy practices.
- **Knowledge Dissemination:** Facilitating the sharing of best practices and lessons learned among stakeholders to enhance the overall effectiveness of circular economy education in Thailand.

Table 14: Operations in circular economy practices

Quality of data collection and Analysis	Recognition and treatment of circular economy education in trade and investment policies	Extent of circular economy education conduciveness of the business environment	Level of attention paid to risk and crisis management
A significant gap in data collection and analysis related to circular economy education in Thailand. As the SWOT analysis, there is a "Lack of data and research" specifically concerning "waste generation, resource flows, and the feasibility of circular business models" in the context of Chiang Mai. This deficiency poses a challenge to evidence-based policymaking and implementation of circular economy initiatives. Should do the collaboration between local universities, research institutions, and other stakeholders to gather data and develop innovative solutions. However, the extent and quality of existing data collection efforts are not explicitly detailed, indicating a potential area for improvement in the circular economy education ecosystem.	The Thai government has been proactive in recognizing the importance of circular economy education in its policies. The Bio-Circular-Green (BCG) Economy Model is cited as a key government initiative that promotes resource efficiency and innovation. This suggests that circular economy principles are being integrated into broader economic and trade policies.	The business environment in Thailand appears to be increasingly conducive to circular economy education, albeit with some challenges. There is "Growing environmental awareness" among the public, particularly younger generations, creating a receptive audience for circular economy practices. Additionally, the "Strong local crafts and design scene" in Thailand is highlighted as an asset that aligns well with circular economy principles.	"Community Resilience" as a social benefit of the circular economy, indicating a focus on mitigating risks at the community level. It also acknowledges potential economic risks, such as "Fluctuations in commodity prices," which could threaten circular business models. The importance of "Effective Implementation" of policies and regulations at all government levels is noted, underscoring the need for managing implementation risks. Thailand's approach could improve by incorporating formal risk management frameworks and crisis preparedness strategies to enhance the resilience of circular economy education programs.

Source: Authors' Compilation

[60]Alka, T.A., Raman, R. & Suresh, M. Research trends in innovation ecosystem and circular economy. Discov Sustain 5, 323 (2024). https://doi.org/10.1007/s43621-024-00535-5

The value chain model for circular economy education in Thailand consists of three interlinked phases: planning, development, and operations. In the planning phase, the groundwork is laid to establish a strong foundation for circular economy education. This begins with environmental scanning to assess the current state of circular economy awareness and practices within Thailand, which includes evaluating government initiatives like the Bio-Circular-Green (BCG) Economy Model.

Stakeholder analysis plays a crucial role in this phase, identifying and engaging with key entities such as government agencies, educational institutions, businesses, NGOs, and community organizations that are instrumental in driving circular economy education forward. Resource allocation is another essential component, as it involves determining the financial, human, and technological resources needed to implement circular economy initiatives. Strategy formulation completes the planning phase by developing comprehensive plans that align with national policies and address existing gaps in understanding and applying circular economy principles in Thailand.

The development phase focuses on the creation and refinement of educational content and delivery mechanisms. A key aspect of this phase is curriculum design, where educational materials are crafted to integrate circular economy principles across various academic disciplines, from primary education through to higher learning institutions. Capacity building is also prioritized, with efforts directed towards training educators and facilitators so they can effectively impart knowledge on circular economy concepts and practices.

To ensure the approach is sound and scalable, pilot programs are implemented and evaluated in small-scale educational settings before broader rollout. Additionally, the development phase involves building collaborative partnerships between educational institutions, businesses, and community organizations to provide practical learning opportunities and real-world applications of circular economy principles, fostering a holistic approach to learning and application.

In the operations phase, the model shifts towards the active implementation and management of circular economy education initiatives. Program delivery is a primary activity in this phase, encompassing the execution of educational programs across various levels and sectors, including formal education, professional development, and community outreach.

To gauge the effectiveness of these initiatives, monitoring and evaluation processes are established, using metrics such as participant engagement, knowledge retention, and the practical application of circular economy concepts to measure progress. Adaptive management is also integral to the operations phase, allowing educational content and delivery methods to be refined and updated based on feedback, emerging trends, and new research in circular economy practices.

Finally, knowledge dissemination ensures that best practices and lessons learned are shared among stakeholders, thereby enhancing the overall effectiveness and reach of circular economy education in Thailand.

Knowledge Development for Circular Economy Transition

12

Future Prospects in Circular Economy Education

12.1. Government Support & Policy Framework

The Thai government's commitment to the Bio-Circular-Green (BCG) Economy Model provides a robust platform for integrating circular economy principles into national education. Building on this, the future prospects could include:

- **National Educational Standards:** Developing comprehensive educational standards with circular economy principles at the core can create a structured approach across all educational levels. This could involve integrating modules focused on resource efficiency, waste reduction, and sustainable practices into existing subjects, particularly within STEM and business education.
- **Increased Budget Allocation:** Government investment in circular economy education can accelerate adoption across schools and universities. Funding could support resources, teacher training, and curriculum development. Such initiatives could also make circular economy education accessible to under-resourced areas, helping to close regional disparities in educational access and awareness.
- **Incentives for Educational Institutions:** Offering incentives, such as grants or tax breaks, could motivate educational institutions to pioneer circular economy initiatives. This could include financial rewards for schools that adopt eco-friendly campus practices, introduce circular economy curricula, or collaborate with industries on sustainability projects.

12.2. Educational Institution Engagement

Universities, technical colleges, and research centers are key drivers of innovation and skill development. Their role in advancing circular economy education will likely grow in the following ways:

- **Expansion of Circular Economy Courses:** Higher education institutions could develop specialized degree programs, certification courses, or electives focused exclusively on circular economy principles. These programs would be interdisciplinary, covering subjects such as environmental science, industrial engineering, business management, and design thinking.
- **Research and Knowledge Dissemination:** As circular economy concepts evolve, Thailand's universities could increase their research output

on topics such as waste valorization, eco-design, and circular supply chains. This research could be disseminated through publications, public seminars, and partnerships with industries to influence both academia and the private sector.

- **Industry Partnerships for Practical Learning:** Enhanced collaboration with industry could give students hands-on experience through internships, apprenticeships, and industry-led workshops. Real-world case studies and projects with local businesses would allow students to apply circular economy principles, such as product life extension, recycling, and resource optimization, directly in Thailand's context.

12.3. Industry Involvement and Partnerships

The role of industry is crucial in creating a practical, skills-based approach to circular economy education. Businesses are expected to deepen their collaboration with educational institutions, leading to:

- **Increased Industry-Academia Partnerships:** The establishment of industry-academia consortiums could facilitate real-world learning experiences, including co-developed courses, joint research projects, and sponsored competitions focused on circular economy innovations.

- **Investment in Research and Circular Solutions:** Companies with vested interests in sustainability may invest in R&D, supporting educational institutions in developing circular economy solutions that are industry-specific, such as closed-loop manufacturing or sustainable packaging. These investments would also create job opportunities for students specializing in circular economy practices.

- **Incorporation into Corporate Training Programs:** Companies can adopt circular economy principles into their internal training programs, which will not only upskill employees but also set an example of sustainable business practices. This integration into professional development will reinforce the role of circular economy education beyond academia and into workplace norms.

12.4. Community and Civil Society Engagement

Community involvement is essential for widespread awareness and adoption of circular economy principles at a grassroots level. Future prospects include:

- **Expansion of Community Projects:** Local governments, NGOs, and community groups may expand circular economy projects, such as urban gardens, composting programs, repair cafes, and zero-waste initiatives, providing tangible examples of sustainable living. These projects also serve as informal educational opportunities for community members of all ages.
- **Public Awareness through Media:** As circular economy issues gain prominence, increasing coverage in local media could play a major role in educating the public. Campaigns on waste reduction, responsible consumption, and recycling can help shift cultural perceptions towards sustainability and circular practices.
- **Development of Informal Education Programs:** NGOs and civil society organizations could lead informal learning programs, workshops, and awareness campaigns that reach beyond traditional classrooms. These programs could be designed for diverse demographics, from children to adults, promoting lifelong learning and community-based knowledge sharing on circular economy practices.

12. 5. International Collaboration and Exchange

Thailand's circular economy education can benefit significantly from global partnerships, allowing the exchange of ideas, best practices, and expertise. Future developments may include:

- **Student and Faculty Exchange Programs:** Partnerships with universities abroad could facilitate exchange programs focused on circular economy studies, allowing Thai students and educators to learn from international practices and bring back innovative ideas.

- **Joint Research and Development Initiatives:** Collaborative research between Thai institutions and international counterparts could produce breakthrough innovations tailored to Thailand's unique needs, such as circular solutions for agriculture or the textile industry.

- **Participation in Global Networks and Conferences:** Engaging in international circular economy networks and forums can provide Thai educators, policymakers, and business leaders with access to cutting-edge research, funding opportunities, and global circular economy benchmarks, accelerating the adoption and implementation of circular economy principles in Thailand.


Knowledge Development for
Circular Economy Transition

13

Opportunities for Growth in Circular Economy Education in Thailand

Thailand have revealed a critical need for enhanced knowledge dissemination and practical training across various sectors of society. The findings indicate a significant gap in understanding and implementing circular economy principles among the general population, businesses, and even some educators. This conclusion synthesizes the key points and proposes recommendations for addressing these challenges, with a particular emphasis on the role of universities in spearheading educational initiatives.

Key Findings:

- **Limited Public Awareness:** There is a widespread lack of knowledge about circular economy concepts and practices among the Thai public. This knowledge deficit hinders the adoption of sustainable consumption patterns and circular business models.
- **Business Sector Challenges:** Many businesses, particularly SMEs, struggle to understand how circular economy principles can be integrated into their operations while maintaining profitability. This highlights a need for targeted education that demonstrates the economic benefits of circular practices.
- **Educator Preparedness:** Even within academic circles, there is a need for more hands-on experience and practical knowledge of circular economy implementation. This gap affects the quality and relevance of circular economy education provided to students and the community.
- **Community Engagement:** While there is potential for community-led initiatives, there is a lack of coordinated efforts and central organizations to facilitate knowledge sharing and collaboration in circular economy projects.
- **Leadership Awareness:** Community leaders, who play a crucial role in setting local priorities and regulations, often lack a comprehensive understanding of circular economy principles and their potential benefits.

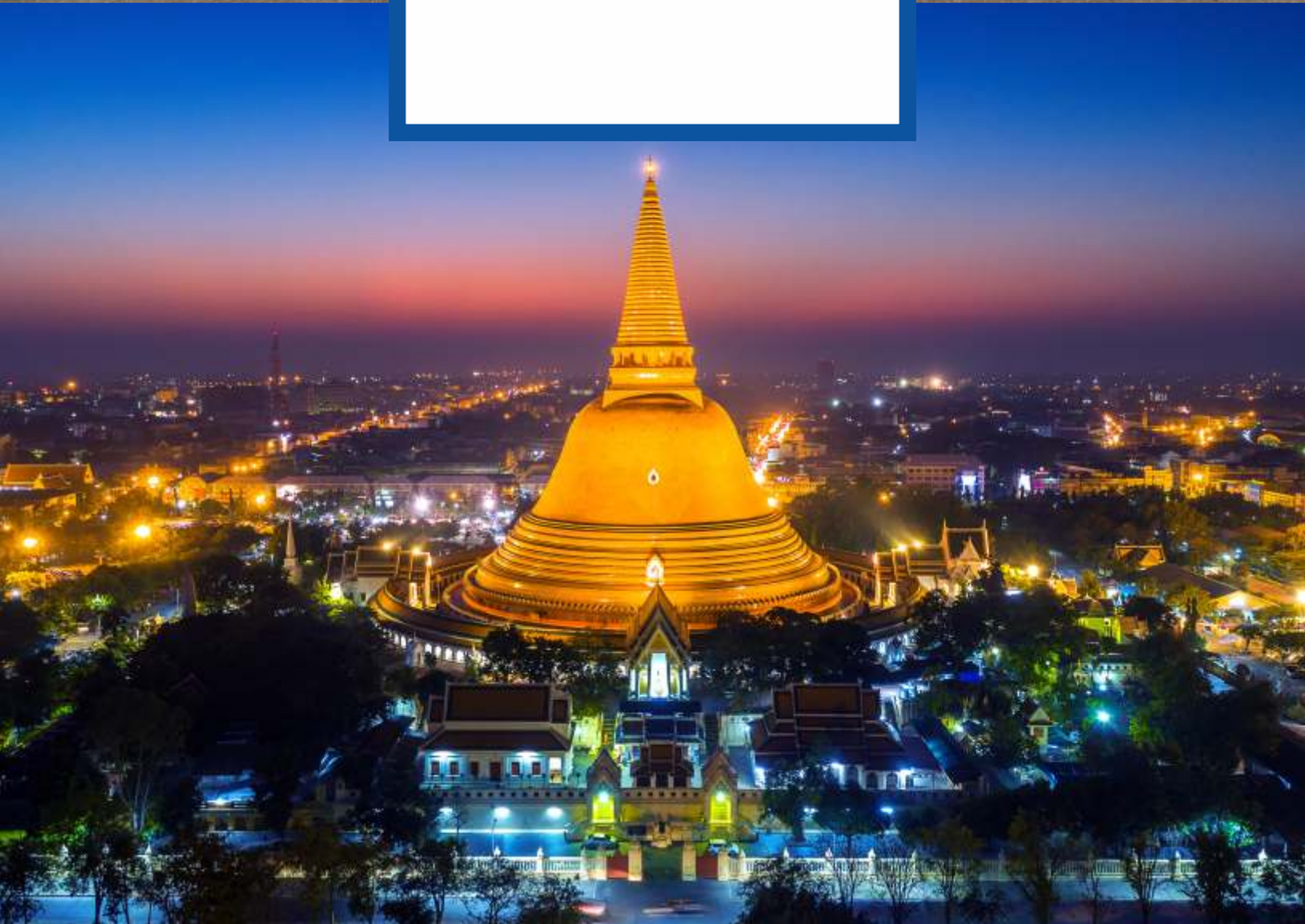
Recommendations:

- **University-Led Training Programs:** Universities should take a leading role in developing comprehensive training programs on circular economy principles and practices. These programs should target not only students but also businesses, community leaders, and the general public.
- **Practical Learning Experiences:** Academic institutions should incorporate more hands-on, experiential learning opportunities in their circular economy curricula. This could include internships with circular businesses, community projects, and case study analyses.
- **Collaborative Research Initiatives:** Universities should initiate and lead collaborative research projects involving businesses, government agencies, and community organizations. These projects can generate locally relevant knowledge and solutions for implementing circular economy practices in Thailand.

- **Knowledge Dissemination Centers:** Establish university-based centers dedicated to circular economy education and outreach. These centers can serve as hubs for information, training, and consultancy services for businesses and community organizations.
- **Capacity Building for Educators:** Develop programs to enhance the practical knowledge and skills of educators in circular economy principles. This could include industry placements, workshops with circular economy practitioners, and international knowledge exchange programs.
- **Public Awareness Campaigns:** Universities should collaborate with media and community organizations to design and implement public awareness campaigns that explain circular economy concepts in accessible ways and highlight their relevance to daily life in Thailand.
- **Policy Advisory Role:** Leverage academic expertise to advise government bodies on developing coherent policies and incentives that support circular economy education and implementation across various sectors.

In conclusion, addressing the circular economy knowledge gap in Thailand requires a concerted effort led by universities in collaboration with government, business, and community stakeholders. By focusing on practical, locally relevant education and training initiatives, universities can play a pivotal role in building the knowledge base and skills necessary for Thailand to transition effectively towards a circular economy. This approach not only enhances public understanding but also equips businesses and community leaders with the tools needed to implement circular practices, ultimately contributing to Thailand's sustainable development goals.

COMPARATIVE REPORT: INDIA AND THAILAND



Knowledge Development for Circular Economy Transition

14

Policy and Governance: A Comparative Perspective

14. Policy and Governance: A Comparative Perspective

The growing environmental and economic challenges faced by India and Thailand have propelled both nations toward embracing the principles of the Circular Economy (CE). This model focuses on minimizing waste, reusing materials, and promoting sustainable consumption and production practices. Education plays a vital role in building capacity and raising awareness of circular economy principles, both in formal and informal settings. The need for Circular Economy Education (CEE) is essential for transitioning to sustainable development models that align with global climate and resource efficiency goals. This comparative report reviews the current status of circular economy education in India and Thailand, analyzing the stakeholders, processes, and gaps in the system to provide an overview of how CEE is evolving in these two countries.

14.1. National-Level Context in Circular Economy Education

The national-level context of Circular Economy Education (CEE) examines the broader frameworks, policies, and strategic initiatives undertaken by governments to integrate circular economy principles into the educational system. This involves analyzing the policy landscape, identifying key stakeholders, and assessing existing programs that promote sustainability, resource efficiency, and environmental literacy. In both India and Thailand, the integration of CEE has gained momentum due to growing awareness of environmental challenges and the need to transition from a linear economy model to a circular one. It also offers an interpretation of the comparative context, highlighting the similarities, differences, and potential areas for improvement in their respective approaches.

14.1.1. India

India has begun integrating circular economy principles into its educational frameworks, primarily through vocational training and higher education programs. The National Education Policy (NEP) 2020 emphasizes skill development, sustainable practices, and interdisciplinary learning, which provide an opportunity for circular economy concepts to be incorporated into curricula. However, the policy lacks direct references to CE education, limiting its widespread adoption.

Stakeholders: Government bodies such as the Ministry of Education and NITI Aayog, as well as educational institutions and private sector players, are key actors in promoting CE education in India.

Existing Programs: CE concepts are incorporated into technical programs at Indian Institutes of Technology (IITs) and Indian Institutes of Management (IIMs), and through Skill India initiatives targeting green jobs.

14.1.2. Thailand

Thailand's Bio-Circular-Green (BCG) Economy model, launched by the government, serves as a key framework for promoting the circular economy across sectors, with education being a critical component. Thailand's commitment to the Sufficiency Economy Philosophy (SEP) further embeds sustainability and resource efficiency within educational practices. Universities have developed sustainability programs that align with CE principles, particularly in environmental science and engineering disciplines.

Stakeholders: The Thai government, educational institutions, and industry sectors are working in collaboration to promote CE through formal education and vocational training programs.

Existing Programs: CE principles are integrated into Thai higher education, particularly in universities focusing on sustainable business practices and renewable energy sectors.

The national-level contexts of circular economy education in India and Thailand reveal both similarities and differences in their approaches, driven by distinct policy frameworks, cultural influences, and educational strategies. Observations can be seen in Table 17

Table 15: Observation on National Level Context in India and Thailand

Criteria	India	Thailand	Observation
Policy Framework	• National Education Policy (NEP) 2020 emphasizes skill development and interdisciplinary learning. • Limited direct reference to Circular Economy (CE) concepts in policies.	• Guided by the Bio-Circular-Green (BCG) Economy model. • Influenced by the Sufficiency Economy Philosophy (SEP), which emphasizes sustainability and resource efficiency.	Thailand's policy framework provides a more structured and explicit focus on CE, while India's NEP lacks direct CE references, potentially limiting widespread adoption.
Educational Integration	• Integration primarily through vocational training and higher education programs. • Focus on technical skills and sustainability concepts in universities and skill development initiatives.	• Broader integration strategy across formal education and community-based programs. • Emphasis on sustainability in curricula, leveraging local wisdom and SEP principles.	India's approach focuses on higher education and skill development, whereas Thailand emphasizes a more holistic and community-based integration of CE principles.
Stakeholder Collaboration	• Involves government bodies (Ministry of Education, NITI Aayog), educational institutions (IITs, IIMs), and industry players. • Strong emphasis on industry-academia partnerships for practical exposure.	• Collaborative efforts include government, universities, and private sector, with a strong focus on community engagement. • Public-private partnerships play a key role in CE initiatives.	Both countries involve diverse stakeholders, but Thailand places a stronger emphasis on community involvement and public-private collaborations compared to India's industry-academia focus.
Existing Programs	• Skill India Initiative, focused on vocational training for green jobs.	• University programs focused on sustainable business	India's programs are more centered on technical skills and higher education, while Thailand integrates CE

	• CE concepts integrated into technical courses at IITs and IIMs.	practices and renewable energy. • Vocational training expanded to include CE topics, aligned with the BCG model initiatives.	across various educational levels and aligns with its national BCG model.
Challenges	• Limited direct policy support for CE education. • Regional disparities in access to quality education and funding constraints.	• Gaps in policy enforcement and infrastructure limitations for waste management.	India's main challenge is the lack of direct policy references, while Thailand faces enforcement and infrastructure issues, highlighting different implementation hurdles in both countries.
Opportunities	• Potential for growth through digital learning platforms and public-private partnerships. • Increasing interest in international collaborations for CEE initiatives.	• Emphasis on innovation, technology adoption, and international collaborations to enhance CEE programs.	Both countries have significant opportunities for scaling up CEE, with potential for shared learning and collaboration in research, digital education, and international partnerships.

Source: Authors' Compilation

15

Stakeholder Engagement and Educational Integration

15.1. Stakeholders and Systems

Overview of Stakeholders and Systems:
In the context of Circular Economy Education (CEE), stakeholders play a vital role in shaping policies, developing curricula, driving research, and ensuring practical application. Stakeholders include government agencies, educational institutions, the private sector, non-governmental organizations (NGOs), and local communities. Their collective involvement forms the backbone of CEE systems, guiding the direction of educational initiatives and ensuring the successful implementation of circular economy principles.

15.1.1. India

India's approach to circular economy education involves a diverse range of stakeholders, including government agencies, educational institutions, industries, and NGOs. However, there are notable challenges, particularly in fostering effective industry-academia partnerships. This lack of collaboration limits the practical application of CE concepts, resulting in gaps in skill development and real-world exposure for students. The stakeholders in India play distinct roles, but their efforts often lack coordination, which hinders the scaling up of CEE initiatives (Table 18).

Table 16: Stakeholders and Their Role in India

Stakeholder	Role
Government Agencies	Policy formulation, curricula development
Educational Institutions	Curriculum design and research
Industry	Providing internships, funding, and training
NGOs	Advocacy, grassroots awareness programs

Source: Authors' Compilation

15.1.2. Thailand

Thailand's circular economy education system benefits from a well-structured network of stakeholders, supported by strong policy frameworks and community engagement. The Bio-Circular-Green (BCG) Economy Model plays a central role in guiding educational initiatives and promoting collaboration among stakeholders. Thailand's emphasis on integrating local knowledge and community-based practices distinguishes its approach, making it more inclusive and culturally relevant (Table 19)

Table 17: Stakeholders and their role in Thailand

Stakeholder	Role
Government	Promotes CE education through policy frameworks like the BCG model
Universities	Develops sustainability curricula and research in CE
Private Sector	Collaborates with universities for skill development
Local Communities	Participates in grassroots environmental initiatives

Source: Authors' Compilation

15.2. Observations and Comparative Analysis of Stakeholders and Systems

The following table provides a comparative analysis of the stakeholders and systems supporting circular economy education in India and Thailand, highlighting the key differences and similarities (Table 20)

Table 18 : Comparative analysis of the stakeholders and systems

Aspect	India	Thailand
Government Role	Focuses on policy formulation, but faces challenges in consistent enforcement across regions due to huge population and tiered system of governance i.e. Centre, State, Municipal Corporation and Panchayati Raj'	Active promotion of CE through comprehensive policies like the BCG Model, with strong integration in educational standards.
Educational Institutions	Leading universities emphasize theoretical knowledge and research but struggle with industry integration.	Universities actively collaborate with the private sector, emphasizing hands-on learning and practical skill development.
Industry Involvement	Limited participation, with few partnerships between academia and industry, affecting practical training.	High level of collaboration with educational institutions, providing funding, internships, and research support.
NGOs and Community Engagement	NGOs play a critical role in awareness-raising, but their impact is often localized.	Community involvement is integrated into educational practices, leveraging local wisdom and traditional knowledge.

Source: Authors' Compilation

The analysis of stakeholders and systems in India and Thailand reveals distinct approaches influenced by cultural, economic, and policy factors. India's focus on policy frameworks and the involvement of NGOs highlights a top-down approach, but it faces challenges in linking academic knowledge with industry needs. In contrast, Thailand's strong policy support, industry collaboration, and community engagement provide a more integrated and holistic approach to circular economy education.

Both countries demonstrate potential for growth in circular economy education, but the success of these initiatives will depend on enhanced collaboration between stakeholders, improved policy enforcement, and the development of standardized curricula that incorporate practical and cultural elements of the circular economy.

15.3. Need Gap Analysis

The need gap analysis examines the existing shortcomings and areas of improvement in circular economy education (CEE) for both India and Thailand. It focuses on identifying the gaps in current educational practices, industry collaboration, curriculum integration, and public awareness. This analysis aims to provide targeted recommendations for bridging these gaps and enhancing the effectiveness of CEE in both countries.

15.3.1. India

In India, circular economy education is still in its nascent stages and faces several significant challenges. Despite growing interest in sustainability and environmental education, the integration of CE principles across disciplines remains limited. Most educational institutions treat CE as a niche area, primarily focusing on traditional environmental studies without emphasizing circular business models, resource optimization, or sustainable production methods (Table 21).

Table 19: Challenges faced in the Indian Context related to circular economy education and recommendations

Challenges	Recommendations
Limited curriculum coverage of CE	Integrate CE principles across disciplines
Weak industry-academia partnerships	Foster public-private partnerships for skill development
Lack of vocational training for CE jobs	Expand Skill India programs to include CE-specific courses

Source: Authors' Compilation

15.3.2.Thailand

Thailand has made significant progress in promoting sustainability through the Bio-Circular-Green (BCG) Economy Model, but challenges remain in effectively integrating circular economy education across the educational spectrum. While there is growing interest in CE, especially at the policy level, the implementation of CEE is hindered by limited public awareness and a lack of specialized training programs (Table 22).

Table 20: Challenges faced in the Thailand Context related to circular economy education and recommendations

Challenges	Recommendations
Limited grassroots awareness of CE	Run national campaigns to raise public awareness
Lack of skilled workers in CE fields	Develop targeted vocational training programs
Inadequate funding for CE research	Increase government grants for circular economy innovation

Source: Authors' Compilation

15.4. Comparative Observations: India vs. Thailand

The table (Table 23) below provides a side-by-side comparison of the key challenges and recommendations for improving circular economy education in India and Thailand:

Table 21: Key Challenges faced by India and Thailand in improving circular economy education

Aspect	India's Status	Thailand's Status	Observations
Curriculum Integration	Limited inclusion of CE principles across disciplines.	CE integrated mainly at the higher education level.	Both countries need to expand CE coverage in primary and secondary education.
Industry Collaboration	Weak partnerships between academia and industry.	Growing industry-academia partnerships, but limited to urban areas.	Strengthening public-private partnerships is crucial for practical exposure in both countries.
Vocational Training	Lack of CE-specific training programs under Skill India.	Limited targeted vocational programs for CE skills.	Both countries should incorporate CE skills into their national vocational training initiatives.
Public Awareness	Awareness of CE principles remains low, particularly outside urban centers.	Limited grassroots awareness, especially in rural areas.	Public awareness campaigns are needed to educate communities about CE practices.
Funding for Research	Inadequate funding for CE research and innovation.	Limited financial support for CE research and development.	Increased government investment in CE research is necessary in both countries.

Source: Authors' Compilation

The need gap analysis highlights that both India and Thailand face significant challenges in effectively implementing circular economy education, despite strong policy frameworks and growing interest in sustainability. In India, the primary gaps are related to limited curriculum integration, weak industry-academia partnerships, and a lack of vocational training programs. Meanwhile, Thailand's challenges stem from low public awareness, insufficient vocational training, and inadequate funding for CE research. Addressing these gaps requires a multi-faceted approach, including curriculum reform, enhanced public-private collaboration, and increased investment in research and training.

By implementing these recommendations, both India and Thailand can strengthen their circular economy education frameworks, build a skilled workforce, and foster a culture of sustainability that aligns with their national development goals.

15.5. Mapping of the Influence Factors and Performance

The mapping of influence factors and performance in the context of circular economy education (CEE) involves analyzing the key elements that drive the adoption and success of CE principles within educational frameworks. This includes policy frameworks, stakeholder involvement, curriculum integration, industry collaboration, and measurable outcomes. Understanding these factors is crucial to gauge the effectiveness of circular economy education programs and their impact on students, industries, and communities.

15.5.1 India

India's Policy Frameworks: India's approach to circular economy education is shaped by various national policies that emphasize sustainability, skill development, and environmental awareness. The National Education Policy (NEP) 2020 is a key policy document that advocates for experiential and hands-on learning, including topics related to sustainability. However, while the NEP 2020 supports green skills and sustainable practices, it does not explicitly mention circular economy education. This gap suggests that the integration of circular economy principles into the curriculum is still in its early stages. The Smart Cities Mission, launched by the Government of India, also emphasizes sustainability through efficient resource use, waste management, and green infrastructure. Although the mission indirectly supports circular economy practices, it lacks specific directives for educational programs focusing on circular economy principles.

15.5.2. Thailand

Thailand's Policy Frameworks: Thailand has adopted a comprehensive approach to promoting circular economy education through its Bio-Circular-Green (BCG) Economy Model, which integrates biological resources, circular economy principles, and green technologies. The BCG Economy strategy is a cornerstone of Thailand's efforts to transition towards a sustainable economy, providing clear guidelines and support for integrating circular economy concepts into educational curricula. The Thai government has established monitoring and evaluation systems to assess the effectiveness of circular economy initiatives across industries and educational programs. This proactive approach includes setting performance targets and regularly reviewing the progress of CE practices, ensuring that the goals of resource efficiency and waste reduction are being met.

15.5.3. Comparative Analysis: Influence Factors and Performance Metrics in India and Thailand

The table (Table 24) below summarizes the key influence factors and performance metrics for circular economy education in India and Thailand, highlighting the similarities and differences in their approaches.

Table 22: Key influential factors and performance metrics for circular economy education in India and Thailand

Aspect	India	Thailand	Observation
Policy Frameworks	NEP 2020, Smart Cities Mission; indirect support for CE.	BCG Economy Model; direct and comprehensive support for CE.	Thailand's policies offer clearer directives for CE education.
Government Support	Broad focus on sustainability but lacks explicit CE focus.	Strong emphasis on CE with monitoring and evaluation systems.	Thailand has a more targeted approach to CE education.
Industry Collaboration	Partnerships with universities for green skills development.	Strong focus on industry-academia partnerships for CE innovation.	Both countries emphasize industry involvement, but Thailand integrates it more systematically.
Curriculum Integration	Fragmented integration of CE concepts in environmental science and vocational programs.	Holistic integration across higher education and vocational training programs.	Thailand has a more unified approach in curriculum integration.
Performance Metrics	Student enrollment, industry engagement, circular business models.	Waste reduction, energy conservation, skills development.	Thailand uses more defined and measurable metrics for performance.
Skills Development	Focus on green skills and entrepreneurship in CE.	Emphasis on technical skills for waste management and recycling.	Both countries prioritize skill development but differ in focus areas.

Source: Authors' Compilation

The comparative analysis reveals that while both India and Thailand are making strides towards integrating circular economy education, their approaches differ significantly. India's focus is broader, emphasizing general sustainability education and green skills development without a specific emphasis on circular economy principles. In contrast, Thailand has adopted a more structured and targeted approach through the BCG Economy Model, which provides clear guidelines and performance metrics for circular economy initiatives.

India's approach benefits from its cultural heritage and traditional practices, which align with the principles of circularity, but the lack of explicit policy support for CEE poses a challenge. On the other hand, Thailand's comprehensive policy framework, strong industry-academia collaboration, and proactive monitoring systems position it as a leader in implementing circular economy education.

The differences in their strategies offer opportunities for cross-country learning and collaboration. India could benefit from adopting more defined performance metrics and monitoring systems similar to Thailand's approach, while Thailand could explore integrating traditional ecological knowledge and community-based practices, which are strengths of India's educational landscape.

15.6. Building the Value Chain of Circular Economy Education

The concept of a value chain in the context of circular economy education (CEE) refers to the series of interconnected activities that add value to the process of learning and applying circular economy principles. The value chain encompasses various stages, including curriculum development, stakeholder engagement, and skills development. Each stage plays a crucial role in equipping individuals with the necessary knowledge, skills, and competencies to transition from a traditional linear economy model to a more sustainable circular economy.

In both India and Thailand, building the value chain of circular economy education involves integrating CE concepts into educational frameworks, fostering collaboration with key stakeholders, and developing skills through practical learning experiences. However, the strategies and focus areas differ based on each country's unique socio-economic and cultural contexts.

15.6.1. India's Status in Building the Value Chain of Circular Economy Education

India has been actively working towards integrating circular economy concepts into its educational system, focusing on creating a robust value chain that includes curriculum development, stakeholder engagement, and skills development.

- **Curriculum Development**
  In India, curriculum development for circular economy education is guided by the National Education Policy (NEP) 2020, which emphasizes experiential learning and the integration of sustainability concepts across all educational levels. Higher education institutions, such as the Indian Institutes of Technology (IITs) and the Indian Institutes of Management (IIMs), have introduced specialized courses on sustainable development, environmental management, and circular economy principles. Vocational training programs have also been expanded to include CE-related topics, addressing the need for skilled labor in areas like waste management, recycling, and resource optimization. The focus on curriculum development in India includes the incorporation of project-based learning, hands-on activities, and real-world case studies that allow students to gain practical insights into circular economy practices. For example, programs in environmental science and engineering now include modules on product lifecycle management, sustainable product design, and closed-loop supply chain management.

- **Stakeholder Engagement**
  India's approach to stakeholder engagement in CEE involves close collaboration between government agencies, educational institutions, industries, and non-governmental organizations (NGOs). The government's role is pivotal in setting the policy framework and providing funding support for circular economy initiatives. Public-private partnerships are also common, with businesses partnering with universities to offer internships, joint research projects, and practical training in CE practices. For instance, the Swachh Bharat Mission has played a key role in mobilizing stakeholders at various levels, from grassroots organizations to large corporations, to promote waste reduction and recycling initiatives. Educational institutions collaborate with industry partners to align their curricula with the needs of the job market, ensuring that graduates have the skills required to implement circular economy solutions in their respective fields.

- **Skills Development**
  Skills development is a crucial component of the value chain in India's circular economy education. Vocational training programs, skill development initiatives under the Skill India Mission, and internships are focused on equipping students with practical skills related to waste management, product design, and resource efficiency. The emphasis is on hands-on learning, where students engage in real-world projects that allow them to apply circular economy principles directly. Programs like the National Skill Development Mission (NSDM) and the Pradhan Mantri Kaushal Vikas Yojana (PMKVY) have been instrumental in offering specialized training in areas such as waste segregation, recycling

technologies, and sustainable business practices. These initiatives aim to create a workforce that is knowledgeable and skilled in implementing CE practices across various sectors.

15.6.2. Thailand's Status in Building the Value Chain of Circular Economy Education

Thailand has developed a comprehensive approach to building the value chain of circular economy education, influenced by the Bio-Circular-Green (BCG) Economy Model. The focus is on integrating CE principles into educational curricula, fostering partnerships across sectors, and developing skills through vocational and experiential learning programs.

- **Curriculum Development**
  In Thailand, curriculum development for circular economy education is aligned with the government's strategic focus on the BCG Economy Model, which emphasizes resource efficiency and green technologies. Thai universities, such as Chulalongkorn University and Thammasat University, have taken the lead in offering courses that incorporate CE principles into business, engineering, and environmental studies programs. The curricula are designed to include theoretical knowledge, as well as practical skills in sustainable product design, waste management, and resource optimization. Vocational training programs in Thailand have also been expanded to include CE topics, providing students with industry-relevant skills in areas like waste recycling, sustainable manufacturing, and circular product design. The emphasis is on project-based learning, where students engage in collaborative projects that apply CE concepts to solve real-world problems.

- **Stakeholder Engagement**
  Thailand's approach to stakeholder engagement involves strong partnerships between the government, educational institutions, businesses, and community organizations. The Thai government has played a proactive role in promoting circular economy education through policies and initiatives like the Roadmap for Plastic Waste Management and the 20-Year Master Plan for Waste Management. Public-private partnerships are encouraged, with businesses supporting educational programs through funding, internships, and collaborative projects. Community involvement is a key aspect of stakeholder engagement in Thailand, with local wisdom and traditional practices playing a significant role in shaping circular economy education. NGOs and community organizations work closely with educational institutions to raise awareness about sustainability and promote grassroots initiatives that align with CE principles.

- **Skills Development**
  Skills development in Thailand's circular economy education focuses on practical learning experiences and vocational training. The government's emphasis on the BCG Economy Model has led to the creation of specialized training programs in areas such as green technologies, sustainable agriculture, and waste-to-energy solutions. Thai universities and vocational colleges offer internships and hands-on projects that provide students with opportunities to apply their knowledge in real-world settings. Programs like the Thai Vocational Education System have been expanded to include CE-related courses, focusing on equipping students with skills in recycling, waste management, and sustainable product design. The aim is to create a skilled workforce capable of driving the country's transition to a circular economy.

16 Conclusion and Recommendations

16.1. Future Prospects

The future of circular economy education (CEE) in both India and Thailand appears promising, as both countries have recognized the importance of integrating circular economy principles into their educational systems. This chapter examines the potential pathways for enhancing CEE in these nations, focusing on expanding curriculum integration, strengthening industry partnerships, and leveraging innovations in teaching methodologies. By assessing the current progress and identifying areas for improvement, this chapter aims to highlight the strategic initiatives that could drive the future growth of CEE in India and Thailand, positioning them as regional leaders in sustainable development education.

16.1.1 India

India's diverse educational landscape and its commitment to sustainable development provide a strong basis for expanding circular economy education. The country has immense potential to scale up CEE, capitalizing on its extensive network of higher education institutions, technical colleges, and vocational training centers.

India's National Education Policy (NEP) 2020 lays the foundation for integrating sustainability and environmental education into the national curriculum. The policy emphasizes experiential learning and aims to include circular economy principles across all educational levels, from primary schools to universities. With over 1,000 universities and 40,000 colleges, India's higher education system has the capacity to offer specialized programs and courses focused on the circular economy.

In addition to formal education, vocational training programs play a significant role in developing the skills required for a circular economy. The Skill India Mission and the Pradhan Mantri Kaushal Vikas Yojana (PMKVY) are government-led initiatives that focus on providing skill development opportunities to the youth. These programs are increasingly incorporating modules on sustainable practices, waste management, and resource optimization, aligning with the principles of the circular economy.

16.1.2. Thailand

Thailand's commitment to sustainability and its strategic focus on the Bio-Circular-Green (BCG) Economy Model have positioned the country as a frontrunner in promoting circular economy practices in Southeast Asia. The BCG model provides a comprehensive framework for integrating circular economy principles into various sectors, including education.

Thailand's approach to CEE is guided by the BCG Economy Model, which emphasizes the integration of biological resources, circular economy practices, and green technologies. The government has introduced several policies aimed at promoting sustainability education, including the Roadmap for Plastic Waste Management (2018-2030) and the 20-Year Master

Plan for Waste Management. These policies support the incorporation of CE principles into educational curricula at both the higher education and vocational training levels.

Thailand's educational institutions, such as Chulalongkorn University and Thammasat University, are actively involved in promoting CEE through specialized courses and research initiatives. These universities offer degree programs focused on environmental management, sustainable development, and circular economy practices.

In addition, vocational training programs have been expanded to include modules on waste management, resource efficiency, and circular product design, preparing the workforce for the demands of a circular economy.

16.2. Strategic Recommendations for Advancing CEE

The conclusion chapter synthesizes the key findings from the comparative analysis of circular economy education (CEE) in India and Thailand. This chapter draws together the insights gained from examining the educational frameworks, policies, stakeholder involvement, and challenges in both countries. By reflecting on the progress made and the areas needing improvement, this conclusion aims to provide a holistic overview of the current status quo and offer strategic recommendations for advancing CEE in the region.

The focus is on identifying the strengths of each country, acknowledging the shared challenges, and highlighting opportunities for growth and collaboration.

16.2.1 Circular Economy Education in India: Status and Progress

India has embraced the concept of a circular economy by integrating it into its educational policies and curricula at multiple levels. The country's National Education Policy (NEP) 2020 is a key driver in promoting sustainability across the education system. NEP 2020 emphasizes experiential learning, critical thinking, and environmental literacy, all of which align with the principles of the circular economy. The Indian approach is characterized by a strong emphasis on vocational training and skill development, aimed at equipping the workforce with practical skills for implementing circular economy practices in various industries.

Strengths of India's Approach:

- **Vocational Training Programs:** India has focused extensively on vocational education, offering numerous training programs that cover waste management, recycling, and sustainable product design. Initiatives such as Skill India and the Pradhan Mantri Kaushal Vikas Yojana (PMKVY) provide large-scale vocational training aimed at enhancing the employability of young people in industries aligned with circular economy principles.
- **Academic Research and Innovation:** Indian universities and research institutions like the Indian Institutes of Technology (IITs) and Indian Institutes of Management (IIMs) play a pivotal role in advancing circular economy knowledge. Their research focuses on sustainable business models, resource efficiency, and the development of innovative technologies for waste reduction.
- **Community and Cultural Engagement:** India's rich cultural heritage, including Gandhian principles of self-reliance and resource sensitivity, supports a strong foundation for circular economy practices. Grassroots initiatives and local NGOs actively engage communities in sustainable consumption and waste management projects, promoting awareness and behavioral change at the grassroots level.

Despite the progress, India faces challenges in implementing circular economy education on a broader scale. The main issues include limited funding for sustainability programs, regional disparities in access to quality education, and a lack of trained educators familiar with circular economy concepts.

Additionally, industry collaboration remains inconsistent, and there is a need for stronger public-private partnerships to support the integration of circular economy principles in the business sector.

16.3 Circular Economy Education in Thailand: Status and Progress

Thailand's approach to circular economy education is largely shaped by its Bio-Circular-Green (BCG) Economy Model, a strategic framework that integrates biological resources, circular economy practices, and green technologies. The BCG Model serves as the backbone of Thailand's national strategy for sustainable development, emphasizing resource efficiency, waste reduction, and the use of innovative green technologies. This policy-driven approach offers a strong foundation for integrating circular economy concepts into the educational system.

Strengths of Thailand's Approach:

- **Policy Support and Frameworks:** The Thai government has been proactive in promoting circular economy education through well-defined policies, including the 13th National Economic and Social Development Plan and the Roadmap for Plastic Waste Management. These policies emphasize the need for integrating circular economy principles into national educational standards and curricula across all levels of education.
- **Higher Education and Research Institutions:** Thailand's universities and research institutions play a significant role in advancing circular economy education. Leading institutions like Chulalongkorn University and Thammasat University offer specialized courses and degree programs focused on sustainable development, environmental management, and circular economy practices. Research output from these institutions contributes to policy development and industry innovations.
- **Community and Local Wisdom:** Thailand's approach to circular economy education is also influenced by traditional ecological knowledge and local wisdom. Community-based projects, particularly in rural areas, focus on sustainable farming practices, local recycling initiatives, and the conservation of natural resources. These culturally rooted practices align with modern circular economy principles, offering practical learning experiences for students and local residents.

Thailand faces several challenges in scaling up circular economy education, including gaps in policy enforcement, limited infrastructure for waste management, and a need for greater public awareness of circular economy principles. While the BCG Model provides a robust policy framework, there is still a need for increased investment in educational programs and stronger collaborations between educational institutions and the private sector.

The future of circular economy education in both India and Thailand will depend on holistic curriculum development, enhanced stakeholder collaboration, and continuous capacity-building efforts. By aligning educational strategies with the broader goals of sustainable development, both countries have the potential to become leaders in circular economy education in the region. Strategic partnerships, increased funding, and innovative teaching methods will be key drivers of success in this endeavour. The comparative analysis highlights the distinct pathways taken by India and Thailand in advancing circular economy education.

While India leverages its strengths in vocational training and grassroots initiatives, Thailand's policy-driven approach and emphasis on higher education provide a strong framework for sustainable development. Both countries have made significant progress but face similar challenges that can be addressed through strategic investments and collaborative efforts. As the demand for sustainable solutions continues to grow, circular economy education will play a pivotal role in shaping the future workforce and fostering a culture of sustainability across industries and communities.

Co-funded by
the European Union

Project number: 101129088 - KODECET - ERASMUS-EDU-2023-CBHE

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Project number: 101129088 - KODECET - ERASMUS-EDU-2023-CBHE