SEAMEO CENTRES POLICY RESEARCH NETWORK (CPRN) SUMMIT 2025

Building Bridges to a Sustainable Future: Inclusive Collaboration and Innovation in Education, Science, and Culture

GREEN TRANSITION IN ASEAN: Greening TVET as a driver for innovation and community engagement

Dr Margarita Pavlova

HOSTED BY

SEAMEO VOCTECH
Regional Centre, Brunei Darussalam

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Focus

Connecting science, education and culture:

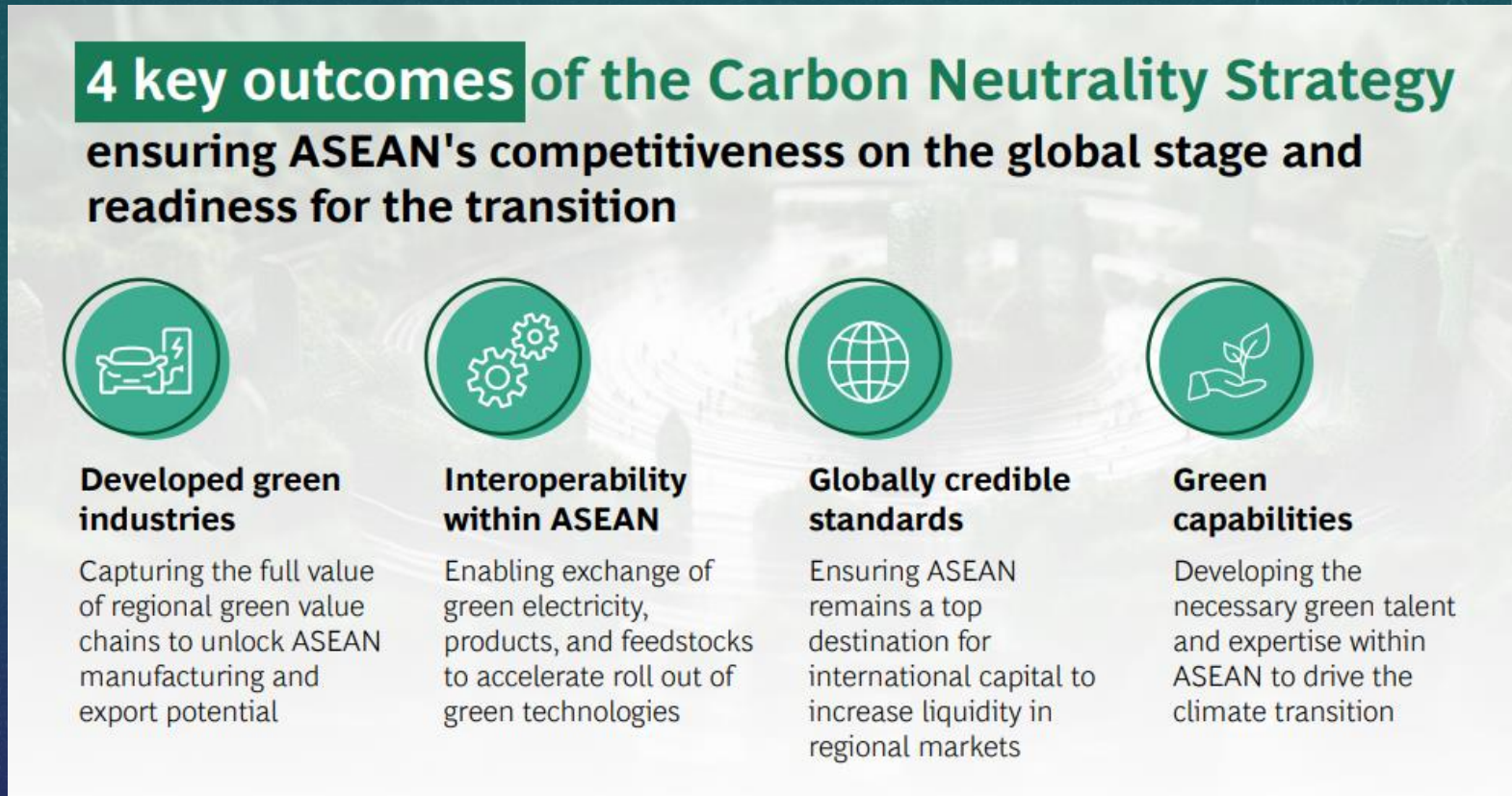
Green human capital development

Points to be addressed

- Green transition in ASEAN
- Conceptual framework to link science, education and culture in the context of greening
- How three interlinkages contribute to green human capital development:
  - Scientific research – education – environment
  - Educational research- educational policy – economy – environment
  - Education – culture/community – economy - environment
- Greening TVET as a master key for green human capital development
- Conclusion

ASEAN vision for low-carbon economy

- ASEAN State of Climate Change Report (ASCCR) (2021)
- ASEAN Carbon Neutrality Strategy



ASEAN Carbon Neutrality Strategy

Eight strategies to accelerate the journey towards carbon neutrality

1
Accelerate green value chain integration
Establish cooperation frameworks & remove barriers to bring green products to market faster

2
Regional circular economy supply chains
Incorporate definitions & facilitate trade deals to support circular economy via regional trade

3
Connect green infrastructure & market
Build interconnectivity for green technologies & decarbonization solutions to underpin regional deployment

4
Interoperable Carbon Markets
Develop credible carbon markets that are interoperable with each other & global markets

5
Credible & common standards
Develop taxonomies & definitions on GHG reporting, carbon credits & energy efficiency that align with requirements of key markets

6
Attracting & deploying green capital
Build effective pathways to attract necessary capital to region and between member states

7
Green talent development & mobility
Classify and ensure regional access to skills needed for carbon neutrality journey

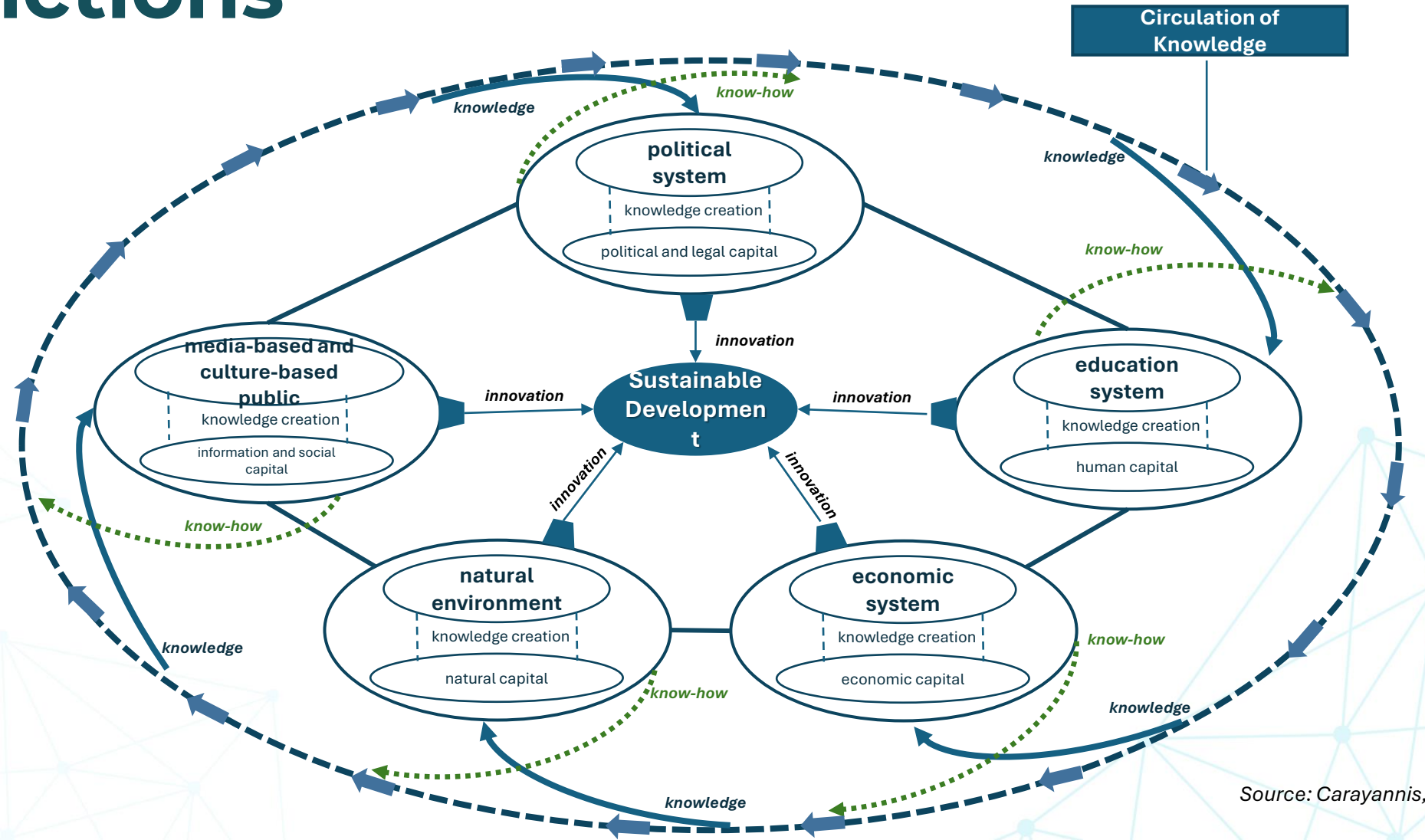
8
Green best practice sharing
Share best practices in R&D, technology & green transition from within ASEAN and borrowing from the best of the world

Innovation for greening

Innovation is the driving force that is shaping our future by transforming ideas into impactful realities. It requires curiosity, creativity, and the courage to seek solutions to complex problems. It inspires collaboration, unlocking human potential and igniting change. In a rapidly changing world, the essence of innovation lies in its ability to envision sustainable future and realise opportunities.

- Critical enabler to support green transition
- Pulling together science, education and culture, and other systems
- Require attention of all stakeholders and specific policies to support
- Important to have on different levels

Quintuple Helix Model and its functions



Source: Carayannis, Barth & Campbell, 2012

Three interlinkages with the focus on green human capital

- Scientific research – education – environment
- Educational research – policy – economy – environment
- Education – culture/community – economy - environment

Scientific research – education – environment

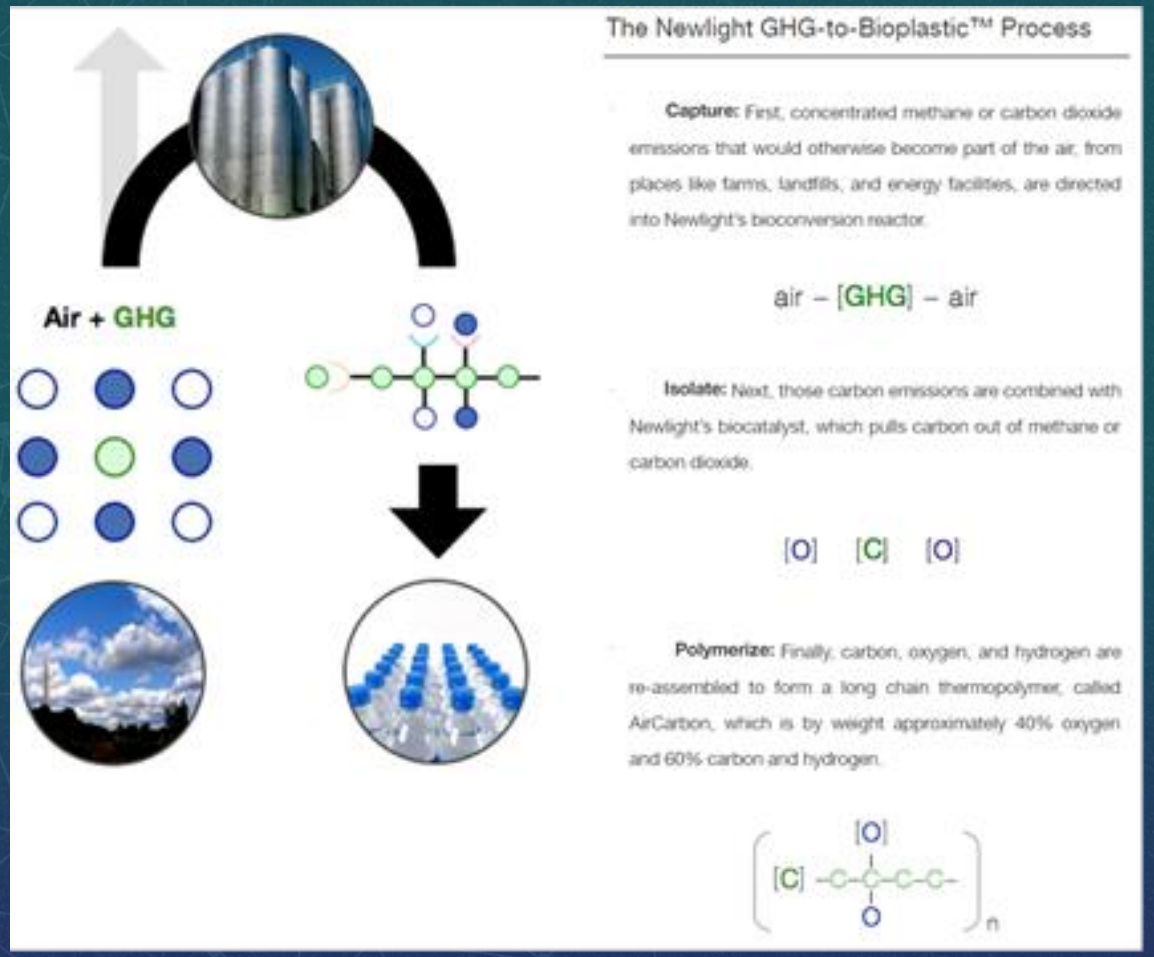
Smog Free Tower

It is equipped with environmentally friendly technology, **cleans 30.000 m3 per hour and uses very little green electricity**. The SMOG FREE TOWER represents a local

Smog free Bicycle

The design of the first prototype of the SMOG FREE BICYCLE was inspired by the manta ray, a fish that filters water for food. The bicycle works in a similar way; a plug-in device is mounted on the steering wheel of an existing bicycle and filters the air. The innovative bicycle "inhales" polluted air, cleans it, and provides clean air for the cyclist.

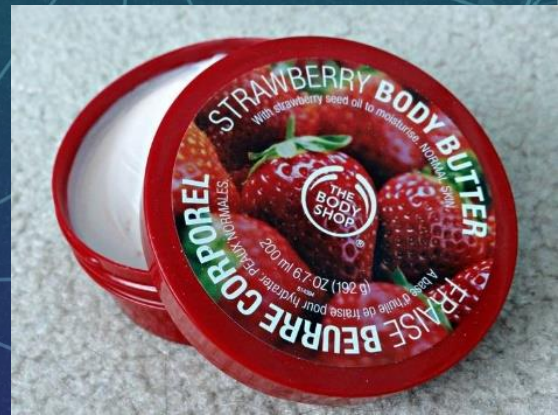
AirCarbon Technology
Air + Greenhouse gases = Plastic



This process sequesters more carbon than it produces, pulling carbon from the air and generating a net positive impact on the environment.

The new AirCarbon packaging is greener and less expensive to manufacture than oil-based plastic packaging.

The Body Shop – A major retailer is starting to make its plastic packaging from air pollution.



Use innovation examples for education

Information sheets about concepts, student activity sheets, teacher guidelines, and case studies are built upon **SDG 2030**

Industry, Innovation and infrastructure

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

The aim of SDG 9 is to implement modern industrial policies and compliance with global standards and norms. It promotes environmentally sustainable growth through greening industries and their facilities via cleaner production technologies and resource-efficient methods and innovation.

Concepts and case studies under SDG 9 are as follows:

Green Technology

Green technology is a type of technology that is environmentally friendly. Its main purpose is to conserve nature, tackle problems related to the depletion of natural resources and to repair the negative impact of human activities, such as pollution and environmental degradation. The term 'green technology' is also known as 'environmental technology' or 'clean technology'. These technologies are used in various aspects of our lives: from renewable energy and power storage, smart building innovations, green living technology, to smart transportation and mobility, waste management and recycling (Dasy, 2016; Babbitt, 2017).

- Concept - Green technology
- Student worksheet - Concept Green technology
- Teacher guidelines - Concept Green technology

Green buildings

Construction

- Case study - Green buildings
- Student worksheet - Case study Green buildings
- Teacher guidelines - Case study Green buildings

How much energy do data centers use?

Renewable energy

- Case study - How much energy do data centers use
- Student worksheet - Case study How much energy do data centers use
- Teacher guidelines - Case study How much energy do data centers use

Closed-loop economy

The closed loop model is a biomimetic (life-imitating) approach, which takes nature as an example and considers that systems should work like organisms, processing nutrients that can be fed back into the cycle—hence the terms 'closed loop' or 'regenerative' used to describe it. The closed-loop economy is also called the 'circular economy' and it is an industrial system that is restorative or regenerative by design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, and waste by improving the design of materials, products, systems and business models (Ellen MacArthur Foundation, 2016).

- Concept - Closed-loop economy
- Handout - Concept Closed-loop economy Dream farm
- Student worksheet - Concept Closed-loop economy
- Teacher Guidelines - Concept Closed-loop economy

Sludge treatment in T. Park

Waste management

- Case study - Sludge treatment in T. Park
- Student worksheet - Case study Sludge treatment in T. Park
- Teacher guidelines - Case study Sludge treatment in T. Park

How sustainable fashion contributes to the closed-loop economy

Waste management

- Case study - How sustainable fashion contributes to the closed-loop economy
- Student worksheet - Case study How sustainable fashion contributes to the closed-loop economy
- Teacher guidelines - Case study How sustainable fashion contributes to the closed-loop economy

Educational research - policy - economy - environment

Research and policy

Semantic Network Analysis of the Landscape of Green Vocational Education Research in ASEAN*

The following databases were used:

- Web Of Science
- Scopus
- Grants Index
- ProQuest Dissertations & Theses Citation Index
- SciELO Citation Index

*A Research Assistant for this project was *Mr.* ***Gong Da, The EdUHK*** who suggested the approach for analysis and followed it through

Methodology

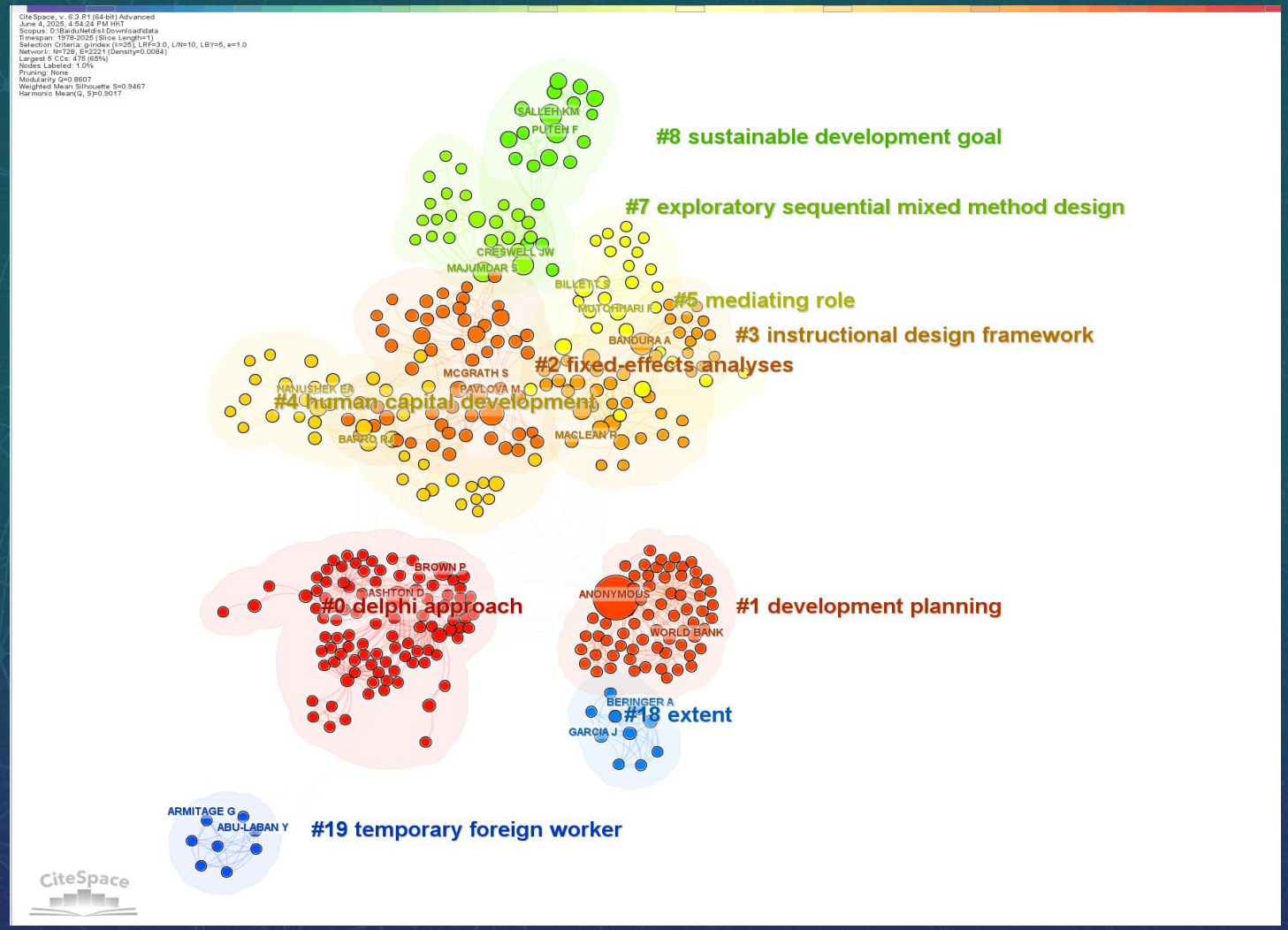
A carefully constructed Boolean query captures literature at the intersection of the following:

- environmental sustainability,
- vocational/technical education, and
- the ASEAN region.

Initially, 528 candidate papers were identified. A large language model (DeepSeek-R1-Distill-Qwen-32B) was used for binary classification. As a result, thirty papers were judged to fit precisely within the thematic scope. These thirty “core” records define the thematic centroid (the geometric centre of all points belonging to a specific theme/topic) for the next phase.

Through further manipulations, ranking and manual verification, 283 papers remain in the final bibliometric dataset that were analysed.

Overall network structure



The network has very well-defined clusters (i.e., distinct subfields or themes) and the items within each cluster are highly coherent (i.e., closely related to one another).

Node Size reflects how often a given author or document is cited (higher "Count" = larger node).

Node Colour goes from red/orange (earlier publications, roughly 1990s–mid 2000s) through green (around 2010–2017) to blue (2020 and later).

Edge Thickness indicates the strength of co-citations or co-occurrences: thicker lines mean those nodes (authors or documents) are more tightly connected.

Main clusters

Cluster	Label	Interpretation
#0	Delphi approach	Many studies used the Delphi method to define a “green skills” framework or to achieve expert consensus on curriculum content. In ASEAN countries, Delphi panels often include government officials, industry representatives, and VET experts who jointly decide which green competencies to prioritize.
#1	Development planning	Focused on how governments integrate “green VET” into national or regional development plans (e.g., Malaysia’s Green Skills Roadmap, Thailand’s VET 4.0 strategy). Researchers cite these strategic documents to show how policy drives curriculum and investment decisions.
#2	Fixed-effects analyses	Represents econometric panel-data studies (often using fixed-effects models) to quantify the impact of vocational-education investment on green economic outcomes, such as reduced CO_2 emissions or improved green employment rates, in different ASEAN countries over time.
#3	Instructional design framework	Studies proposing or evaluating specific curriculum-design models that embed “green literacy” and “green skill” modules into vocational courses, often drawing from ADDIE or competency-based frameworks. This cluster covers how to structure green modules, labs, and project-based learning in TVET.
#4	Human capital development	Explores “green human capital” from an economic or workforce perspective—identifying skill-gaps, training costs, and policies to reskill/upskill workers for green jobs. Often includes workforce projections, competency mapping, and VET system reform proposals.
#5	Mediating role	Research that investigates how one factor mediates the relationship between green VET inputs (like new green curricula) and green outcomes (like students’ green practice intentions).

Countries and people contributed to research

Count	Centrality	Year	Countries
133	0.38	2002	MALAYSIA
79	0.14	1992	INDONESIA
29	0.12	2010	THAILAND
25	0.13	2001	VIET NAM
20	0.08	1994	AUSTRALIA
18	0.15	2009	PHILIPPINES
18	0.06	1992	UNITED STATES
16	0.06	1998	SINGAPORE
13	0.32	2001	UNITED KINGDOM
12	0.21	2011	GERMANY
10	0.01	2009	JAPAN
6	0.19	2018	CAMBODIA
6	0.04	2012	CHINA
5	0.01	2014	TAIWAN
5	0.00	2006	HONG KONG

Visible	Count	Centrality	Year	Cited Authors
✔	53	0.26	1992	ANONYMOUS
✔	12	0.05	2019	PAVLOVA M
✔	11	0.25	1998	ASHTON D
✔	11	0.05	2010	BANDURA A
✔	10	0.00	2023	SALLEH KM
✔	9	0.01	2023	PUTEH F
✔	8	0.03	2023	MCGRATH S
✔	8	0.04	2017	CRESWELL JW
✔	8	0.05	2017	MAJUMDAR S
✔	7	0.01	2000	BROWN P
✔	7	0.03	2015	BILLETT S
✔	7	0.05	2019	MACLEAN R
✔	5	0.01	2017	RASUL MS
✔	5	0.01	2019	SCHWAB K
✔	5	0.03	2000	BARRO RJ
✔	5	0.02	2023	MINGHAT AD

The “Count” column indicates how many times each country appears in the literature. **Malaysia (Count = 133)** is by far the most frequently mentioned, followed by **Indonesia (79)**, **Thailand (29)**, and **Vietnam (25)**. on green vocational education in the ASEAN context.

Summary of results (1)

Policy-Driven Foundations

- The fact that “ANONYMOUS” (government/agency) documents occupy the top citation slot demonstrates that *policy papers and strategic roadmaps* are the cornerstone of any research on green TVET in ASEAN. Researchers frequently point to these official reports when justifying why and how green vocational education should develop.

Methodological Variety

- We see a balance between *qualitative expert consensus* (Delphi, cluster #0), *quantitative econometric assessment* (fixed-effects, #2), and *mixed-method designs* (#7). This suggests that a good mix of approaches for studying green TVET in the region has been used.

Summary of results (2)

Curriculum & Human Capital Emphasis

- Clusters #3, #4, and #5 show that researchers are not only defining policy frameworks—they are also asking practical questions: “How do we actually design green architecture classes, green agriculture modules, or sustainable technical labs?” and “How do these curricula translate into measurable improvements in students’ green competencies?”

ASEAN-Specific Considerations

- The “Temporary Foreign Worker” cluster (#19) highlights ASEAN-specific reality: a segment of the green workforce may be cross-border (e.g., Filipino as greenhouse technicians working in Malaysia).

Implications

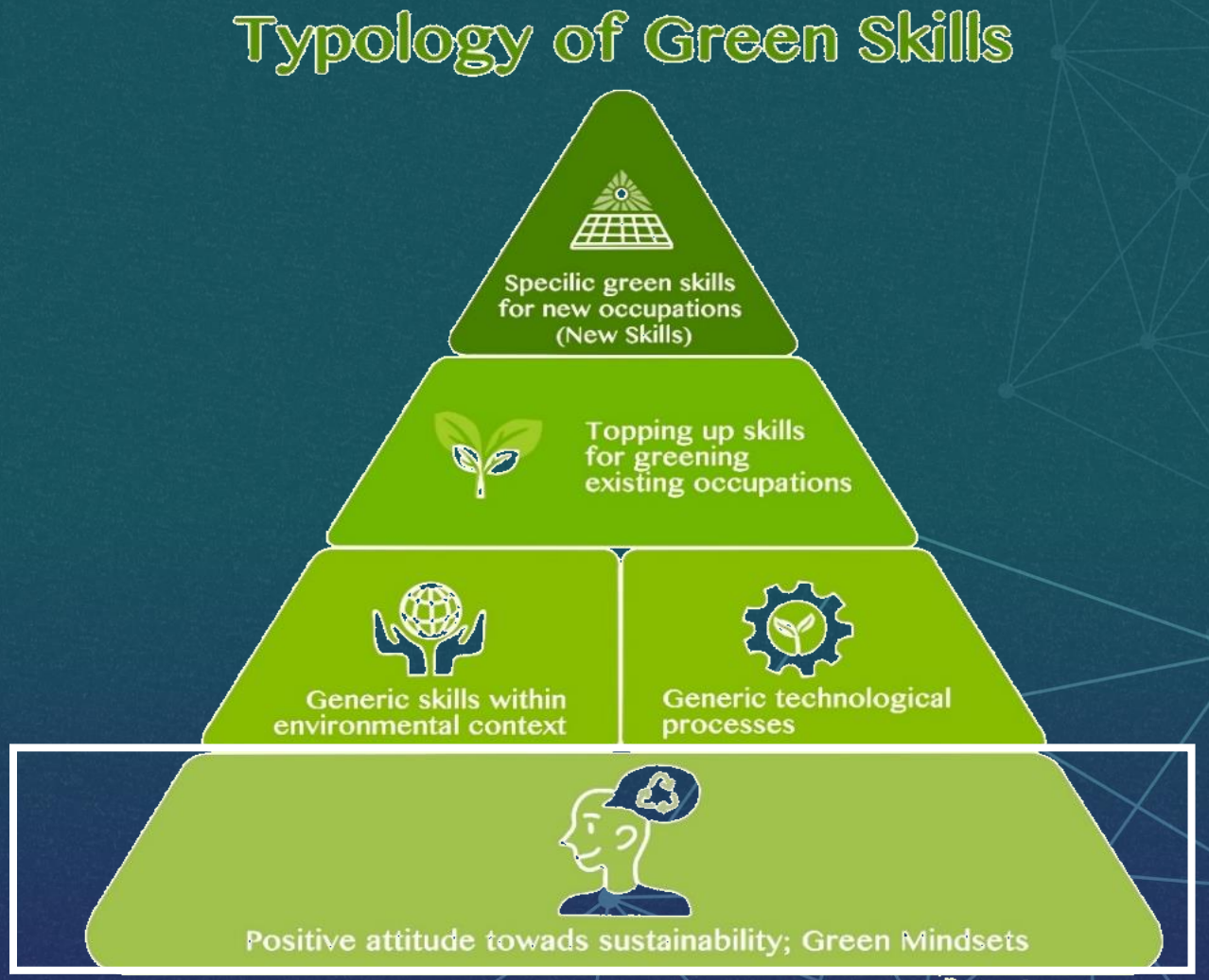
- There is a significant amount of research that has been done in ASEAN in relation to greening and TVET.
- Therefore, it is important to ensure that ASEAN and national governments have mechanisms in place to summarise and implement these findings.
- Studies from clusters #3 (instructional design) and #4 (green human capital) can be further examined to identify specific effective approaches that can form a foundation for policy recommendations : *Guidelines for greening TVET curriculum*.
- Good examples of capacity building and curriculum development should be shared across different countries in the region, considering that some countries are not active in publishing research.
- The results of research can help evidence-based policy formulation that support greening of economy and preserving environment through building green human capital.

Education- culture/community - economy - environment

Green mindsets and indigenous knowledge

- **Indigenous knowledge** - local knowledge unique to a particular culture or society.

- **Green skills** are understood as the knowledge, skills and attitudes (including values) required for developing and supporting the green growth.



Case study 1

- Water management is a critical issue affecting agriculture. It is essential for sustainable crop production. The efficiency of traditional irrigation system such as *Subak* in Bali can be improved by the use of AI.
- The integration of AI algorithms with sensor networks and real-time data analytics aims to optimize water usage and improve plant yield.
- Deep Learning algorithms can be employed to estimate the optimal watering management system.

https://tripbucket.com/dreams/dream/see-subak-irrigation-system-bali-unesco-site

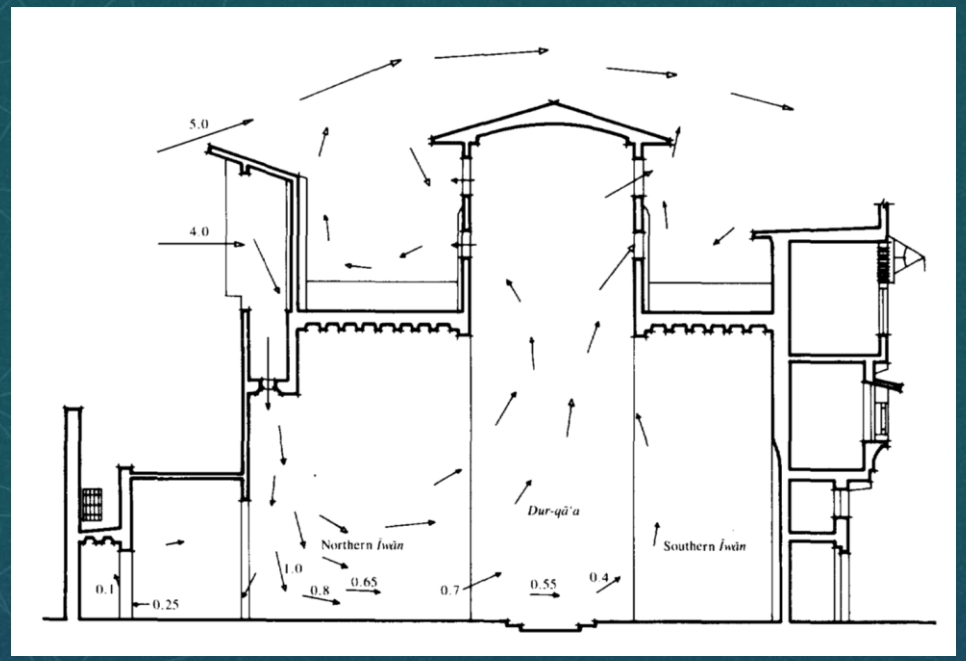
Case study 2

The Philippines: Typhoon resilient bamboo housing designed with a local knowledge.

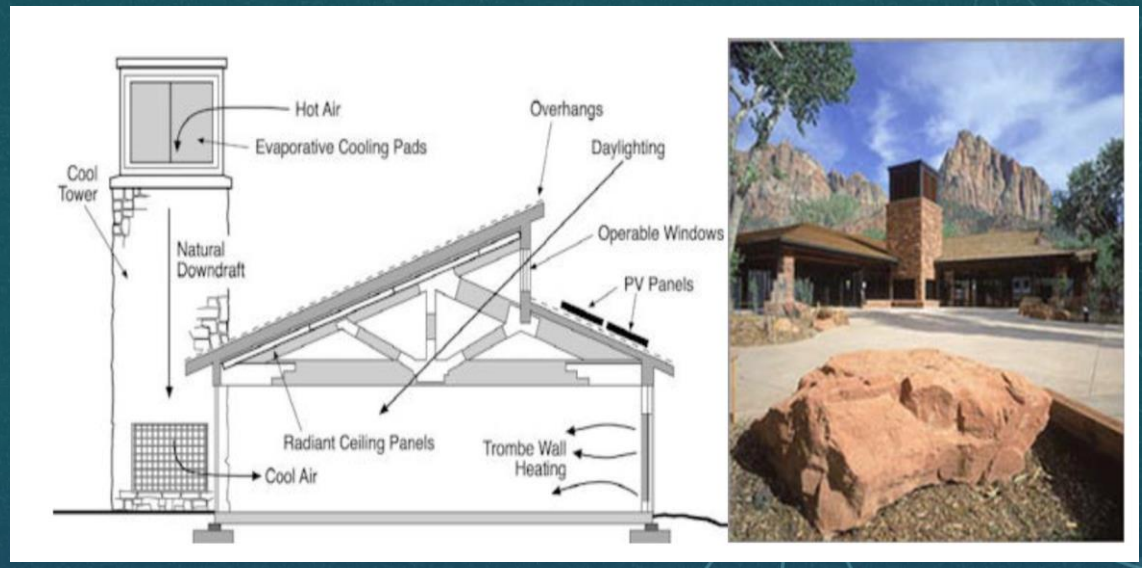
“The design itself has a purpose and reason. It’s flexible. It’s bamboo. So, it’s strong and also aerodynamic”.

https://www.channelnewsasia.com/asia/philippines-typhoon-resilient-huts-to-fight-climate-change-783371

Case study 3



The qa'ah of Muhin Ad-Din, Cairo (c. 1350)



The Visitor Centre at Zio National Park, US

Source: El-Shorbagy, A. M. (2010). Design with nature: windcatcher as a paradigm of natural ventilation device in buildings. *International Journal of Civil & Environmental Engineering IJCEE-IJENS*, 10(03), 26-31.

Greening TVET as a master key for green human capital

Greening TVET at the institutional level

Greening the campus

Managing campus to reduce the carbon footprint of the campus by deploying proper resources and sustainable principle

Greening the institutional culture

Promoting green values and attitudes in all aspects of the institution culture

Greening the curriculum and training

Integrating “sustainability” in the curriculum and training

Greening the workplace and community

Engaging enterprises and the wider community

Greening research

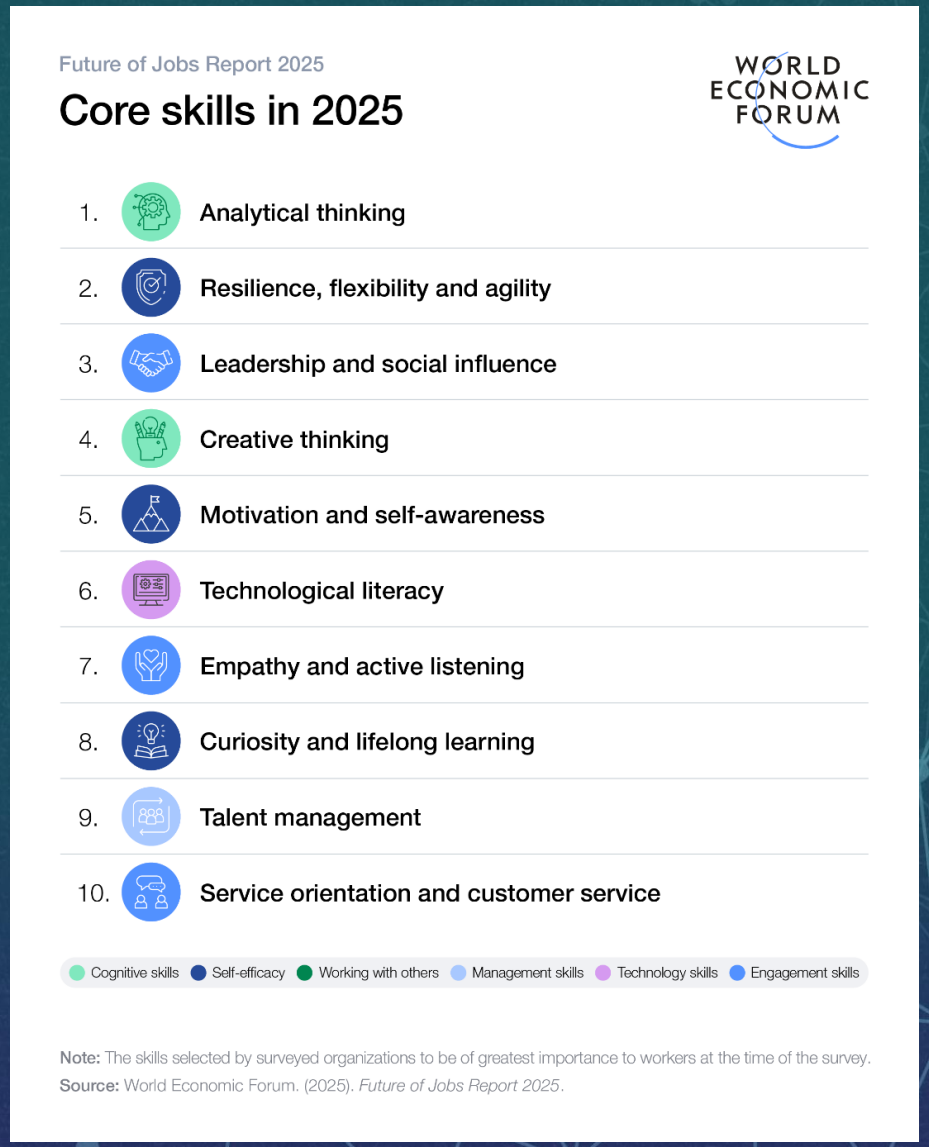
Applying sustainability in research philosophies, content, ethos and standards

+ Teachers’ capacity building

Source: UNESCO-UNEVOC (2017).

Conclusion

- Focus on green talent development and mobility (#7, ASEAN Carbon Neutrality Strategy) brings education, culture and science to work together for innovation to achieve ASEAN Green Future.
- Education should focus on core skills in the context of greening and specific guidelines for ASEAN should be developed to support a collective effort.



Conclusion

Pillar	Role in Greening ASEAN	Innovation bridge
Culture	Source of traditional ecological knowledge, values (harmony with Nature) and social cohesion	Fuels ethno-innovation (e.g. nature inspired design, circular economy rituals)
Education	Develop green mindsets, green skills, critical thinking, engage with community projects	Creates innovation pipeline (e.g. student-led start-ups, community outreach)
Science	Validates/ advances traditional ecological knowledge with data-driven solutions and technologies (e.g. climate modeling, material science); generates new scientific knowledge	Enable green innovation (e.g. AI optimized traditional framing, low-cost water filters, carbon absorption)
Result:	**Meeting Carbon Neutrality targets by ASEAN**	**Scalable green products, services, processes**

Takeaway points

- Green transition in ASEAN requires green human capital development that is engaged in green innovation
- Green innovation requires systematic approach that brings science, education and culture together
- TVET should apply a holistic approach for greening to serve as a master key in this process
- Guidelines at the ASEAN level can facilitate the process
-