

Proposed Mechanical Recycling Landscape for Singapore

Presented by Er Edwin Khew PBM

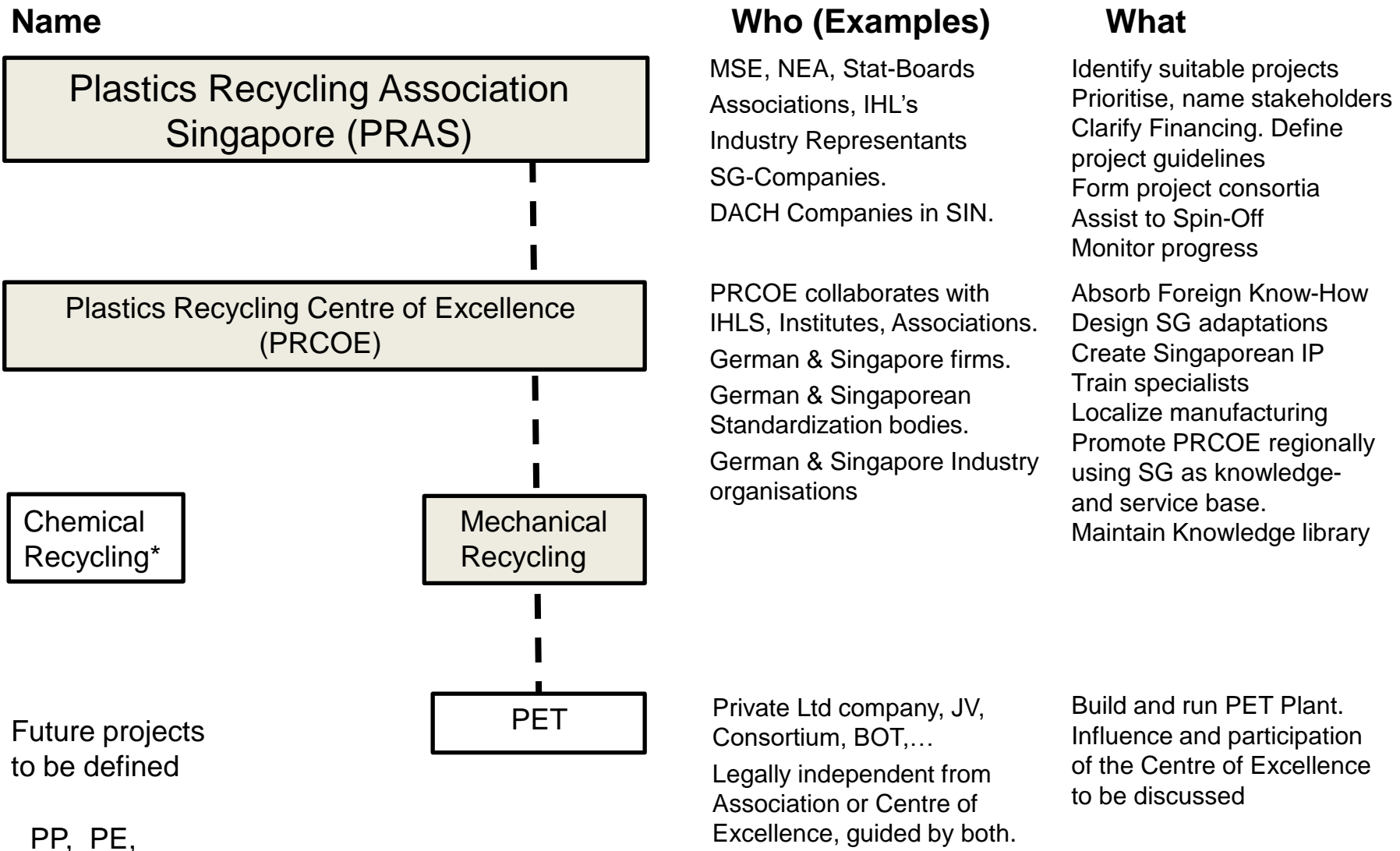
President

PRAS

Event: SCIC Sustainability Conference 2021



1. Establish an Association to identify & monitor Plastics Recycling projects



Plastics Recycling Association Singapore: Founding Members

Office Bearing members/Board Member:

1. Sustainable Energy Association Singapore (SEAS)	Mr Edwin KHEW	President
2. Singapore German Chamber of Industry & Commerce (SGC)	Mr Joachim IHRCKE	Vice President
3. Singapore Chemical Industry Council (SCIC)	Mr Richard HORNE	Secretary
4. Waste Management & Recycling Association Singapore (WMRAS)	Ms Melissa TAN	Treasurer

Selected Founding members/elected Board members:

5. ALBA W&H Smart City Pte Ltd-Board Member	Mr Jacob Lambsdorff
6. Institute of Chemical and Engineering Science,-Board Member	Dr Peter NAGLER
7. National University Singapore-Board Member	Prof SEERAM Ramakrishna
8. TÜV-SÜD-Board Member	Mr Holger LINDNER
9. Alliance to End Plastics Waste-Founder Member	Mr Keng-Huat LIM
10. Evonik Southeast Asia Pte Ltd-Founder Member	Ms Shirley QI
11. Foodpanda Singapore-Founder Member	Mr Yang LI
12. Reifenhäuser Pte Ltd-Founder Member	Mr Jürgen Rehkopf

Honorary Members/Advisors:

Ministry of Sustainability and the Environment, MSE } National Environment Agency, NEA	Mr Dalson CHUNG, NEA
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Economic Development Board Enterprise Singapore	Ms Adeline AW Mr Choon Jin YEOH
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Patron:

Dr. Amy Khor SMS, MSE

Mech Recycling-Identifying partners in Germany, Austria and Switzerland

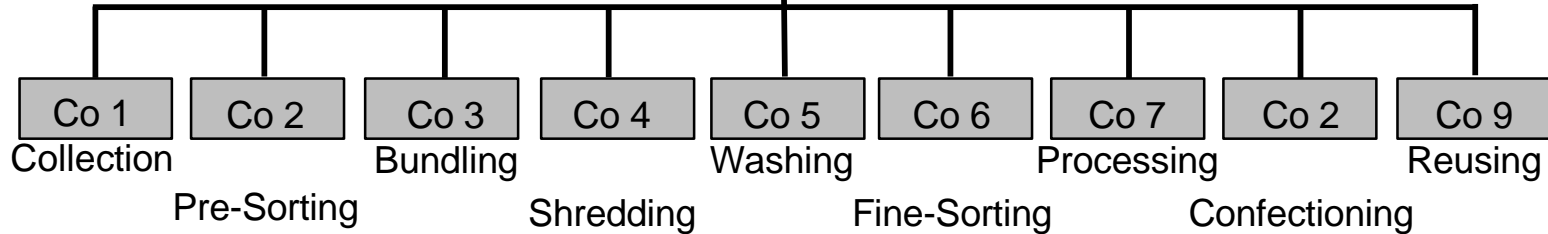
Potential cooperation partners in Europe



Singapore German Chamber in the lead



Each team-member provides technology in his specialty section

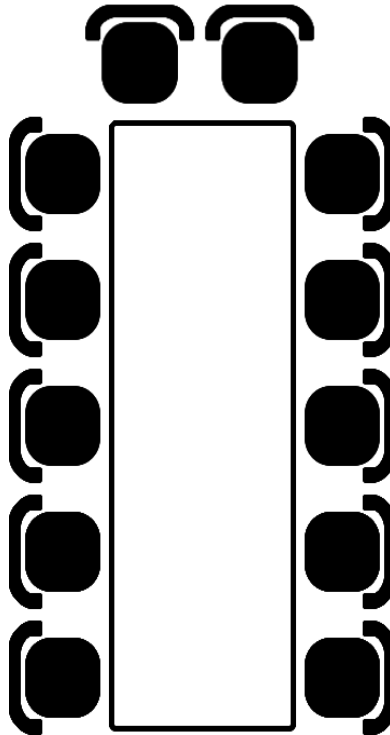


Match-making event in Singapore and Signing of MoU to start Mech Recycling



German/Austrian/Swiss specialist companies*

- System integration
- Collection
- Pre-sorting
- Bundling
- Shredding
- Washing
- Fine-sorting
- Processing
- Reuse
- Reformulation of New-Plastics

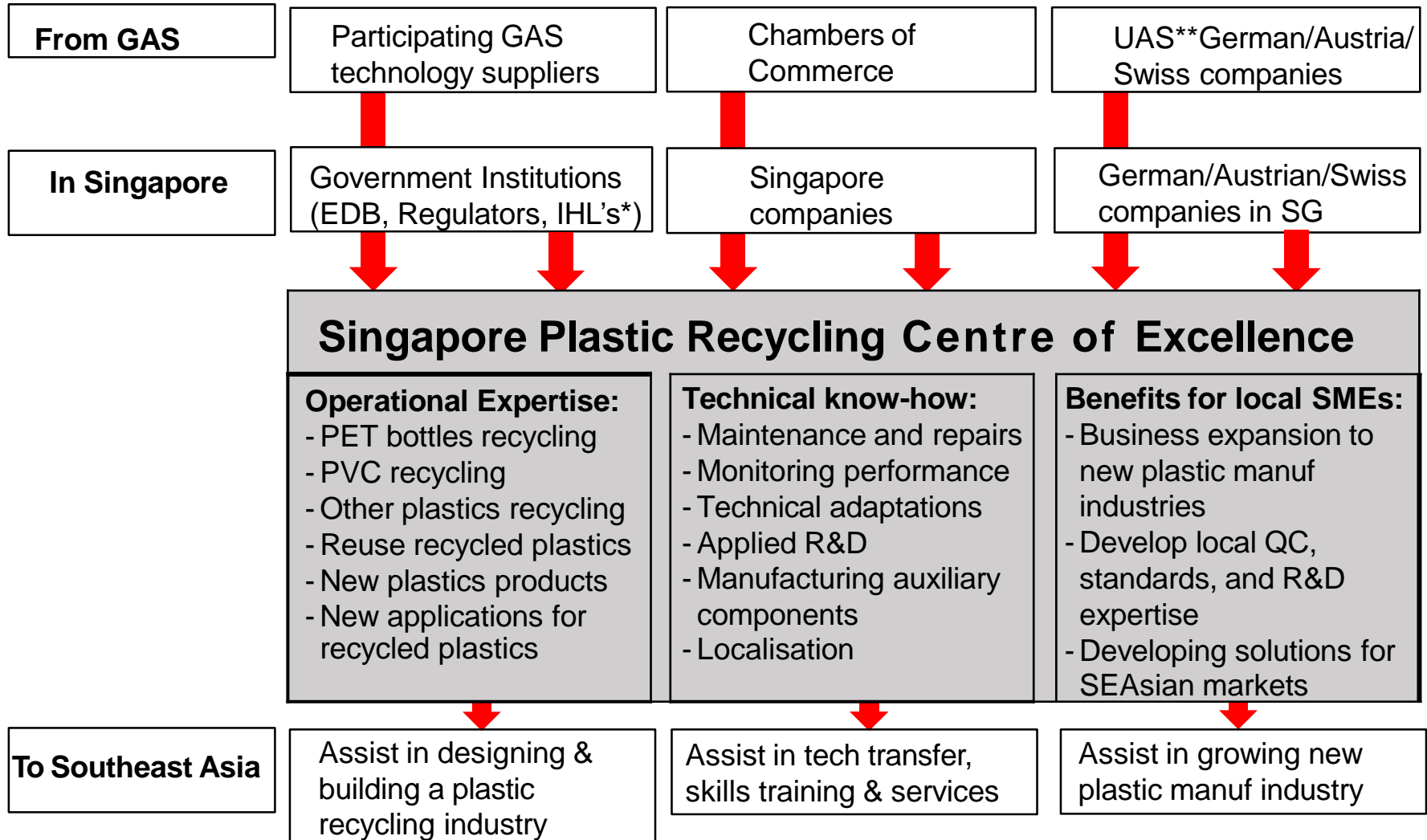


Singaporean potential cooperation partners*

- Government-linked
- Logistics
- Waste collectors
- Recycling Cos
- Precision Engineering
- Local Manuf SMEs
- Environmental Services
- Start-ups, Spin-offs
- Contract manufacturers
- Consumers of plastics pellets
- M&E Service providers

* For details regarding potential cooperation partners, please refer to the company listings in the attachment of the Grün Book

4. Establish a Centre of Excellence for Plastics Recycling



* IHL: Institutes of Higher Learning (Universities etc)

**UAS: University of Applied Science. Cooperation between German dual-education IHLs, Singapore IHLs and German companies. Please refer to next page

2. The first Pilot Project: Mechanical Recycling of PET Bottles

Used PET material



New manufacturing techniques
Meeting new sustainability standards
New Formulations (1% additives)




Longer lasting than original:

- Water bottles
- Food containers
- Thermoform films
- Containers
- Feedstock for other processes

Better than before:

- Flame retardant cladding
- Insulation for Hot Water pipes
- Plastic films, sheets, etc
- Granules and compounds
- Feedstock for other processes

New products/formulations:

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- Car seats for Audi A3
 - Floor mats
 - Underbody skin
 - Textile fibres
 - Pillows
 - Carpets



100 PET bottles for 1 set of seats/floor mats

2.1. Feasibility study for PET Bottle-to-Bottle Mechanical Recycling Plant

Study should not be an isolated view of the bare plant, but must include input and output parameters

Study of the Recycling Plant alone is not enough...



... but should be holistic, including input, plant and output

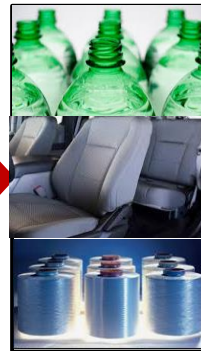
From where



Processing



Into what



Suggestion from advisors and PRAS members: Holistic approach: Plant is part of a concept

Question is not so much what to do, but How.

Example: Baseline in Singapore is the existing 4% (?) recycling rate of PET bottles. Goal of the study must be: How to increase this (to the average European level of ca 30%)?

The PET Recycling Plant will be an integral part of this study, not stand-alone.

According to new Verra Standards, Singapore does not qualify for Plastics Credits yet. There is hope because The European Green Deal 2050 places equal importance on Decarbonisation and on the Circular Economy.

2.2. Feasibility Study: Areas to be addressed for Mechanical Recycling

Present situation:

- Plastics Collection
- Plastics composition
- Plastics Waste separation

Actions assumed:

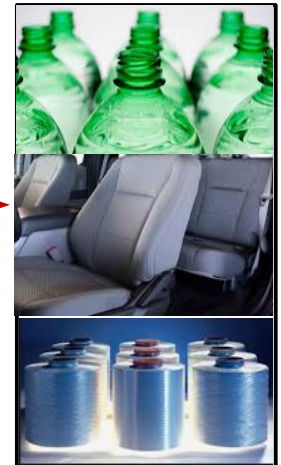
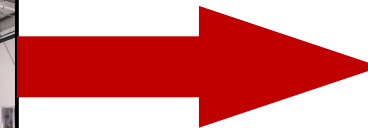
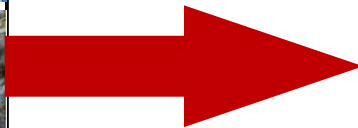
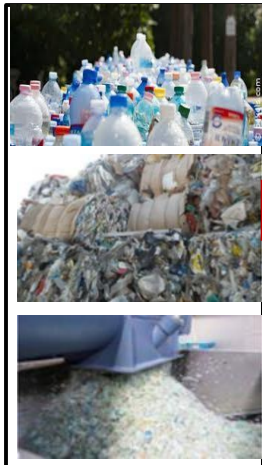
- Collection expansion
- Return deposit scheme
- Producer Responsibility
- Legislation on recyclate use
- Chute system improvement

Expected input incld timeframe

PET Recycling plant:

- Plant component companies
- Technical specifications
- Capacity min/max
- Timeframe
- Investment required

Uptake of plastics pellets:

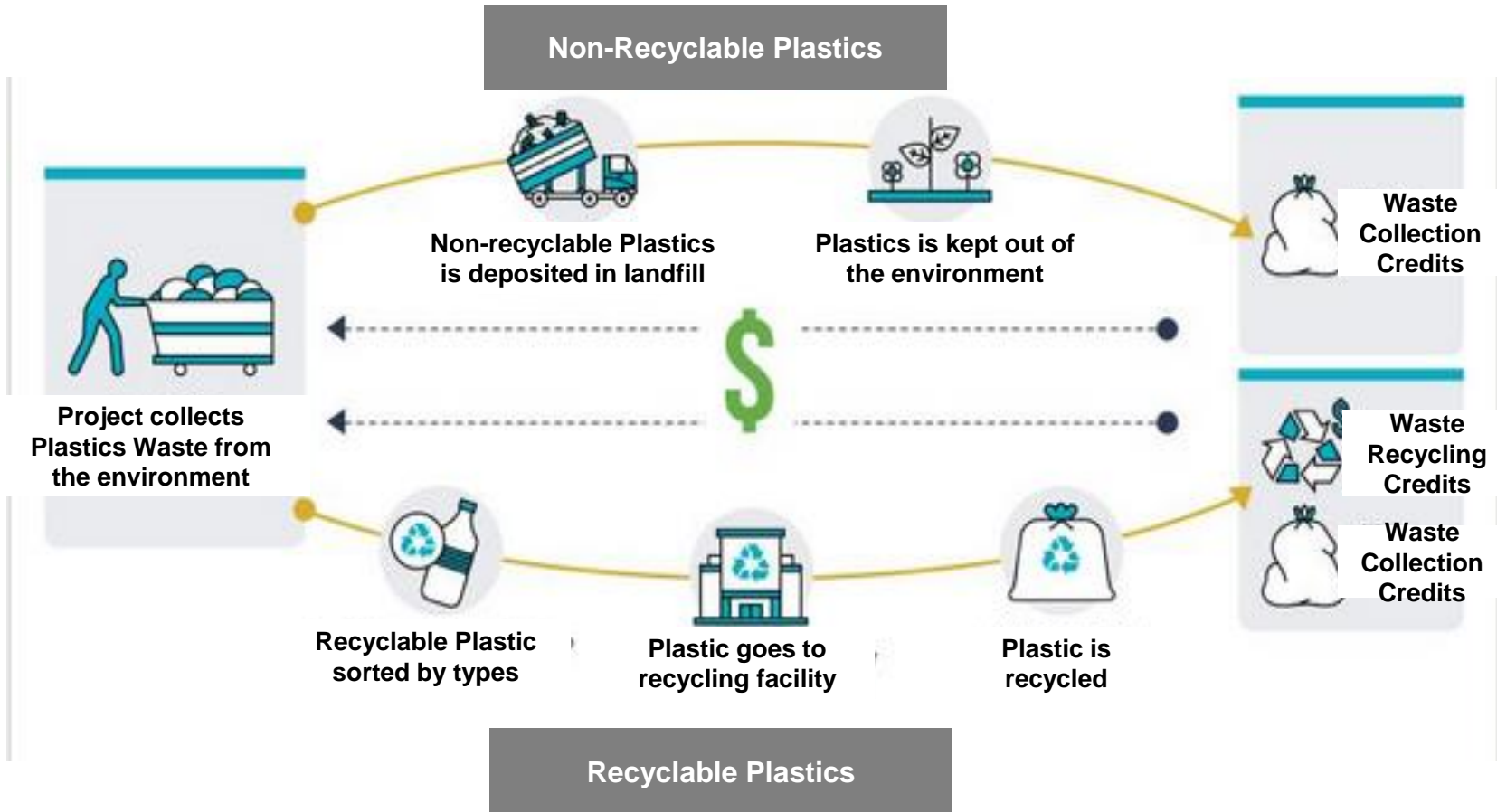


Product- and process certification by TÜV-SÜD

2.3. Verra* Plastics Credits (PC) could influence the outcome of the Study

Singapore already has a waste collection system, no plastics escapes to the oceans. Do Not qualified for PC

Verra Plastics Standard Projects: Material and Credit Flow



* Verra: Verification and Accreditation Body for Carbon- and other Credits

2.4. Feasibility Study: Expected results

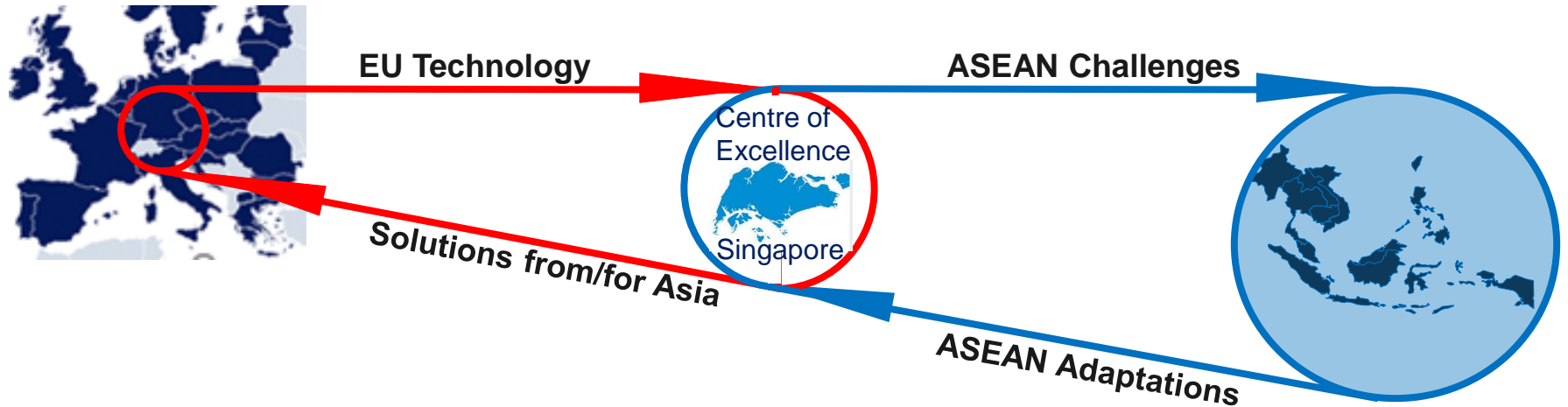
If Feasibility Study outcome is Negative:

- **Conduct detailed post-mortem, see whether we can change parameters, otherwise select another project.**

If Feasibility Study outcome is Positive:

- **Approach Investors**
- **Continue project as planned**

3. Our Vision: International Transmission Belts for Plastics Recycling



5. Build other plastic recycling pilot plants in Singapore and the Region



9. Roadmap to become the ASEAN Centre of Excellence in plastics recycling.

- 1. Establish a Plastic Recycling Centre of Excellence (PRCOE)**
- 2. Conduct seminar with relevant industry players from Germany/Austria/Switzerland**
- 3. Build Pilot plant beginning with a PET recycling plant**
- 4. Train local specialists in Singapore--training done in Germany/Austria/Switzerland**
- 5. Develop technical solutions for local and regional recycling problems**
- 6. Develop knowledge base in Singapore for ASEAN and Asian plastics recycling**
- 7. Train local SMEs to build/operate/maintain recycling equipment and plants**
- 8. Manufacture recycling equipment and components locally in SG**
- 9. Market “Singapore as a regional Plastic Recycling Centre of Excellence” in ASEAN.**

Possible other focus areas to be addressed by Plastics Recycling Association

- **Expand Recycling vertically down:**
 - **Mechanical recycling:**
 - PET, PP, PE Recycling-for segregated plastic waste
 - **Chemical Recycling (Pyrolysis):**
 - Return common plastics products (polymers) to their basic chemicals (monomers), which can then be reused-for mixed plastic waste.
 - **Expand recycling vertically up:**
 - Collection of waste, separation of waste
 - Coordination of regional plastics waste collection
 - Deposit refund scheme (optimize, operate the scheme?)
 - “Grüner Punkt” plastic collection system on behalf of producers/sellers
 - Enhanced producer responsibility
 - Digital Watermarks (accurate identification of packaging)
 - **Expand horizontally:**
 - Certification of recycled plastics:
 - Blockchain for certification of recycled pellets (additives, purity of material)
 - Certification of Plastics Recycling Process
 - **New technologies for usage of recycled materials (eg Audi A3 car seat covers, floor mats)**
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Thank you