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Strengthening the circular economy in the international rubber value chain: Perspectives for value addition

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STRENGTHENING THE CIRCULAR ECONOMY IN THE INTERNATIONAL RUBBER VALUE CHAIN: PERSPECTIVES FOR VALUE ADDITION

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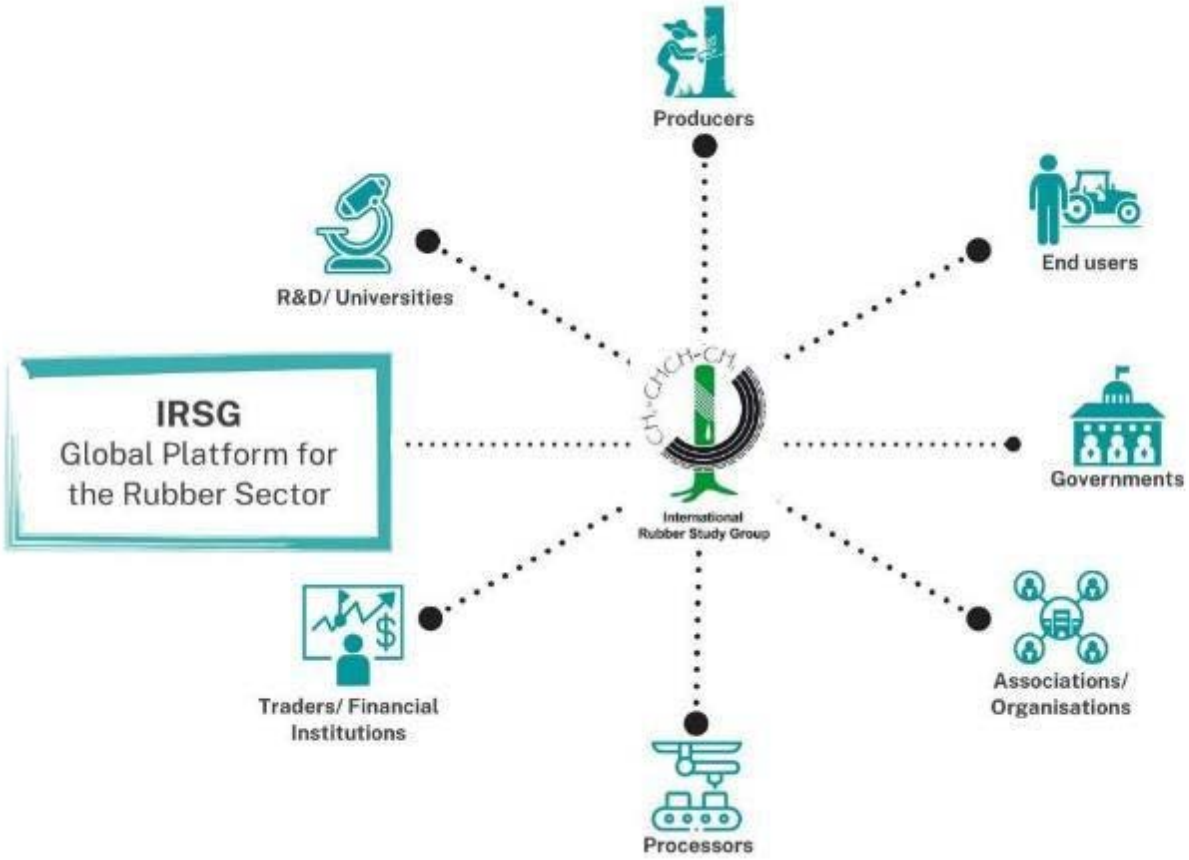
INTERNATIONAL RUBBER STUDY GROUP (IRSG)

- Who are we?
- Established in 1944 as an inter-governmental organization, headquartered in London, UK. As of July 2008, the Group has been based in Singapore.

- IRSG is the forum for discussion of matters affecting the supply and demand for natural as well as synthetic rubber.

- IRSG is the only forum where Governments, Industry and other important stakeholders can meet to discuss the main challenges that the rubber economy faces.

- Authoritative source of statistical data and analysis for all aspects of the rubber industry.


Producers
R&D/ Universities
End users
IRSG
Global Platform for the Rubber Sector
International Rubber Study Group
Governments
Traders/ Financial Institutions
Associations/ Organisations
Processors

IRSG - A WORLD NETWORK OF MORE THAN 100 INDUSTRY MEMBERS

COLLABORATION WITH OTHER ORGANISATIONS

Contents

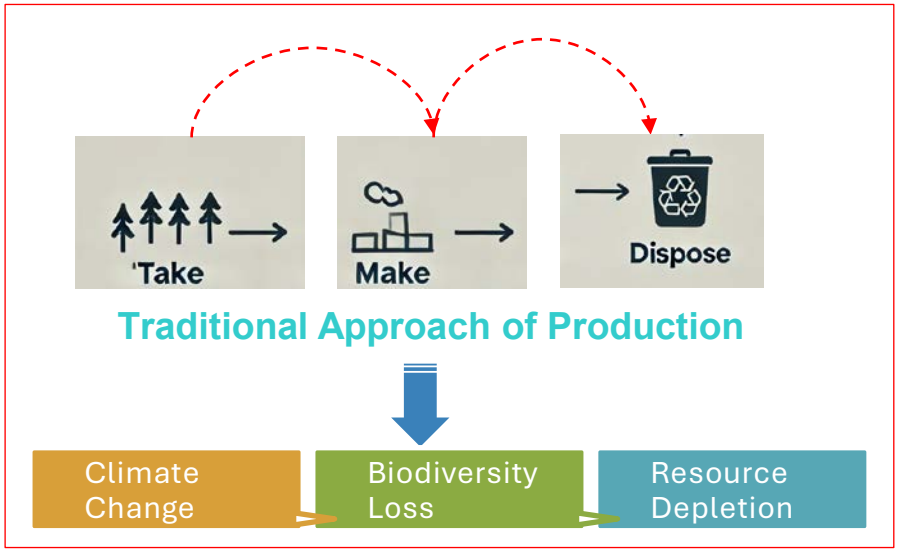
The Circular Economy

•Define: Circular Economy (CE) is an approach to reducing waste and maximizing resource efficiency.

•CE's relevance to the rubber value chain, emphasizing reuse, recycling, and sustainable design.

•Importance of addressing global challenges like climate change and biodiversity loss.

- Core Principles
  - Eliminating waste and pollution
  - Maintaining the highest possible value for products
  - Regenerating Natural Systems



The Circular Economy – Schools of Thought

- **Regenerative Design**
  Lyle, 1994
- **Biomimicry**
  Janine Benyus, 1997
- **Cradle-to-Cradle**
  Braungart and McDonough (2002)
- **Industrial Ecology**
  Ayres & Ayres, 2002
- **Performance Economy**
  Walter Stahel, 2010
- **Blue Economy**
  Pauli, 2010

Why Adopting Circular Economy in the Rubber Value Chain

- Rubber, as one of the major commodities in the world, has a wide range of applications. Rubber value chain is a complex and expansive value chain that spans multiple industries and processes.

- The production of natural rubber, predominantly in Southeast Asia, is linked to deforestation, habitat destruction, and biodiversity loss, while synthetic rubber production relies heavily on non-renewable fossil fuels. Both types of rubber production contribute to greenhouse gas emissions and other forms of pollution.

- Embracing circular economy principles, investing in technological innovations, and enhancing global supply chain resilience are crucial steps towards transforming the challenges of rubber sector into steppingstones for advancement

- The rubber circular economy aims at reducing waste and maximizing resource efficiency, offering significant potential for value addition within the international rubber value chain.

Why Adopting Circular Economy in the Rubber Value Chain

- Rubber circular economy has a wide influence. Rubber is a versatile raw material used in everyday products across a range of industries for various purposes (Esekhade et al, 2014).

- Because of its elasticity, resilience, and toughness, among other properties, rubber is widely used as a basic constituent of many products, predominantly in the automotive and aircraft industries.

- More than 70% of production is directed to automobile tire and non-tire automotive parts (i.e. airbags, padding, tubes, pipes etc.) (Agwu, 2006).

- Rubber is also used in the consumer, hygienic, and medical sectors and made into more than 5,000 products including toys, balls, rafts, elastic bandages, adhesives and paints, conveyor belts, footwear, cables and wires, etc

Why Adopting Circular Economy in the Rubber Value Chain

- Circular economy reduces environmental impact of rubber production. Traditional methods of natural rubber production have frequently resulted in deforestation, biodiversity loss, and soil degradation. Similarly, the production of synthetic rubber utilizes petroleum, a natural resource that is unable to be regenerated

- Circular economy of rubber usage has the potential to reduce the demand for new production of both natural and synthetic rubber and thus mitigate the environmental impacts of rubber production.

- Rubber waste, especially from used tires, poses significant environmental challenges. Globally, over 1.7 billion tires are produced annually, yet only 42% of end-of-life tires (ELTs) are recovered for material reuse, and 15% are used for energy recovery (Mongabay, 2024).

Why Adopting Circular Economy in the Rubber Value Chain

- Each year, around 800 million tires are discarded globally, with many of them ending up in landfills, burned for fuel, or used in products like asphalt or artificial turf.
- These disposal methods often release harmful pollutants such as microplastics, heavy metals, and toxic chemicals into the environment (Leong et al. 2023).
- Tire wear particles, a major source of microplastics, accumulate in waterways, affecting aquatic ecosystems and human health. Chemicals like 6PPD used in tire production are toxic to species such as coho salmon, highlighting the broader ecological damage caused by rubber waste.
- Efforts include recycling technologies focusing on methods such as pyrolysis, which breaks down the rubber into valuable materials like carbon black, oil, and gases.
- Circular usage of rubber is thus needed across the value chain, from rubber growers to manufacturers, to effectively reduce the environmental footprint of rubber waste.

Why Adopting Circular Economy in the Rubber Value Chain

- Circular economy contributes to supply-demand balance of natural rubber. The growths of world economy and population have been pushing up rubber demand.

- The world population is expected to be over 9.8 billion by 2050, while the number of automobiles is forecasted to increase to 3 billion.

- With the increasing population, improving living standards, and growing demand for automobiles, the world is expected to face significant increase of rubber consumption demand.

- As forecasted by the IRSG, the world rubber consumption is expected to reach 35.55 million tons by 2031, and natural rubber and synthetic rubber demand are expected to be 17.37 and 18.17 million tons, respectively.

Why Adopting Circular Economy in the Rubber Value Chain

Projection	Supply	Demand	Excess Supply (+) or Deficit (-)
2024	14,566	14,988	-422
2025	15,008	15,519	-511
2026	15,261	15,999	-738
2027	15,402	16,435	-1,033
2028	15,452	16,820	-1,368
2029	15,445	17,166	-1,721
2030	15,467	17,535	-2,068

Supply	Demand	Excess Supply (+) or Deficit (-)
14,821	14,505	-316
15,252	14,909	-343
15,687	15,259	-428
16,053	15,558	-495
16,393	15,892	-502
16,707	16,188	-519
17,010	16,468	-542

Why Adopting Circular Economy in the Rubber Value Chain

- There have been an increasing number of investment strategies that focus primarily on the opportunities of the low-carbon transition and green finance. Investments in circular economy initiatives have surged, reaching $700 billion globally (Markets and Markets, 2021).
- This growth underscores the increasing potential for creating value through circularity, particularly in industries such as rubber
- Circular economy directly supports value addition in the rubber value chain by aligning product design with principles of material regeneration.
- Walter Stahel's model of *Performance Economy* emphasizes the importance of repair, reuse, and remanufacturing, shifting focus from product ownership to service-based models.
- By reducing waste and promoting material efficiency, this concept offers substantial economic resilience and job creation potential within the global rubber industry (Stahel, 2010).

Why Adopting Circular Economy in the Rubber Value Chain

- Recyclable properties give rubber a higher added value and price premium, and it is expected to improve the livelihood of rubber producers, especially national rubber producers.

- Natural rubber production sustains about 40 million people globally, while around 90% of its production comes from the work of smallholders. Rubber circular economy is particularly beneficial to African natural rubber producers in socio-economic perspective

- The predominant method of rubber production worldwide involves smallholder farming, typically in monoculture systems, modified forests (agroforests), or intentionally planned mixed-crop systems.

- The Asia-Pacific region accounted for 87% of global natural rubber production in 2023, is expected to see a slight decline to 85% by 2031, whereas Africa's share is anticipated to slightly increase by two percentage points, reaching 12% by the same year.

- Africa's contribution to the global natural rubber production, though growing fast, is currently low as the continent only accounts for 5% of world supplies. There remains huge potential for Africa to promote its natural rubber production by attaching higher value to rubber products.

Current Development of Rubber Circular Economy

- Investing in such issues as technology and resource efficiency, waste management, circular economy, and sustainable agriculture and forestry are some of the available investment opportunities relating to sustainability of rubber sector.

- Innovations in rubber recycling technologies can create new markets and reduce the industry's carbon footprint.

- With continuing investments and policy supports, green rubber entrepreneurs have been adopting sustainable practices of circular economy for elastomer products, including natural rubber latex wastewater treatment technologies, conversion of natural rubber latex wastewater to renewable energy, wealth creation from rubber wastes, waste valorization, waste incineration, micronized rubber powder (MRP) from Lehigh technologies and green rubber systems among other green investment options (Ramirez-Canon et al, 2018; Osayi et al, 2018).

- Several strategies and initiatives have emerged within the tire sector to strengthen circularity, reduce environmental impact, and create value.

Current Development of Rubber Circular Economy

- These include tire retreading, end-of-life tire recycling, regulatory support for extended producer responsibility, technological innovations such as abatement technologies to promote material efficiency and circularity, and a focus on the economic and environmental impacts of circular practices.

- Recycling End-of-Life Tires: A Key Circular Strategy. End-of-Life Tire (ELT) recycling is another critical aspect of the circular economy within the rubber sector.

- Approximately 1 billion tires reach the end of their useful life each year, creating a significant waste management challenge. ELT recycling involves recovering valuable materials from used tires and reintegrating them into production processes, thereby reducing the reliance on new raw materials and minimizing waste.

- One of the most promising ELT recycling methods is pyrolysis, a thermal decomposition process that breaks down waste tires in the absence of oxygen, yielding by-products such as carbon black, steel, and oil.

Current Development of Rubber Circular Economy

- Carbon black recovered through pyrolysis can be reused in producing new tires, inks, and coatings, while pyrolysis oil serves as an alternative energy source, reducing dependence on fossil fuels (Pyrolysis Technologies, 2021).
- Studies show that pyrolysis can recover up to 20-25% of a tire's original weight as oil, which can be applied in various industrial sectors (Smith et al., 2019).
- Additionally, ELTs are repurposed for construction materials, such as crumb rubber, which is increasingly used in asphalt for road construction.
- Roads incorporating crumb rubber are more durable and require less maintenance, offering both environmental and economic advantages.
- These applications divert waste tires from landfills and promote resource conservation in infrastructure projects (CalRecycle, 2020).

The Circular Economy – Policy Support and Growing Investments

- **Policy-driven initiatives:** The EU's Circular Economy Action Plan, as part of the EU Green Deal, promotes resource efficiency and value creation, particularly within sectors like rubber.

- **Investment surge:** Global investments in circular economy initiatives have reached $700 billion, reflecting a global trend toward sustainable practices (MarketsandMarkets, 2021).

- **Economic benefits:** The circular economy is projected to increase the EU's GDP by 0.5% by 2030, creating over 700,000 jobs, particularly in recycling and remanufacturing (Ellen MacArthur Foundation, 2020).

- **Environmental impact:** Circular economy strategies aim to halve carbon emissions by 2030, reduce primary material consumption by 32%, and restore ecosystems and biodiversity, significantly benefiting the rubber value chain (Ellen MacArthur Foundation, 2021).

Existing Circular Model in the the Rubber Value Chain

TAKE

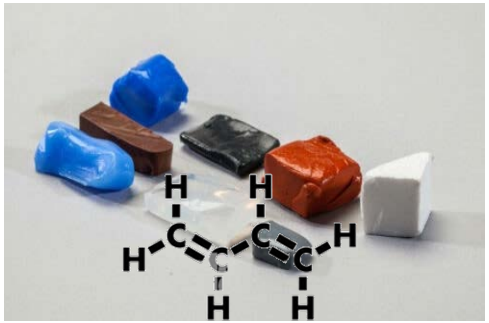
MAKE

DISPOSE

Existing Circular Model in the the Rubber Value Chain
- Mitigates the environmental impact of production by reducing demand

Natural Rubber

Deforestation



Synthetic Rubber

Industrial Pollution

Existing Circular Model in the the Rubber Value Chain
- Mitigates the environmental impact by reducing wastes

Rubber Products

Soil Pollution

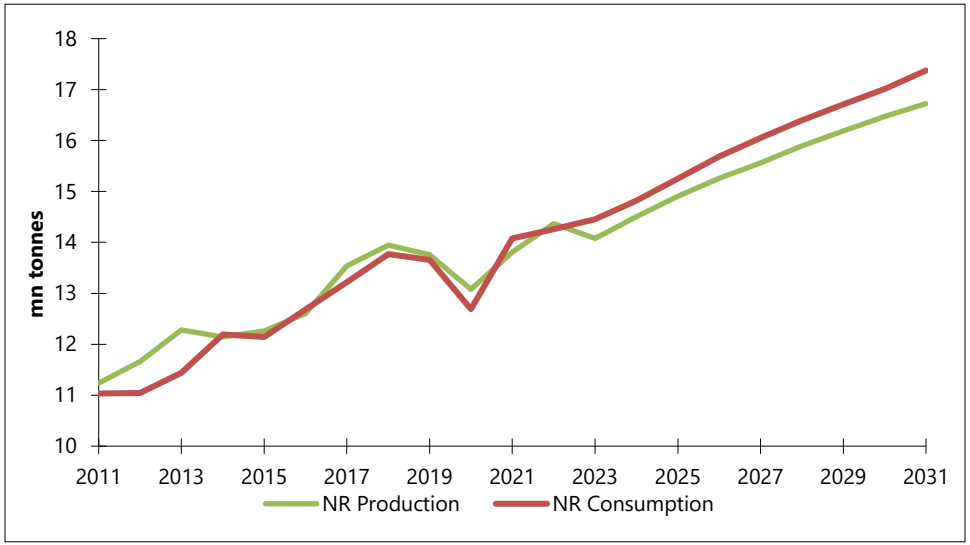
Air Pollution

Water Pollution

Environmental challenges of rubber wastes:
Globally, over 1.7 billion tires are produced annually, yet only 42% of end-of-life tires (ELTs) are recovered for material reuse, and 15% are used for energy recovery (Mongabay, 2024). The remaining volume of tires often ends up inadequately managed, posing significant environmental challenges, including land pollution and the need for extensive landfill space.

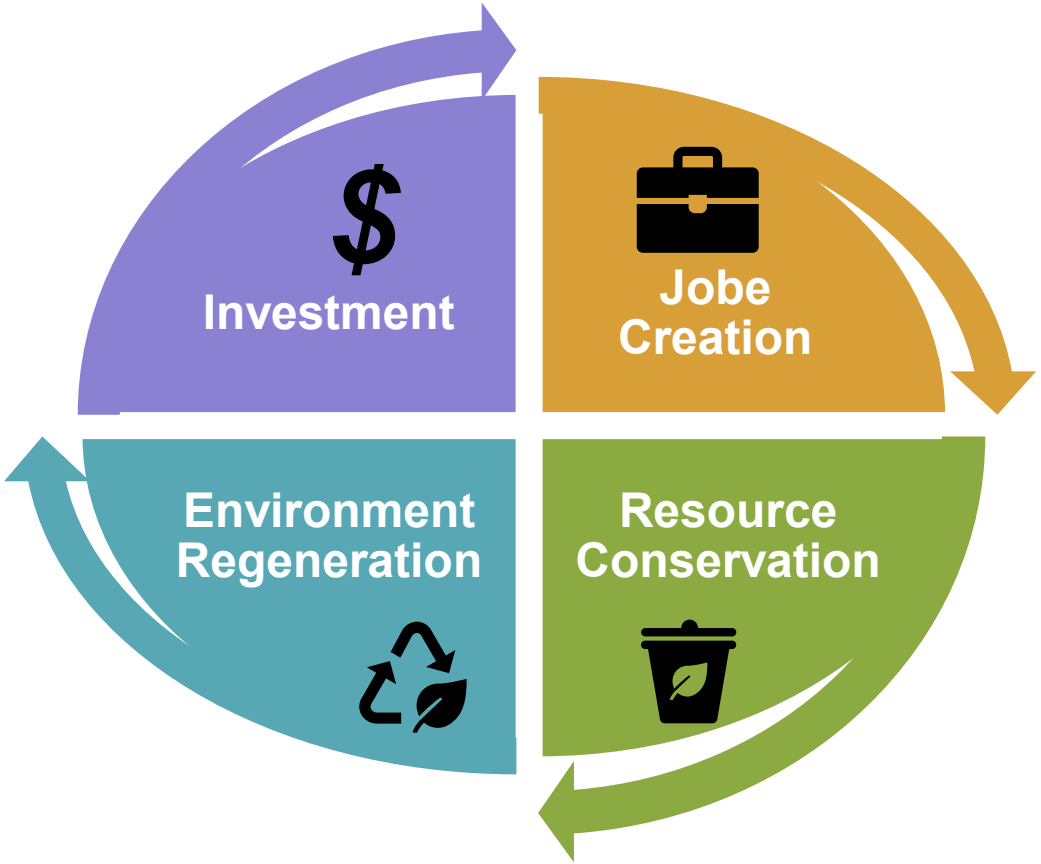
Existing Circular Model in the the Rubber Value Chain - Contributes to Supply-Demand Balance

- As forecasted by the IRSG, natural rubber consumption demand is expected to be 17.37 million tons by 2031, while production is 16.72 million tons.
- The supply-demand deficit will gradually increase to as large as 650 thousand tons by 2031.
- Circular economy curbs the growing demand of rubber consumption.



Natural Rubber Production and Consumption 2011-2031 (Source: IRSG Staff Calculations/Estimations; IRSG RSB Jan-Mar 2024)

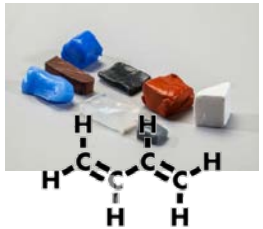
Existing Circular Model in the the Rubber Value Chain
- Adds value to the rubber value chain



Existing Circular Model in the the Rubber Value Chain - Resource Conservation

Production Cycle 1: Linear Model
Total Resource Required = x
Total Output = P

Natural Rubber



Synthetic Rubber

Resources = X

Output/Products = P

Dispose

Recycled/Reusable Products = R

New Resources

Output = P

Production Cycle 2: CE Model
Total Resource Required = X-R
Total Output = P

Existing Circular Model in the the Rubber Value Chain - Resource Conservation

Linear Model

Equation: **P=f(X)**
Waste Generation: **W=P−g(X)**

W=P−g(X)
where E(W)=αW
I=βW

P = X (100% new resources)

W=P
(all product output eventually becomes waste)

CE Model

Equation: **P=f(X−R)+R**

Waste Minimization: **W=P−g(R)**

Maxmization Resource Use =W≈0 and R=W=P−g(X)

$E_{benefit}(R)=\gamma R \mid B(R)=\delta R \mid R_{efficiency} = \frac{R}{X}$

Existing Circular Model in the the Rubber Value Chain
- The Economic and Environmental Impact of Circular Strategies

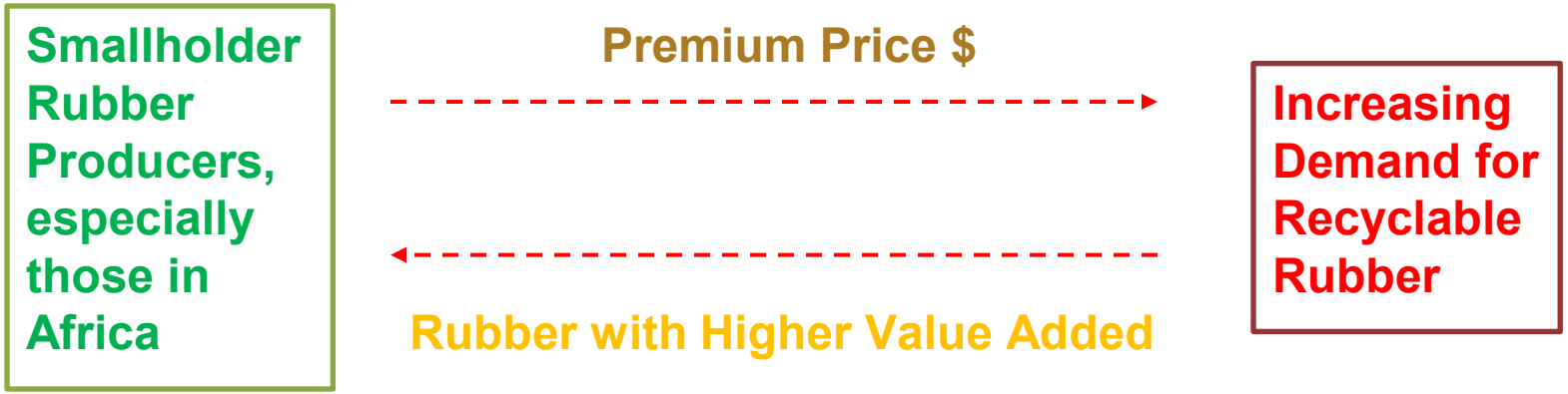
The global tire recycling market was **valued at $11.3 billion** in 2020 and is projected to grow at a compound annual growth rate **(CAGR) of 5.2%** through 2027, reaching approximately $16 billion by the end of the forecast period.

Tire retreading alone saves approximately **80% of the raw materials** needed to produce a new tire, leading to significant cost reductions for manufacturers, fleet operators, and consumers.

Research shows that tire retreading can **reduce CO2 emissions by 24%** compared to manufacturing new tires (Michelin Group, 2020). In addition, pyrolysis and devulcanization-key recycling processes-can **reduce** greenhouse gas **emissions by up to 80%** compared to traditional disposal methods like landfilling or incineration (European Commission, 2021).

Recycled rubber in infrastructure projects can **lower construction costs-by** up to **30%-**while enhancing road durability and reducing maintenance expenses.

Existing Circular Model in the the Rubber Value Chain
- Job creation and livelihood of rubber producers



Existing Practices of Circular Economy for the Rubber Sector

Circular Economy as one of the strategic pillars of IRSG

Key implementation strategies to achieve circular economy objectives

- **The Sustainability and Circular Economy Initiatives to encourage the adoption of sustainable and environmentally responsible practices in the rubber value chain.**

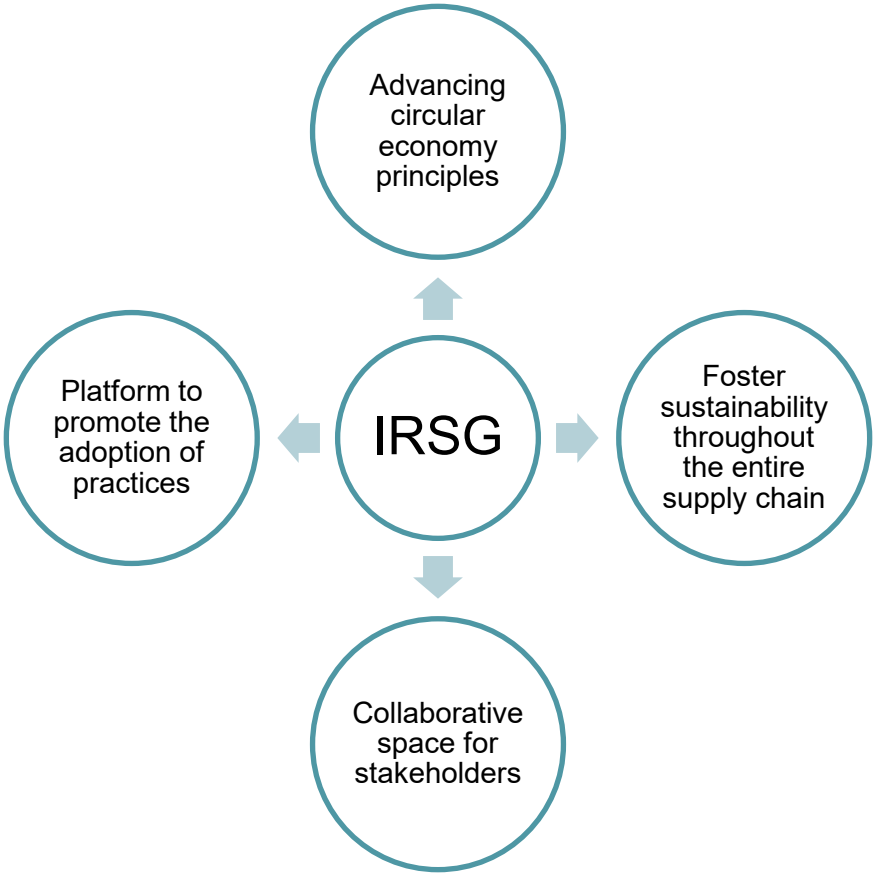
PROMOTING CIRCULAR ECONOMY PRINCIPLES

FORMULATING STRATEGIC PARTNERSHIPS

EDUCATIONAL AND POLICY INITIATIVES

IMPLEMENTING SUSTAINABILITY REPORTING AND BENCHMARKING

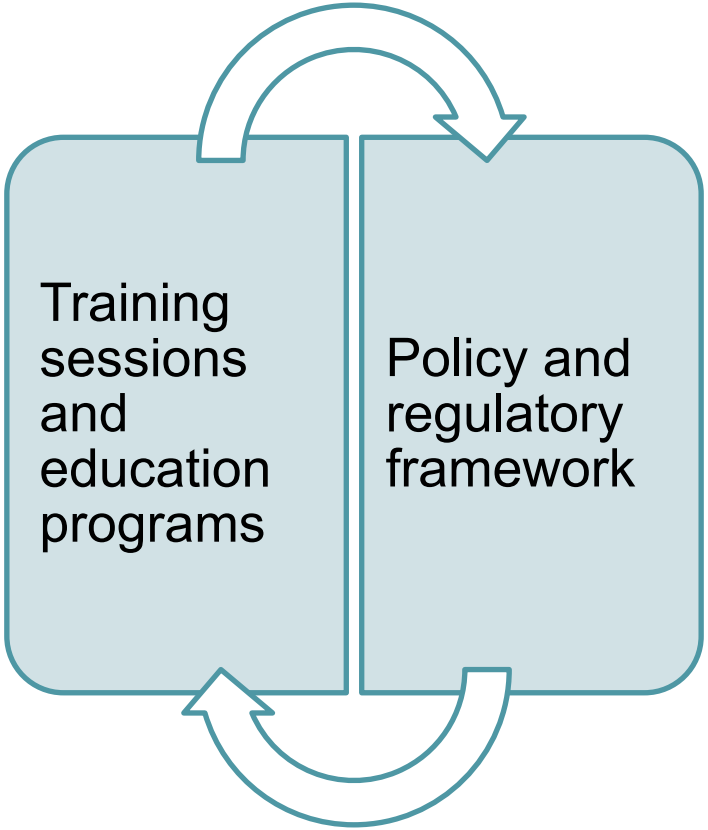
Key implementation strategies to achieve circular economy objectives: Promoting Circular Economy Principles



- **The advancement of circular economy principles within the rubber industry.**
- **Create a specialized platform that promotes the widespread adoption of circular practices.**
- **Foster sustainability throughout the entire rubber supply chain.**
- **Serve as a collaborative space for stakeholders.**

Key implementation strategies to achieve circular economy objectives: Formulating Strategic Partnerships

Key implementation strategies to achieve circular economy objectives: Educational and Policy Initiatives



- **Training sessions and educational programs highlighting the advantages of adopting circular economy principles to influence both industry stakeholders and policymakers.**
- **Forward-looking policies encourage greater awareness of circular economy; educational efforts equip stakeholders with the knowledge and contribute to policy reforms and sustainability initiatives.**

Key implementation strategies to achieve circular economy objectives: Implementing Sustainability Reporting and Benchmarking

- The purpose is to enhance transparency and accountability in circular economy for the world rubber industry.

IRSG as a Platform to Catalyze Rubber Circular Economy

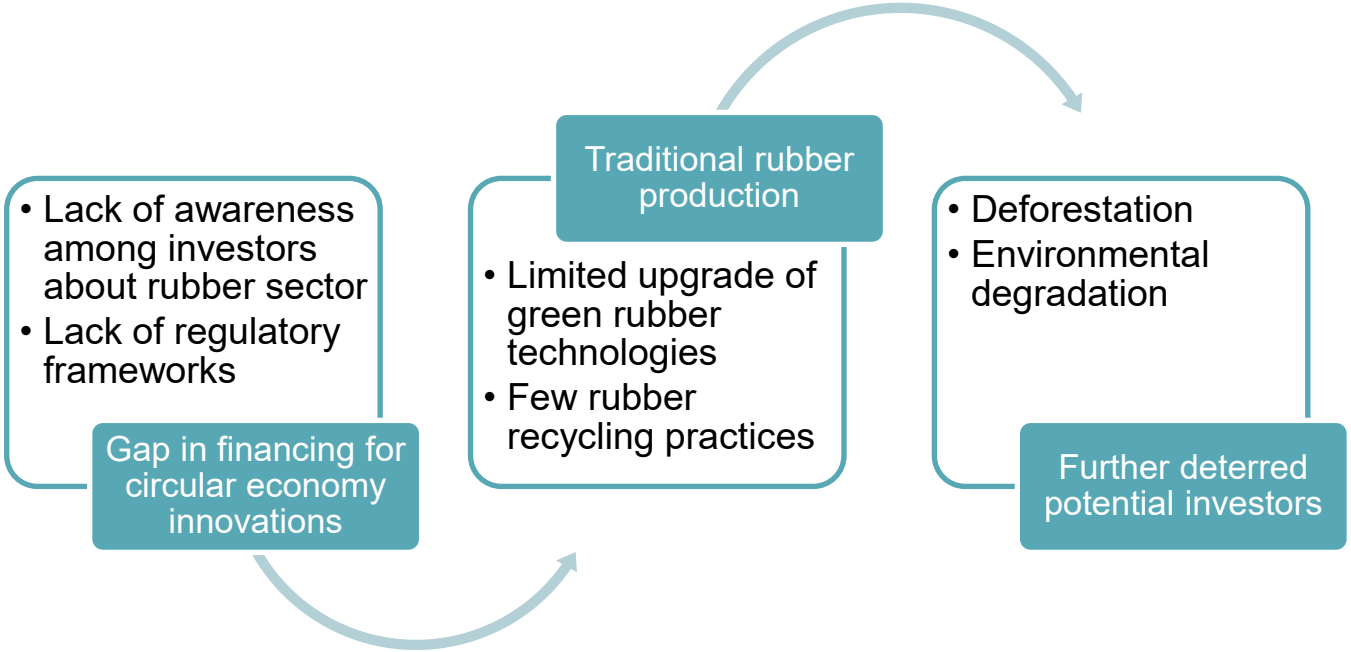
- Investment is important to catalyzing technological innovations of circular economy for the rubber value chain.

Investors may find it difficult to assess investment opportunities in markets they are not familiar with

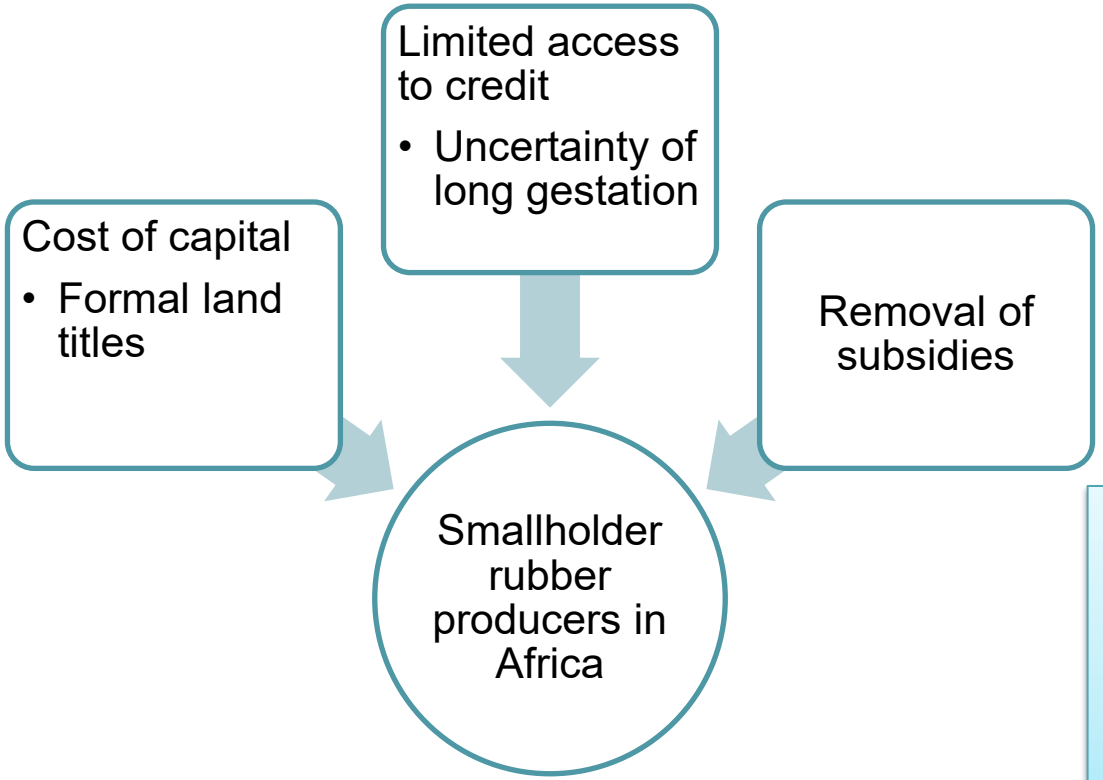
International Rubber Study Group

Entrepreneurs simply may lack the connections to find investment or may be unsure of what investors look for in a business plan.

Financial constraints faced by rubber producers

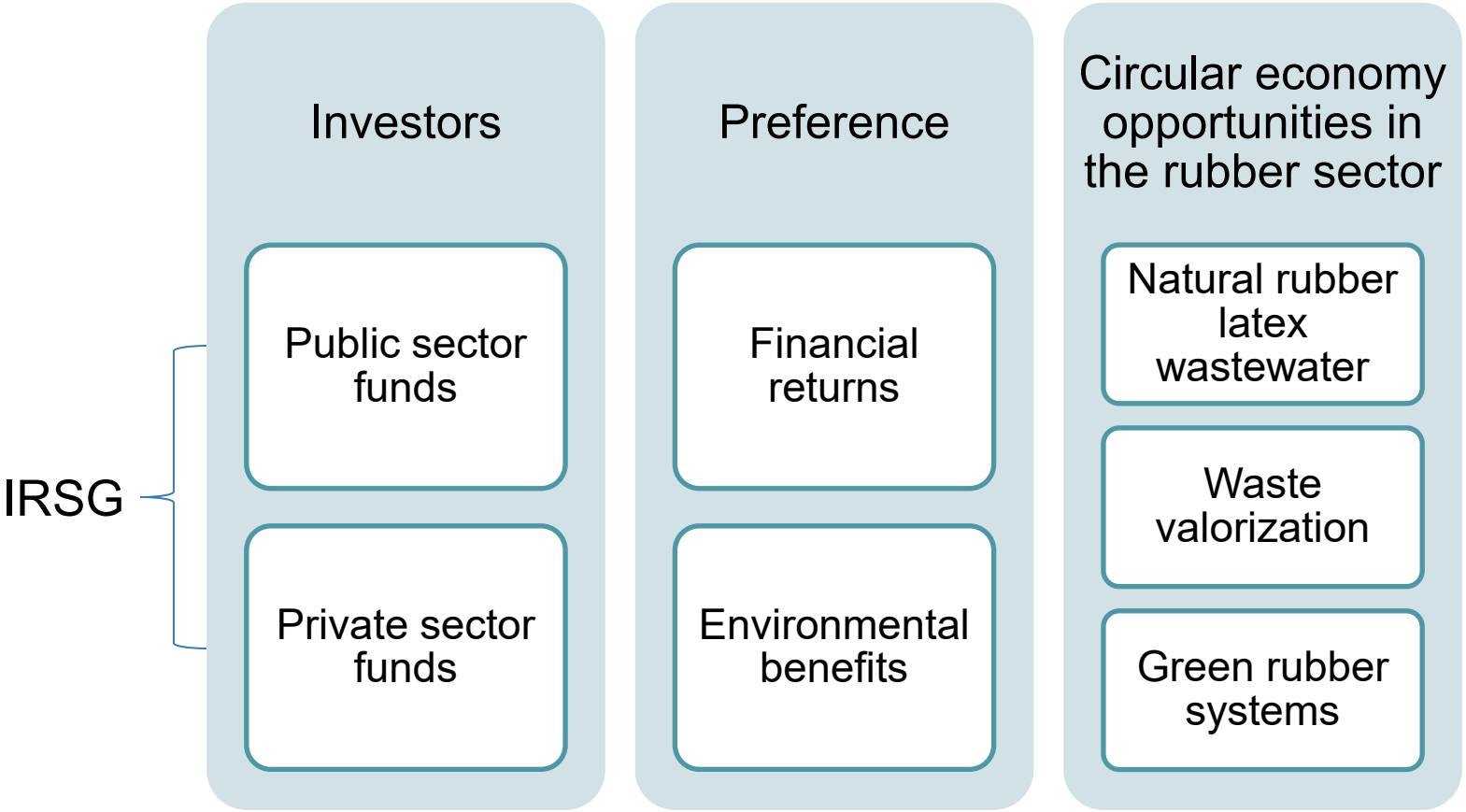


Financial constraints faced by smallholders in Africa



These financial constraints not only limit the expansion of rubber farming, but also discourage natural rubber entrepreneurs from upgrading value chain, including green and recyclable rubber.

Investors and entrepreneurs looking for opportunities



The IRSG Rubber Investment Promotion Programs

Intermediate

- The IRSG Rubber Investment Promotion Programs plays a pivotal role in bridging the gap between entrepreneurs and investors.

Knowledge Hub

- The IRSG Rubber Investment Promotion Programs equip entrepreneurs with the tools and knowledge needed to present their business ideas in a way that resonates with potential investors, using language and metrics that align with investor expectations.

Advisor

- The IRSG helps investors identify and evaluate promising businesses, guiding them to recognize the potential for growth and return on investment in the rubber industry.

Service provider

- the program focuses on creating opportunities for both small-scale startups and established businesses, offering support in areas like financial literacy, market access, and scalability.

Key takeaways

What is Circular Economy

- Circular economy is new mode of economy that transforms tradition linear "cradle-to-grave" model to a "cradle-to-cradle" system, where resources and materials are recycled and reused to the maximum degree.

Why Circular Economy

- Circular economy contributes to sustainable development of value chains by curbing the growing demand for resources and by reducing the wastes.
- Adopting circular economy techniques to increase the sustainability and thus to add value to rubber production is crucial to the livelihood of smallholder producers.

How to Strengthen Circular in the Rubber Value Chain

- The IRSG has been committed to position itself as the circular economy and sustainability hub the world rubber economy.
- The IRSG will work together with all stakeholders in the international rubber value chain to boosts investment into sustainability issues including rubber circular economy, for developing countries pursuing trade and value-addition strategies.

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