

“Sustainability - Circular & Green Economy Challenges and Opportunities for Tyre & Rubber Industry”

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Abstract

Over the past decade, the concept of a “green economy” has moved into the mainstream of policy discourses across the world. A green economy takes care of human well-being, social equity and reducing environmental impacts. Therefore, transitioning to a green economy has sound economic and social justification. There is a strong case for governments as well as the private sector to engage in this economic transformation. For governments, this transition would involve levelling the playing field for greener products by replacing harmful subsidies, reforming policies, redirecting public investment etc. In private sector, this transition would involve responding to these policy reforms and incentives through increased financing and investment, skill building and innovation capacities to take advantage of opportunities arising from a green economy.

The general perception among the people at large about the manufacturing industry, in particular Tyre & Rubber industry is that they are not environmental friendly, energy inefficient, use non-renewable resources etc. To change this perception tyre & rubber industry has to work towards sustainability, circular & green economy through development of green technology, green manufacturing including Resource decoupling - using less land, water, energy & materials to maintain economic growth and to reduce environmental impact.

Introduction

Economies today have two major challenges: The need to create a sustainable growth oriented economy, and the need to be competitive in the global market. It is well known that our current industrial society is on a path of “unsustainable” growth. The industrial revolution was an important step forward when the Earth housed only 1.0 billion people. But today, with more than 7.0 billion based on fossil fuels, unbridled consumption and throwaway products is just not sustainable. Furthermore, a “no growth” scenario is just not a realistic one when running a business or leading a country. If living standards of the people at the bottom of the pyramid (presently 5.0 billion) is to improve along side population growth (expected total world population 10 billion by 2050), it will be done at the cost of our mother planet with the present “unsustainable” growth approach dependant on crude based economic model. So, the solution must be “sustainable” growth through **Circular & Green Economy**.

In a future oriented approach, the United Nations (UN) as a neutral body with the set goal of balancing the needs of mankind, defined 17 sustainable Development Goals (SDGs) in September 2015. Based on the principle of “nobody left behind”, the UN agenda constitutes a holistic approach to achieving a sustainable future for all. The SDGs provides us with a frame work which should enable society to translate global needs and ambitions into solutions. Simultaneously, the agenda points out distinct **megatrends** for industry and society, which will also directly influence the rubber & tyre industry.

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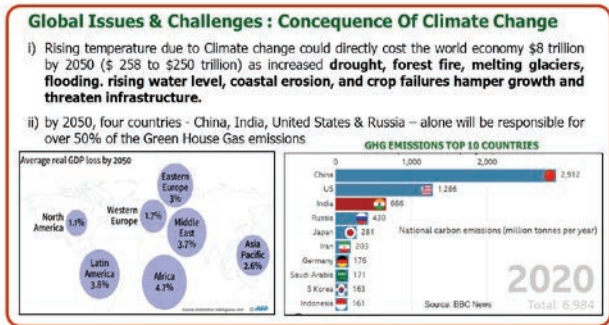
• M.Sc. in Applied Chemistry from IIT Kharagpur • Ph.D in High Polymer & Rubber Technology from IIT Kharagpur • Bachelor of Chemical Engineering (AMIE) from The Institution of Engineers (India)

48+ years experience in education, training, applied research & technical service – Rubber Science & Technology, Rubber Chemicals and Lead Assessor different Quality Management Systems.



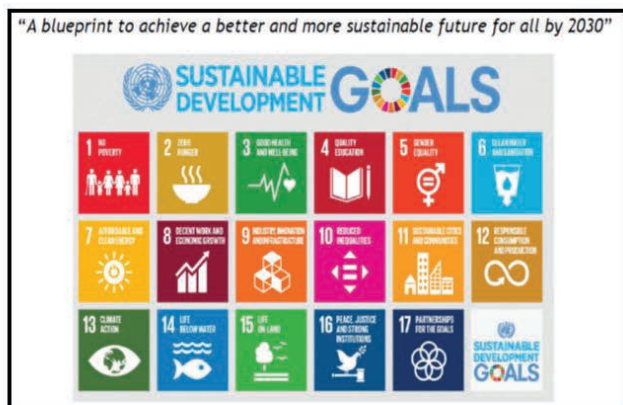
Megatrends for Industry and Society:

- Urbanisation
- Growing (and aging population)
- Potable water



UN's Sustainable Development Goals (SDG)

- The Sustainable Development Goals (SDG) were adopted by all United Nations member states in September, 2015 as a universal call on the principle of "*nobody left behind*"
- This is holistic approach to achieving a sustainable future for all.
- SDGs provide framework which should enable society to translate global needs and ambitions into solutions.
- It also points out distinct megatrends for industry and society, which will also directly influence the rubber industry.
- Tyre Industry selected eight SDGs as priorities and where the sector can have the highest impacts :



3 – Good Health & Well being	4 – Quality Education
5 – Gender Equality	6 – Clean Water & Sanitation
8 – Decent work and Economic Growth	9 – Industry Innovation & Infrastructure
10 – Reduce Inequalities	12 – Responsible consumption & Production

Linear

Economy & Green Economy

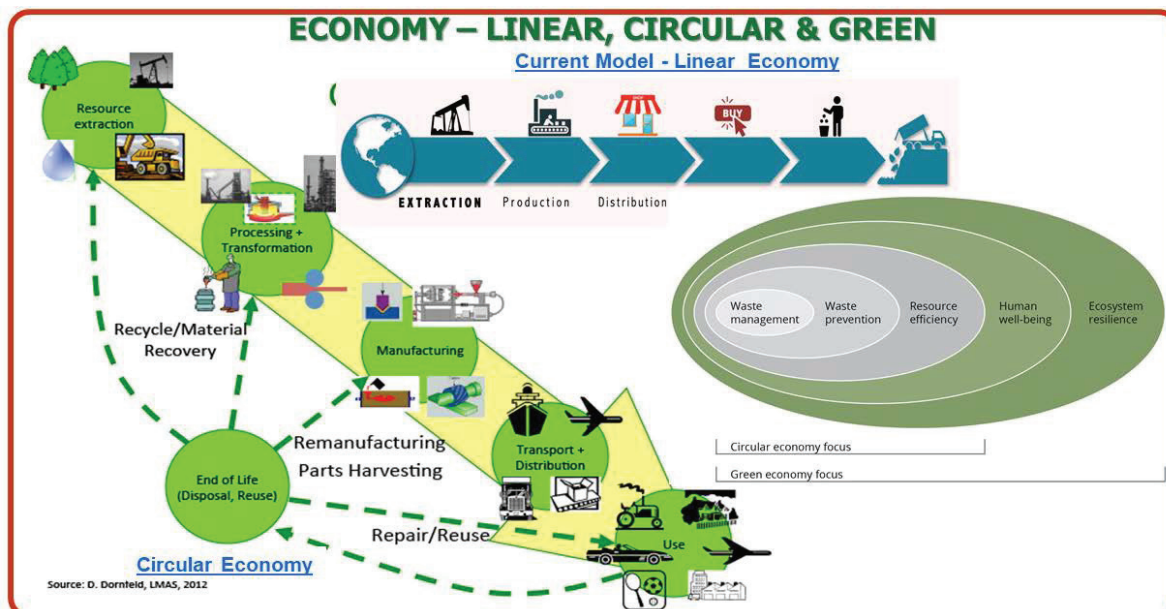
Linear Economy – Take, Make, Use and dispose model of production.

Shared Economy – It is a socio economic system built around sharing of resources. Eg. Free lancing platforms, co-work spare, peer to peer lending, fashion platform etc.

Circular Economy – It is a regenerative development strategy for economic growth that focus on restoration,

waste through superior design of materials, product, systems and business model.

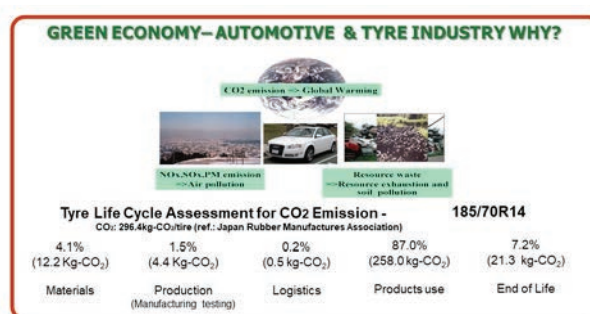
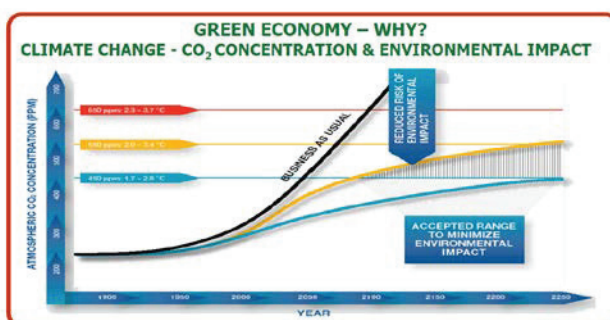
Green Economy –It is an interconnected economic activity that promote global scale sustainable development, poverty eradication, environmental protection and eco efficiency and low carbon development. It results in increased human well-being and social equality, while significantly reducing environmental risks and ecological scarcities.



Environmental Risks	Ecological Scarcities
Failure to Adapt to Climate Change	Less or no provision of ecosystem services which include:
Incurable Pollution	• Food, Water,
Land and water mismanagement	• Raw material,
Mismanaged Urbanisation	• Genetic Resources (Pollination)
Rising Greenhouse Gas emissions etc.	• Energy, Minerals, Medicinal resources etc.

Sustainability – Circular & Green Economy Why?

- Initiative born out of multiple crises and accelerating resource scarcity (limited resources – infinite demand).
- An economic vehicle for sustainable development
- Can take advantage of new growth trajectories designed to be more socially inclusive, as well as responsive to poverty reduction and economic diversification objectives
- A new economic paradigm that can drive growth of income and jobs, without creating environmental risks



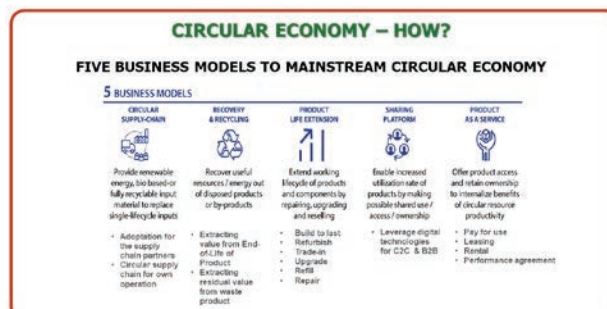
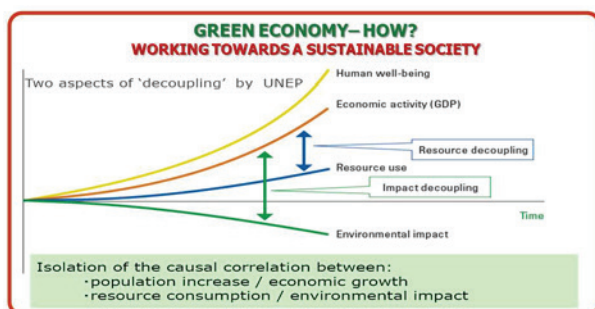
Sustainability – Circular & Green Economy How?

The remarkable economic and population growth of the 20th century was closely coupled to substantial increase in the extraction and consumption of natural resources, leading to increasingly damaging negative environmental impact. However, economic growth globally was faster

than the growth of rate of consumption of natural resources and some negative environment impact have been reduced. It appears that some dematerialisation of the world economy has occurred spontaneously. Accelerating the process of decoupling economic activity from consumption and environmental impact is fundamental to future human well-being. Transition

from present crude based economy to green economy is possible only through Decoupling of natural resources

used and environmental impact from economic growth.



Challenges – Circular Economy

- Achievability of the concept of the Circular Economy
- Desirability for businesses on circular economy objective
- Collection and centralization of the end-of-life products for processing in an economical fashion
- Use of 100% renewable energy as per circular economy objective in contradiction related to resource efficiency
- Addressing social dimension & sustainability as per the frame work of circular economy.
- Without disturbing existing economic activities, deployment of circular economy both at national and international level.

Opportunities of Sustainability – Circular & Green Economy

- Can reduce poverty and inequality. Inextricable link between poverty alleviation and wise management of natural resources and ecosystems
- Ecosystem services provide 47% to 90% of the so-called 'GDP of the poor'
- Common interest between developed and developing countries
- Partnership of policymakers and business community
- Crucial to prioritize spending in sectors that can simultaneously promote social, economic and environmental gains



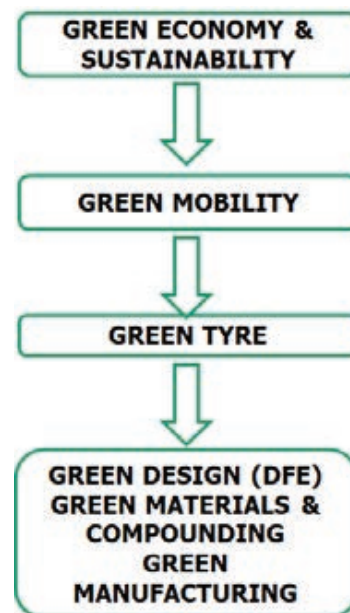
Circular & Green Economy – Drivers & Challenges for Tyre & Rubber Industry

Drivers:

- Sustainability & Green Mobility
- Legislations & Regulations (Tyre Labeling)

Challenges:

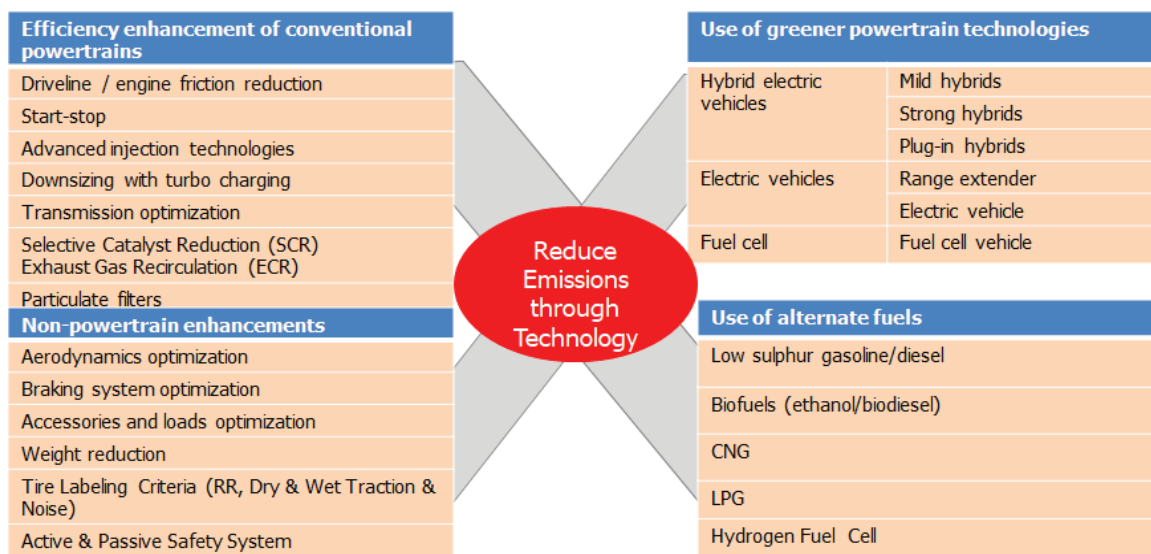
- Technology Innovation Challenge
- Real-time Simulation & Tyre Testing
- Multiscale Simulation Technology
- Material & Product Complexity Challenge
- Green Material/Manufacturing
- Smart Manufacturing - INDUSTRY 4.0
- Manufacturing Implementation Challenge
- Supply Chain Management



Sustainability – Green Mobility Approach

- **Technology Selection & Strategy** : Sustainable Technology works closely with organisations to select and implement the most appropriate vehicle technologies within the context of a long term technology strategy.
- **Low Emission Technologies**: Sustainable Transport advises on vehicle technologies that reduce CO₂ and air quality emissions from road transport including biogas, hybrid and plug-in electric vehicles
- **Carbon & Air Quality management**: Sustainable transport audits transport emissions and helps with identification and implementation of appropriate abatement technologies and behavioural change measures
- **Green Fleet management**: Sustainable Technology helps organisations measure and reduce the environmental impact of their fleet operations and employee business travel including grey fleet issues

Green Mobility – Technology Trends for Emission Reduction



Sustainability –Technology Innovation Challenges

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Mega Trends for Automobile & Tyre Industry

- Sustainable tyre and green material technology [further improvement in RR (Rolling Resistance), safety, durability and NVH (Noise, Vibration and Handling)].
 - Rubber material from bio-mass
 - Completely recyclable tyre, reversible cross linking system
- Greater use of modelling in performance prediction and tyre design
- Real time simulation & Tyre testing
- Application of sensor technology to development of intelligent tyres. In particular use for data collection

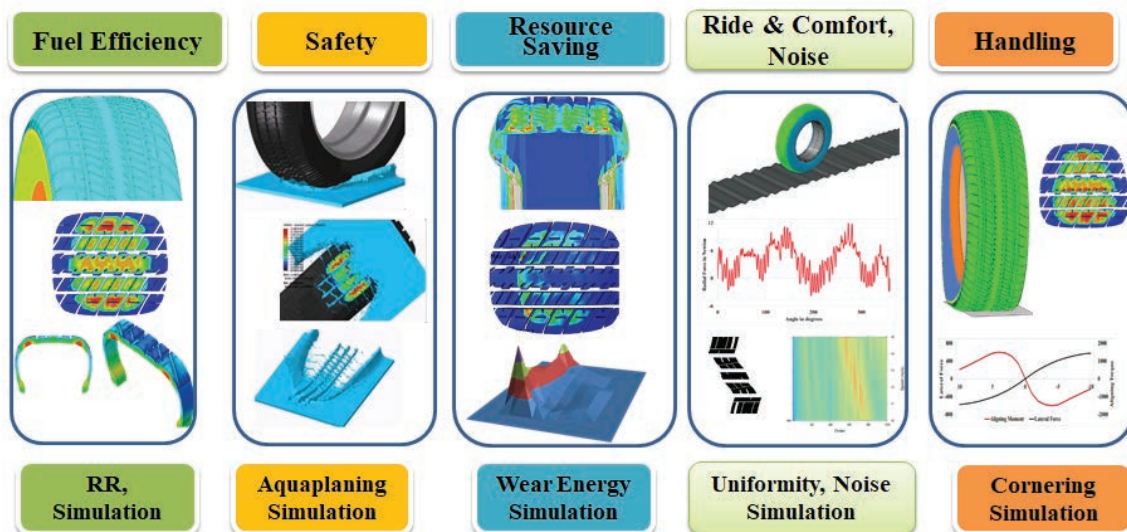
Sustainability - Role of Simulation in Tyre Development

Uses of Simulation & predictive technology, Finite Element Analysis (FEA), service life prediction etc. will improve in determining the reliability aspect of tyre. With the advent of high end software, FEA tools are now extensively used for prediction of structural durability,

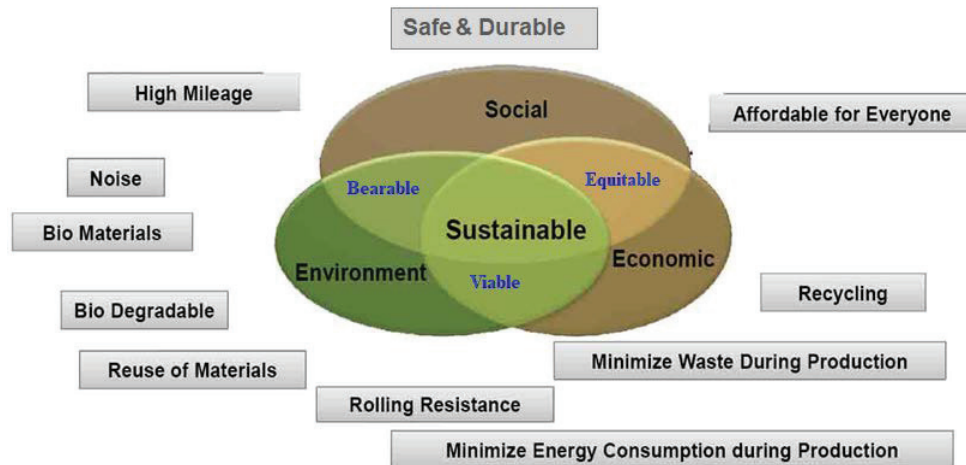
and logging to help with fleet maintenance

- Autonomous Electrical vehicle
 - change in tyre design to tall and thin tires, especially to suit EV
 - Temperature and Wear Rate for Autonomous Vehicles
 - Electrified Rubber with real time monitoring and to respond to road conditions
- Weight reduction technology (tyre) to the extent of 50% by 2050 without sacrificing performance
- Virtual proven ground
- Self-Inflation Technology (SIT)
- Future tyre may generate Electricity
- Non Pneumatic tyre
- Smart Manufacturing (Industry 4.0)

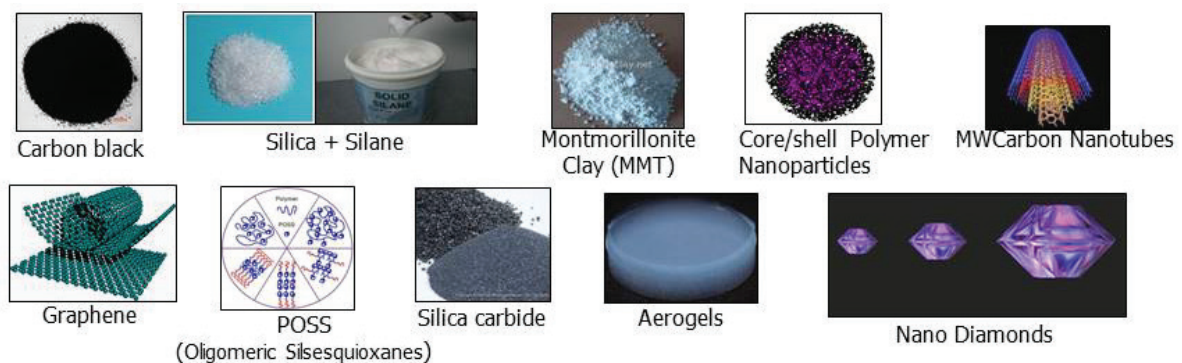
aquaplaning, heat generation, process simulation and NVH. Advanced research is in progress to understand the microscopic behavior of polymer-filler interaction using new generation simulation techniques. This in turn will help to develop ultra high performance tyres with reduced hysteresis and improved safety and durability.



Sustainability - Tyre Industry



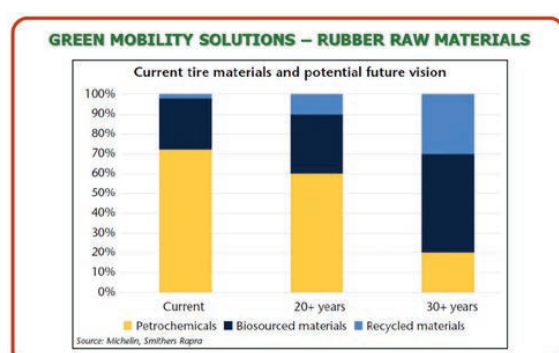
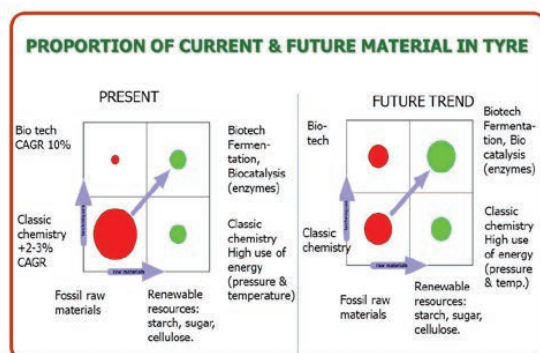
Sustainability – Rubber Material Development Trend



- S-SBR modified with different coupling agent/functionalised.
- Rubbers containing functional groups over the entire length of the backbone.
- Tailor made polymer
- Magneto-rheological elastomers
- Nano Structure Carbon black, Functionalised Carbon Black, Latex Carbon Black Master Batch, Carbon Black from Bio-mass
- Corn Powder/starch as filler material
- Highly dispersible silica with environment friendly silane coupling agent.
- Based on the principle of bionics natural materials are under investigation. To name a few are Natural Silica, Nano clay, Nano

Calcium Carbonate, Montmorillonite Clays, Carbon Nano Fibers, Polyhedral Oligomeric Silsesquioxanes, Carbon Nano Tubes & Graphene.

- Adaptive Material - Tyre properties may adjust to service conditions using “smart” materials
- Fibres/cords :Aramids, Cellulosics, Hybrid cords, Steel
- Process oils: Natural sources (soya, corn, sunflower, palm, neem, castor oil, orange peel)
- Inner Liners - Less permeable polymers/composites, Lighter weight & Elimination
- Stabilisers – REACH Compliance
- Cure systems - reversion resistance, elimination of zinc



Intelligent / Smart Materials for Auto & Rubber Industry - EV

- Self healing materials
- Coatings
- Memory Materials
- New E conductive materials
- Materials for energy storage
- Electro responsive materials
- Solar Materials

Sustainability – Tyre Industry (Design/Construction/Manufacturing Trend)

Design

Modelling, FEA, Rapid prototyping & 3-D printing

Construction

Low weight, Solid (or non-pneumatic), Wheel/tire in one (e.g. Tweel), Taller/thinner, Integrated with wheel assembly, Smart & Intelligent, Adaptive, New tread patterns and Run flat etc.

Manufacturing Trend

Manufacturing technology is also becoming more sophisticated in their integration of complex electronic control system with precision engineering thus paving the way for vast improvement in efficiency of manufacturing process and quality of the product. Limits of variations are getting tightened & constancy of geometrical dimensions are becoming regular feature. This also will add in manufacturing (& thereby total) cost reduction which is essential for survival in today's fiercely competitive market. Latest development

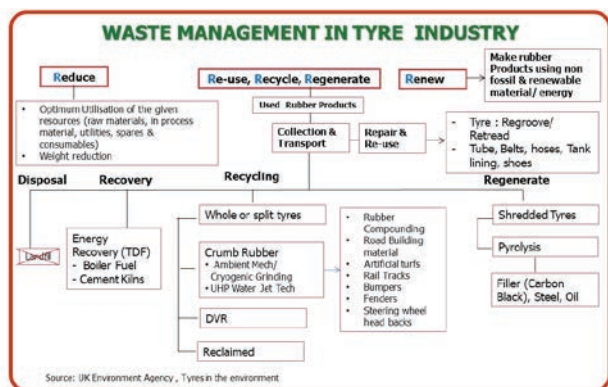
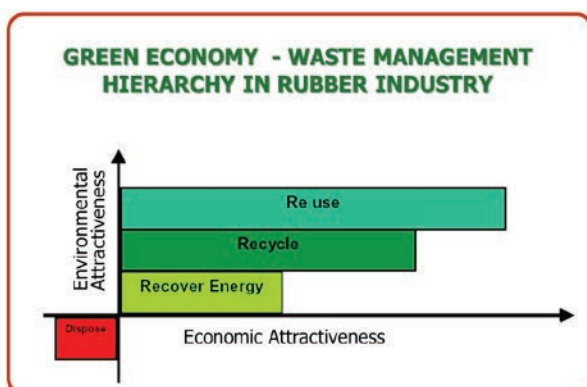
in Banbury mixers (e.g. Tandem mixing), calenders, extruders (quadriplex/pentaplex), tyre building (single stage nearly fully automatic radial tyre building machine), curing (segmented mould etc.) will improve **productivity, quality and performance** while **reducing the cost, waste and scrap**.

Besides this, the automotive & tyre industry is gradually updating their technology and manufacturing practices in line with **New trends in technologies & Manufacturing** like Advanced mixing technologies, Liquid Phase mixing, Low energy/water consumption, Renewable energy, Zero Waste, zero discharge etc. In line with Automobile industry, Tyre Industry is also looking into possibilities of implementing Smart Manufacturing **Practices** (Industry 4.0): Big Data-driven Quality Control, Robot assisted Production, Self Driving Logistics Vehicle, Production Line Simulation, Smart Supply Network, Predictive Maintenance, Machine as a Service, Self Organizing Production, Additive Manufacturing of Complex Parts, Augmented work, Maintenance & Service, etc.

Sustainability - Circular Economy – Waste Management Hierarchy in Tyre Industry

The core principles of the green circular economy are applied by tyre industry through “5R” Strategy i.e. **Reduce, Reuse, Recycle, Regenerate & Renew**.

Over and above our world is increasingly conscious of the need for a recycling society, extending the useful life of limited resources, as far as possible. Disposal of scrap tyres is ascending in the priority list of issues owing to increased awareness for environmental issues and wide publicity.



Sustainability - Design for Environment (DFE)

All Future R&D initiatives in tyre & rubber industry will be concentrated on Design for Environment (DFE).

- **New Concept Development** - Dematerialisation, Shared used of the product, Integration of functions, Functional optimisation of products & components

- **Selection of low impact materials** - Non-hazardous materials, Non-exhaustable materials, Low energy content materials, Recycled materials, Recyclable materials
- **Reduction of material** - Reduction in weight, Reduction in volume

- **Optimization of production techniques** - Fewer production processes, Low/clean energy consumption, Low generation of waste, Few/clean production consumables
- **Efficient distribution system** - Less/clean packaging, Efficient transport mode, Efficient logistics
- **Reduction of the environmental impact in the user stage** - Low energy consumption, Clean energy source, Few consumables needed during use, Clean consumables during use, No energy/auxiliary material use
- **Optimization of initial life time** - Reliability and durability, Easy maintenance and repair, Modular product structure, Classic design, User taking care of product
- **Optimization of end-of-life system** - Reuse of product, Re-mfg./refurbishing, Recycling of materials, Clean incineration

Sustainability – Incorporating Climate action in Business Plan

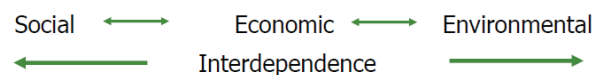
- Participate in Climate change mitigation
 - Carbon footprint (organisation, project or product) to identify hotspots
 - Set achievable reduction targets
 - Stagger mitigation initiatives
 - Consider viability of generating or taking up certified emission reduction (CER) units
- Prepare for Impacts of Climate change
 - Risk Assessment
 - Vulnerability assessment
 - Threshold analysis
 - Adaptation planning
 - Timely implementation
- Communicate to differentiate
 - Sustainability Reporting
 - Organisational or product carbon footprint label
 - Mass Media esp. Digital marketing through the social network

Conclusion

- As vehicles are one of the main source of air pollution responsible for poor urban air quality, suitable measures should be taken by all

concerned to build a green sustainable future through Green Economy.

- The challenge today is to sustain and further improve the air quality gains even as the city is growing and motorising rapidly. This is possible if strategic use of natural gas, electric power and renewable energy can increase along with aggressive clean up of all main stream fuels and technologies to cut toxic emissions (GHG) at source.
- Challenge to Zero-nize on environmental impact, fuel consumption, input cost & energy and the effort to Maxi-mize on safety, reliability, durability, handling, comfort and operational efficiency to continue.
- A change of thinking and a change of culture is needed for pursuing green economy in rubber industry



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