Potential Areas of Research in the Rubber Glove Industry

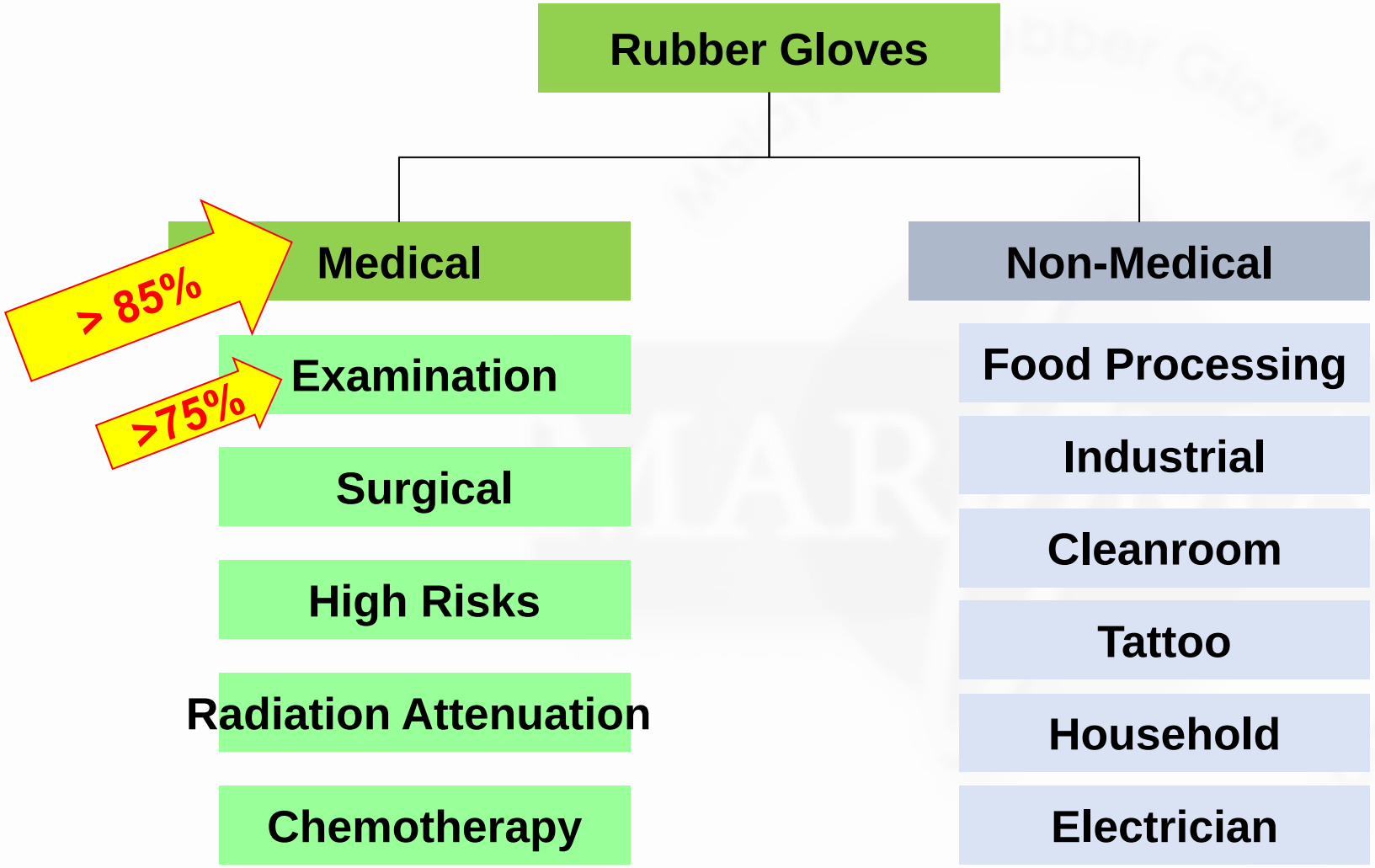
GLOBAL FUNDING for RUBBER INNOVATION

Dr Supramaniam S. Shanmugam
President
Malaysian Rubber Glove Manufacturers Association

Malaysian Rubber Glove Manufacturers Association

Rubber Gloves Categories

Categorize by Applications



Hospital Acquired Infection (HAI) Numbers……

- At any point in time, >1.4 million people are suffering from complications of HAIs globally
- HAIs: one of leading causes of death globally
- Developing Countries HAIs can exceed 25%; with intensive (ICUs) care units at >65%

Categorize by Types of Latex as Feedstock

Rubber Gloves

One-Third

Natural Rubber

Hevea Brasiliensis

R&D On-going

Guayule

Kazakh Dandelion

Eucommia ulmoides (杜仲)

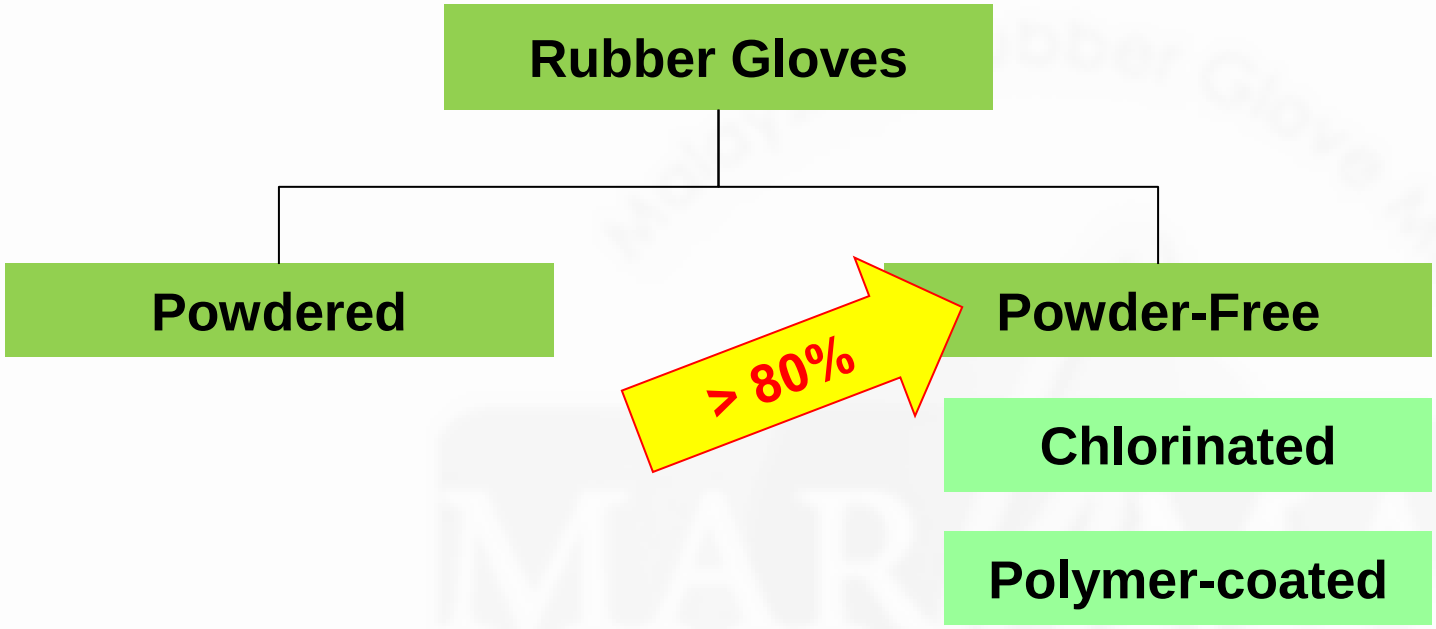
…and other plant sources of rubber.

Two-Thirds

Synthetic Rubber

- **Nitrile (NBR)**
- **Cast Polyethylene (CPE)**
- **Vinyl (PVC)**
- **Neoprene**
- **Polyisoprene**
- **Polyurethane**

Categorize by Surface Treatment Process



Moisturizer coated

Aloe vera coated

Anti-microbial

Malaysian Rubber Glove Manufacturers Association

The Big Picture

Malaysia is the World's Number One Rubber Gloves Producing Nation

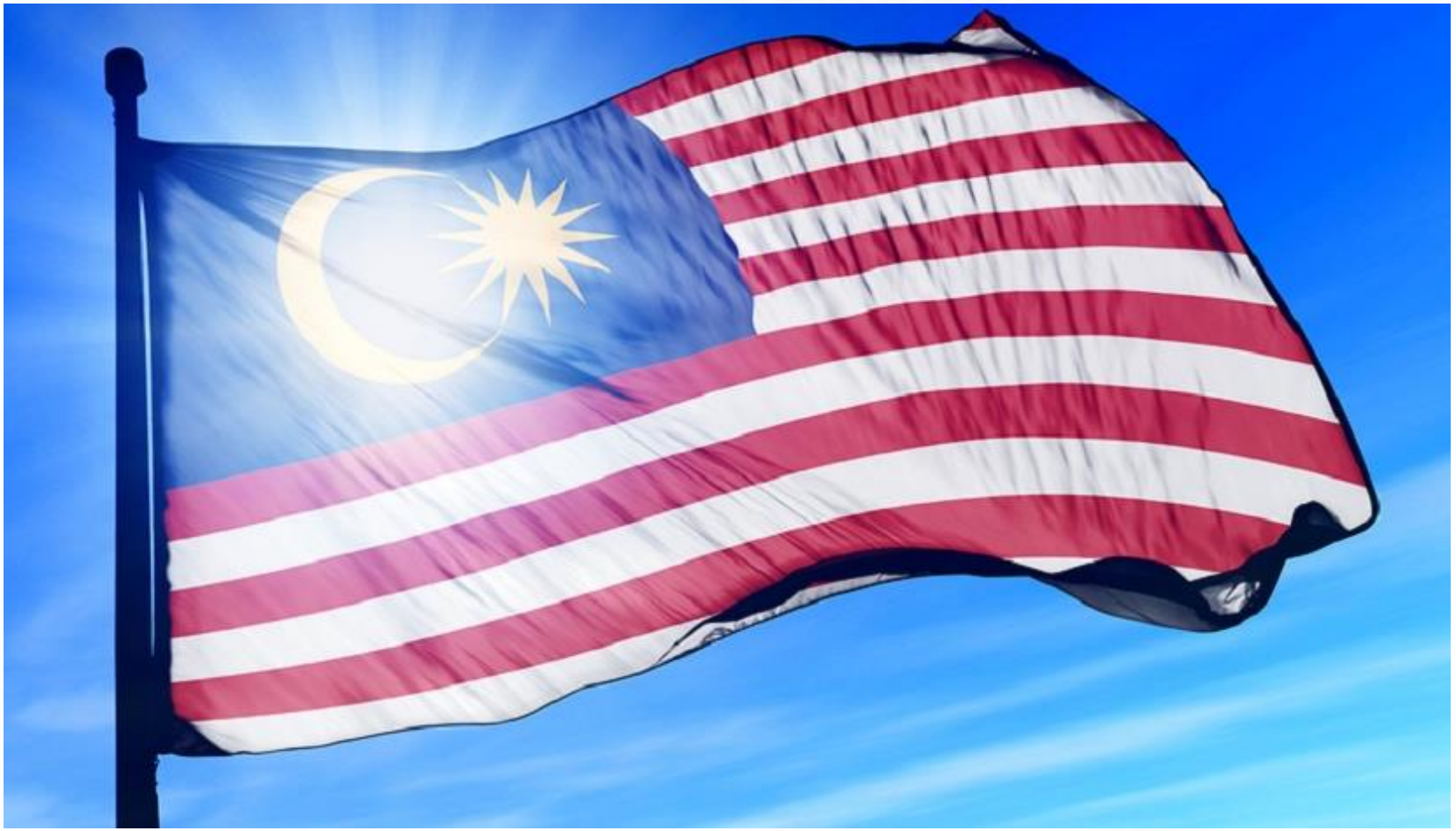


Image credit: http://www.therakyatpost.com/

The Managed Growth

The industry has grown aggressively in the past 25 years and Malaysian companies had developed the technologies required to build state of the art manufacturing facilities with advanced automation in the last decade.

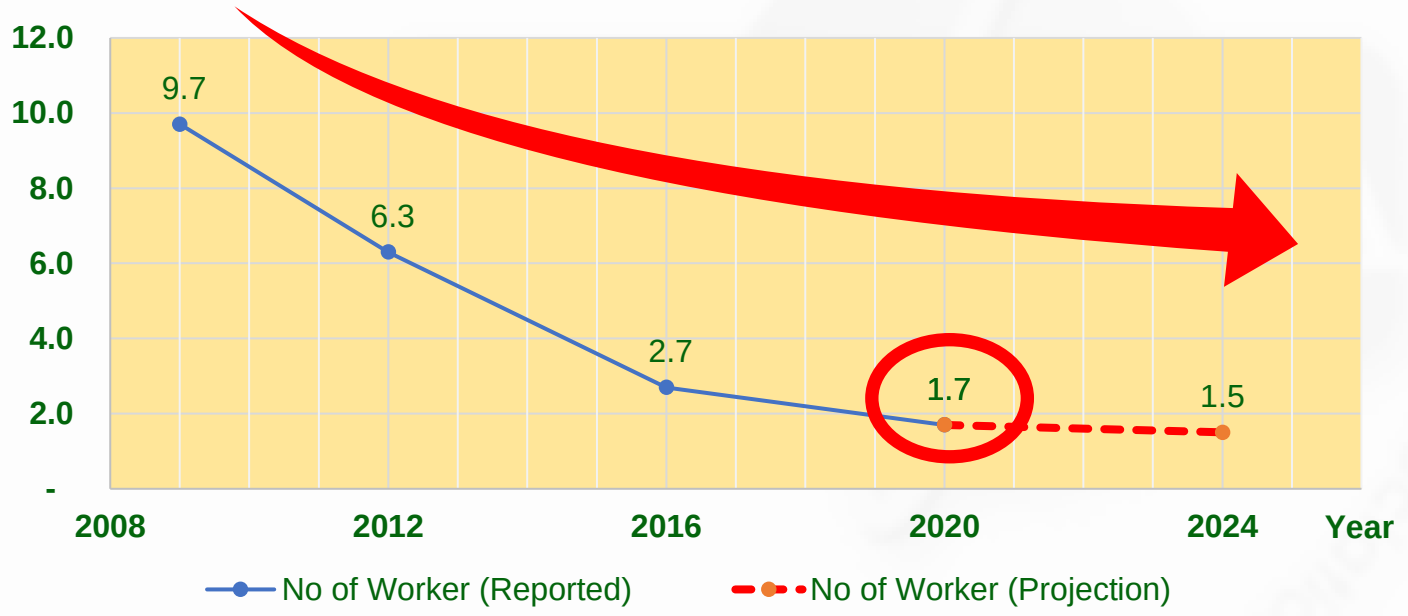
Modern Factory in 2010s

- **Passion**
- **Determination**
- **Entrepreneurial Spirit**

had nurtured our growth for more than three decades.

Increased Productivity in Gloves Manufacturing

Modernization and automation lead to quantum leaps in productivity in some of the **MOST ADVANCED** factories.

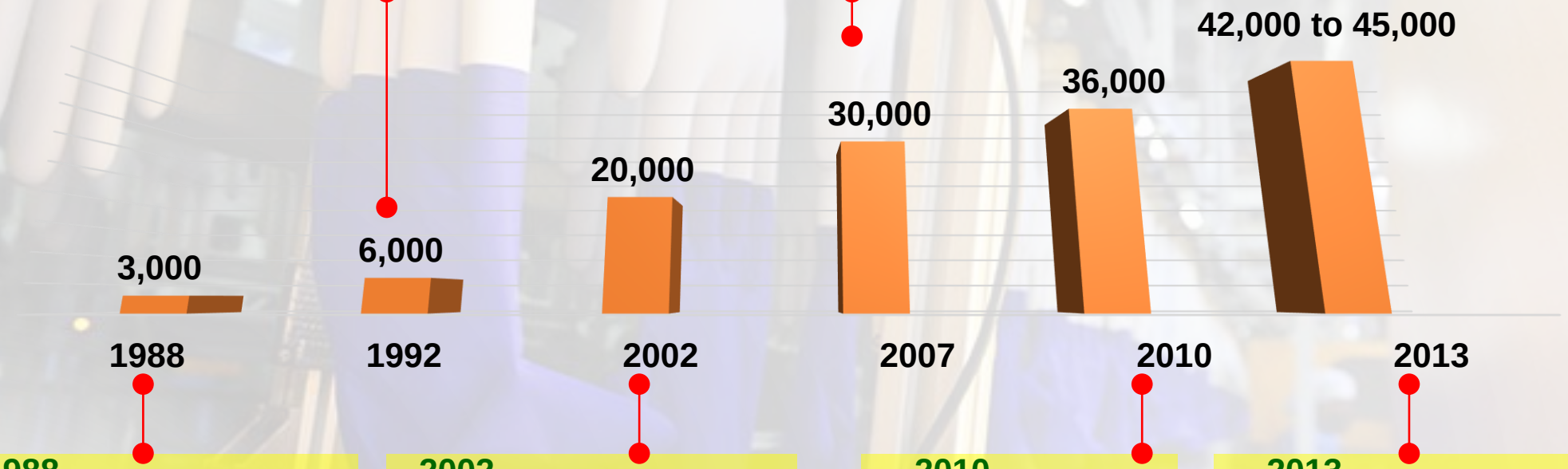


Source: Malaysian Rubber Glove Manufacturers Association (MARGMA)

Advancement in Glove Production Technology

1992
Malaysian Built Lines produce 6,000 gloves/hour

2007
Further improvement resulting in 30,000 gloves/hour



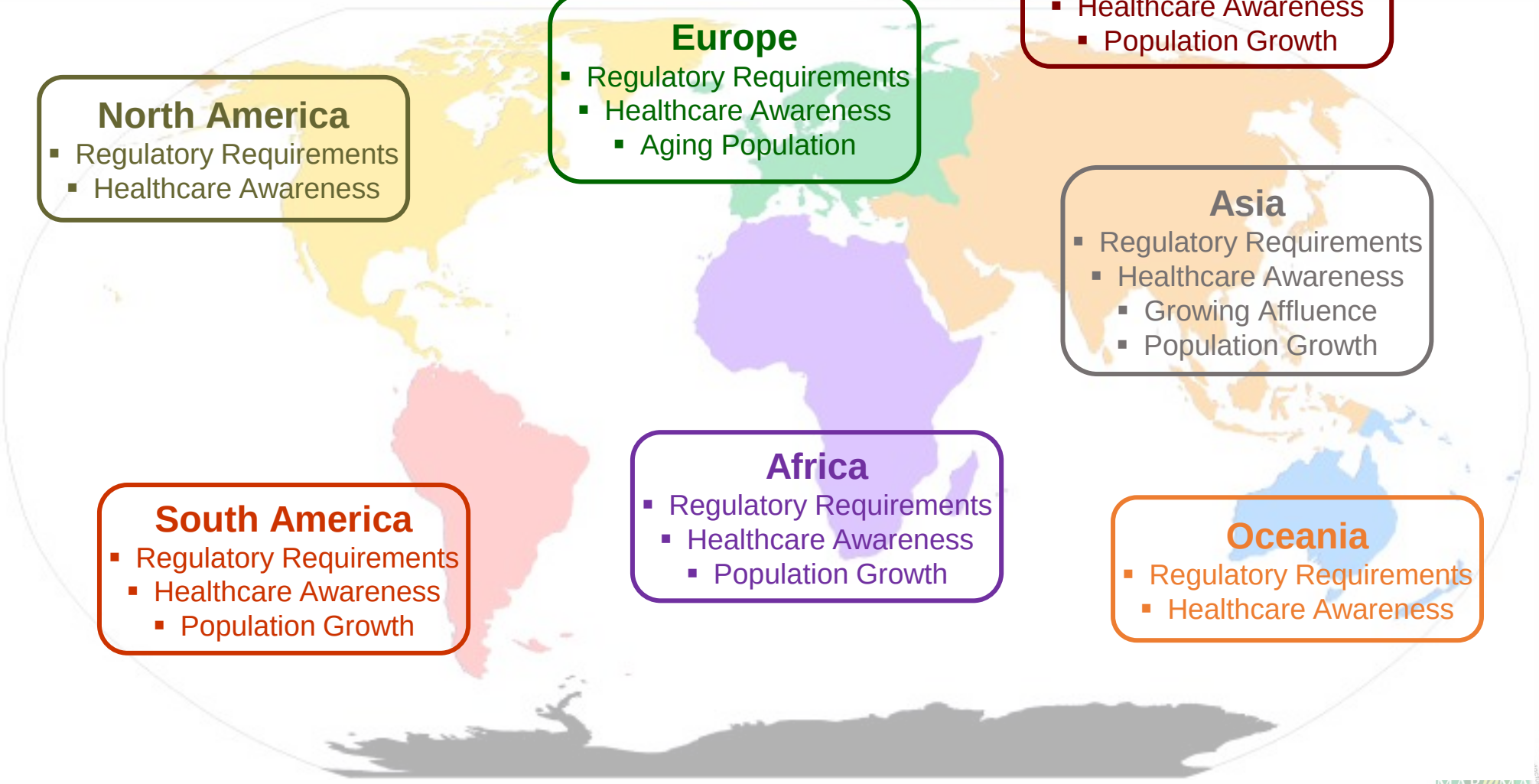
1988
Imported lines from Taiwan produce about 3,000 gloves/hour

2002
Major Innovation using double formers resulting in production of 20,000 gloves/hour

2010
Improved speed to 36,000 gloves/hour

2013
Achieved breakthrough speed between 42,000 and 45,000 gloves/hour

Drivers for Growth of Industry



Russia
- Regulatory Requirements
- Healthcare Awareness
- Population Growth

Europe
- Regulatory Requirements
- Healthcare Awareness
- Aging Population

North America
- Regulatory Requirements
- Healthcare Awareness

Asia
- Regulatory Requirements
- Healthcare Awareness
- Growing Affluence
- Population Growth

Africa
- Regulatory Requirements
- Healthcare Awareness
- Population Growth

South America
- Regulatory Requirements
- Healthcare Awareness
- Population Growth

Oceania
- Regulatory Requirements
- Healthcare Awareness

Last REVISED on 20 Jan 2021

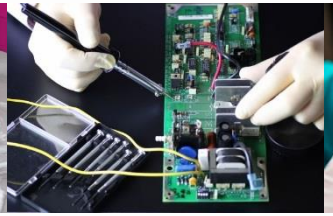
Ever Increasing Applications for Rubber Gloves






Original and major market segment

- **Medical & Dental**
- Pharmaceutical & Laboratory
- Food Industry – Processing & Service
- Electronics – Clean Room
- Industrial – Janitorial/Mechanical
- Tattooing procedures
- Household
- Specialized medical applications



Key Sustenance for Growth

- Product Innovation
- R & D
- Automation
- Engineering
- Harnessing New Energy Sources
- Recycling of Waste Water

Photo credit: https://www.pinterest.com/explore/solar-thermal-systems/

Photo credit: http://www.chfourenergy.com/

Malaysian Rubber Glove Manufacturers Association

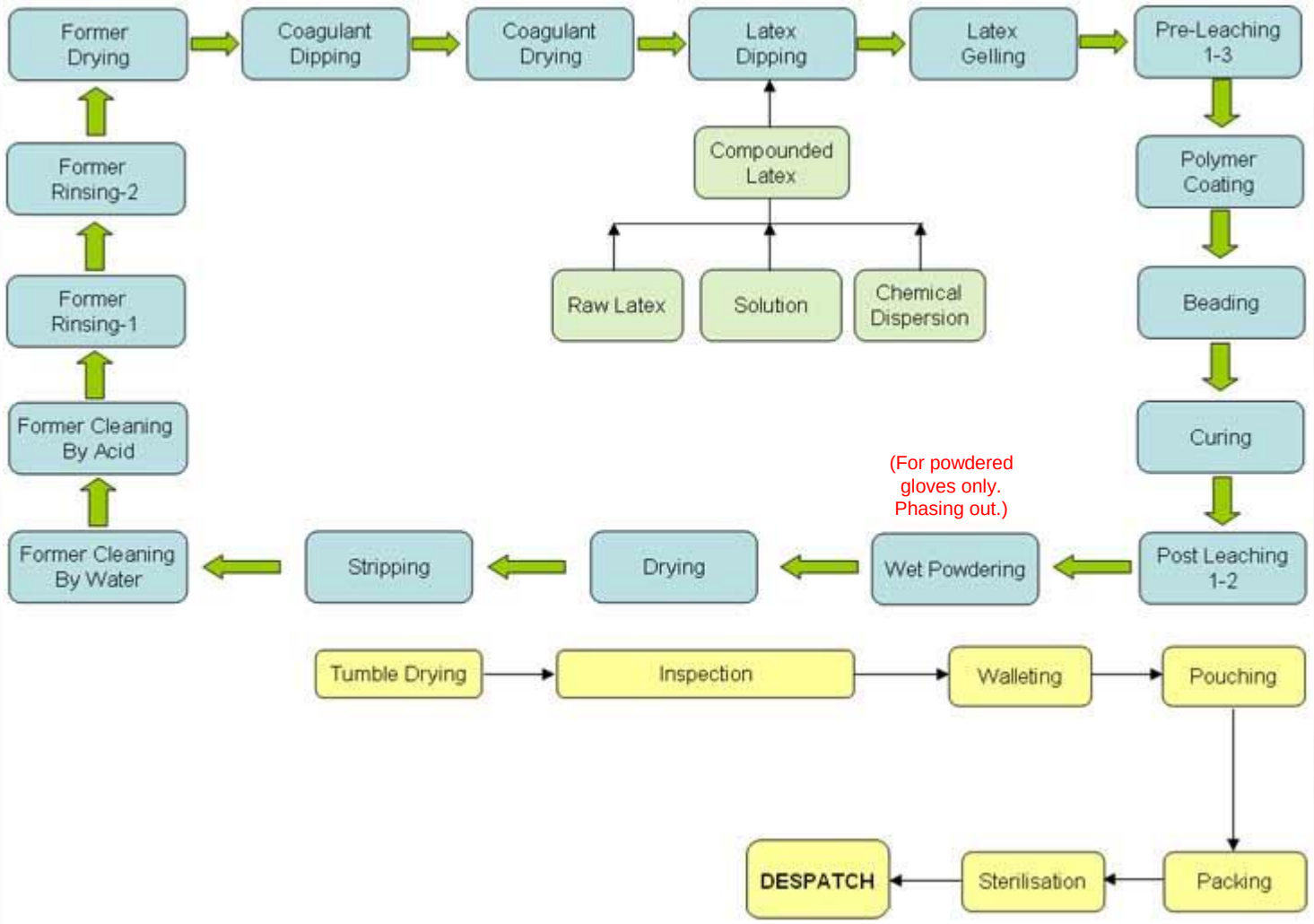
Key Focus Areas for R&D

Our R&D Mantras

- It must fulfil an industrial need
- It must be commercially viable
- Brilliant if its innovative
- Enhances the wellness of mankind
- Adds to the body of knowledge leading to a desirable end result.

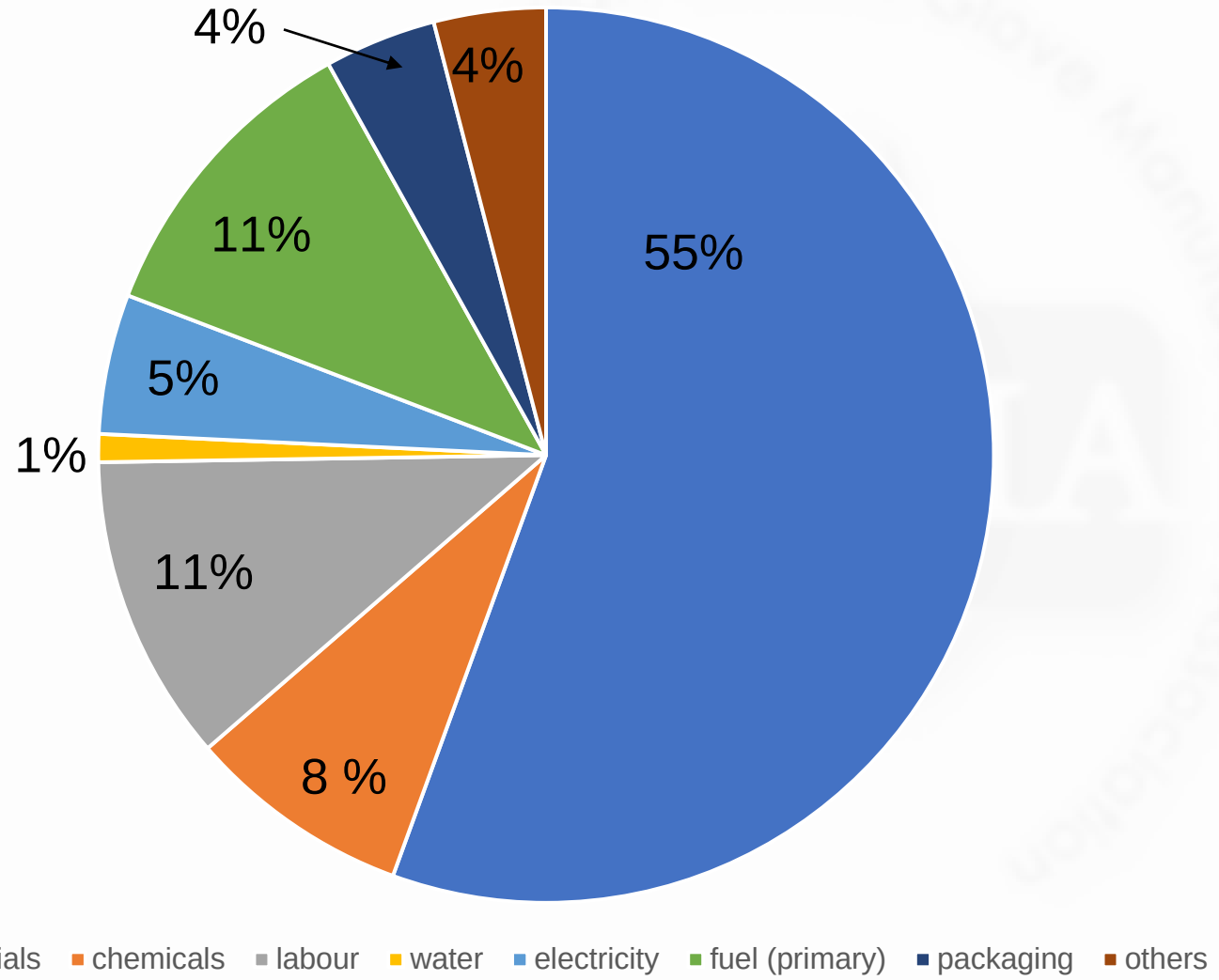
Graphics credit: http://www.feron-tech.com/rd/

Schematic Diagram of Dipping Process for gloves

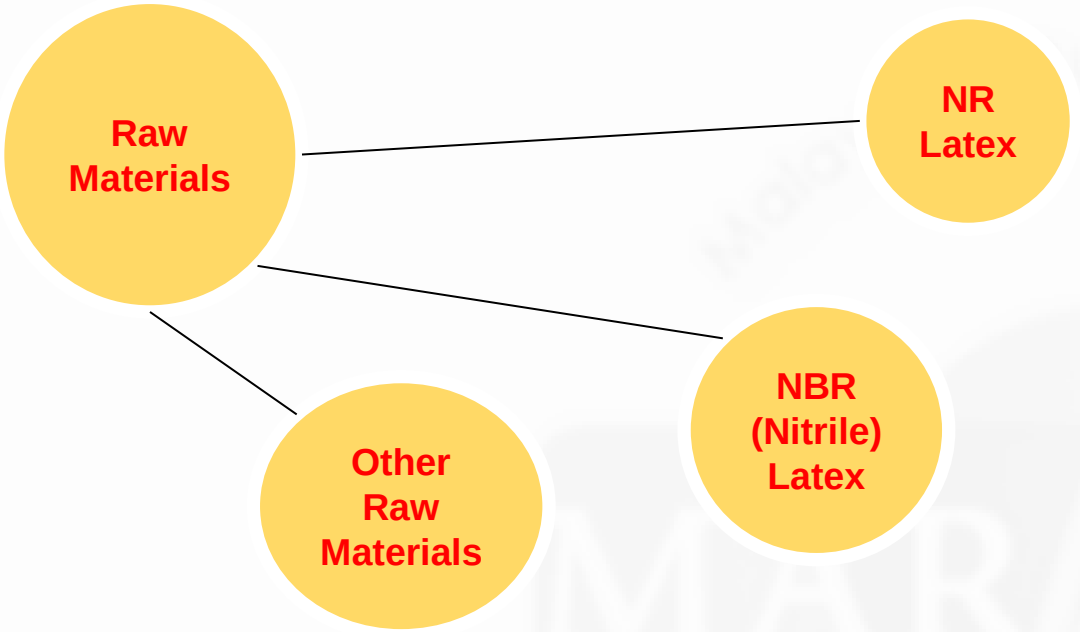


Key Focus Areas for R&D

Glove production cost breakdown



R&D on Latex used for Glove

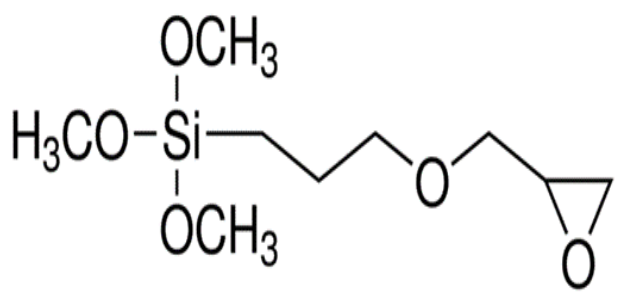


- Ability to produce a thinner glove (NR) yet fulfilling all the desirable quality requirements.
- Bio-based raw materials
- Thinner & Lighter Gloves
- Raw materials ….biodegradable, green

TWO TYPES OF CHEMICAL MODIFICATIONS

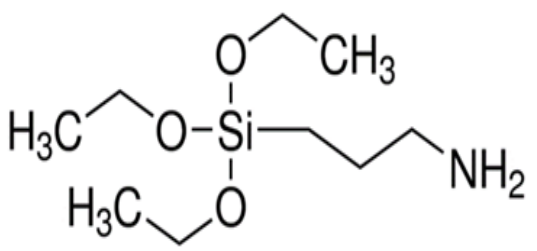
Chemical modifications…..GS

- 3-glycidyloxypropyl-triethoxy silane (GS)
- 3-glycidyloxypropyl-triethoxy silane (GS) is a silane that has epoxy and ethoxy as functional groups. Epoxy functional group has the ability or the potential to react with carboxylic on graphene oxide and forms chemical linkages



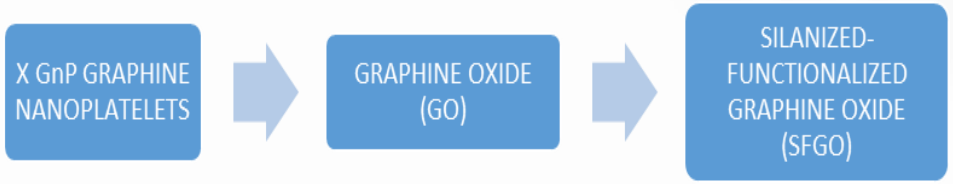
Chemical modifications……ES

- 3-aminopropyltriethoxysilane (ES) having amino and ethoxy functional groups.
- The –NH2 in amino component can react with carboxylic to form chemical linkages
- Ethoxylated component on the silanes can form chemical linkage with latex by condensation process and crosslink could occur due to the multifunctional components



Chemical reaction

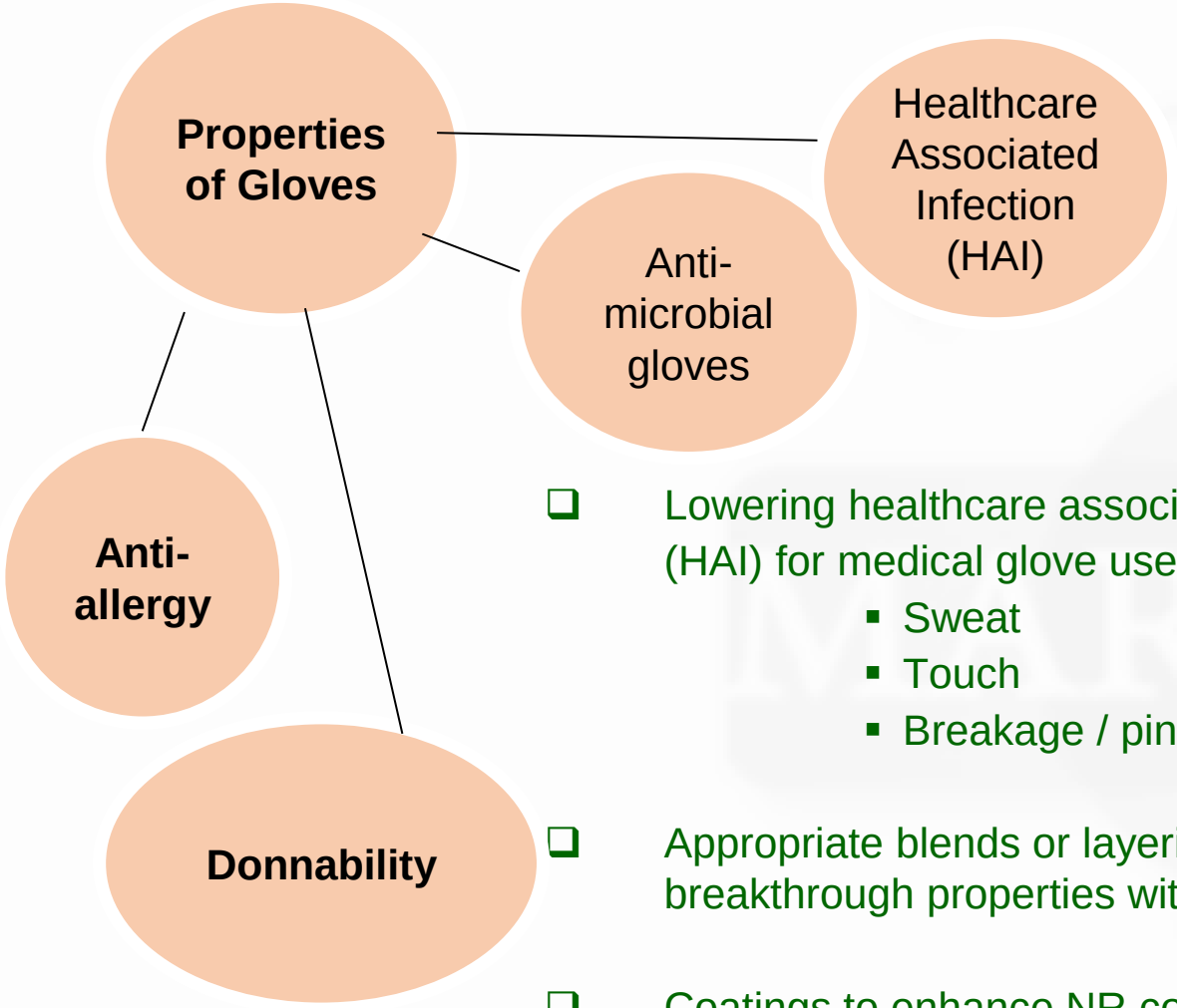
- The surface of graphene was modified by means of Hoffman Rearrangement Method to produce carboxyl and amino functionalized graphene as shown by the flow chart
- The concentration of GS and ES were varied at three different levels namely, 3%, 15% and 30% to see if the interaction between the graphene particles and the rubber particles are affected by the concentration of GS and ES. The treated GS graphene was further treated with **thiolene chloride** to enhance the reactivity of the functionality



CONCLUSIONS

- The best commercial dispersing agent performed 22% better than the rest of the field.
- Chemical modification on the graphene helps to enhance it further.
- Further chemical treatment of GS using thiolene chloride to produce GSCl enhanced the tensile properties of the vulcanized NR latex film markedly.
- Addition of optimal levels chemically modified graphene, allows for lighter weight gloves, yet, fulfilling all glove specifications.

R&D on Glove Properties



- Lowering healthcare associated infection (HAI) for medical glove users.
  - Sweat
  - Touch
  - Breakage / pin-hole
- Appropriate blends or layering to enhance permeation, penetration and breakthrough properties with regards to chemicals and cytotoxin drugs
- Coatings to enhance NR contact properties (lignin filled composite)
- Allergy Type I - addition of anti-allergic component
- Allergy Type IV Allergy Free gloves

SEVERITY OF COVID-19……..

- ***INFECTED:*** ***175.6 million***
- ***RECOVERED:*** ***159.1 million***
- ***IN TREATMENT:*** ***12.8 million***
- ***DEATHS:*** ***3.7 million***

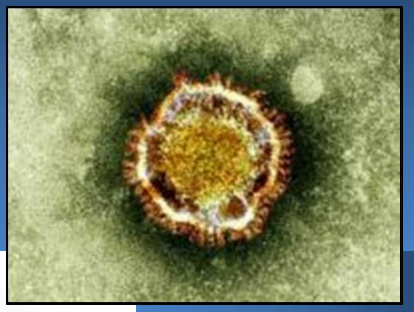
Mitigating and Containing the Virus and Bacteria Onslaught.

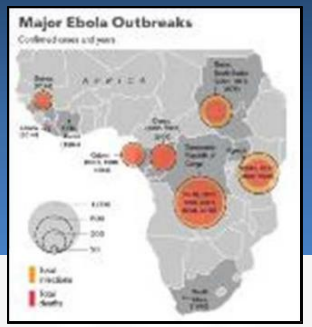
Hospital Acquired Infection (HAI)

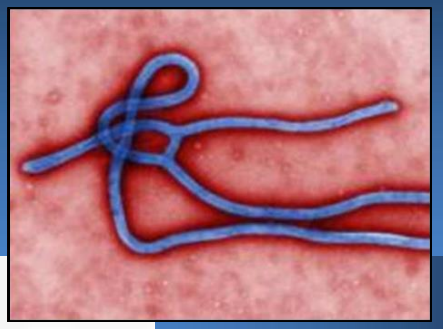
- At any point in time, >1.4 million people are suffering from complications of HAIs globally
- HAIs: one of leading causes of death globally
- Developing Countries HAIs can exceed 25%; with intensive (ICUs) care units at >65%

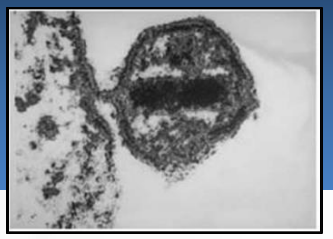
Emerging Pathogens

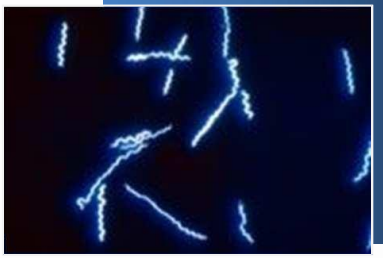
- MERS
  Camel to Human
- H7N9, H5N1, H1N1
  Bird or pig to Man
- SARS
  Civet cat to Human
- HIV Chimpanzee to man (most likely)
- Lyme disease (*Borrelia burgdorferi*)Mouse to Tick to Human
- Ebola (animals to humans)
- Covid 19 (animals to humans)









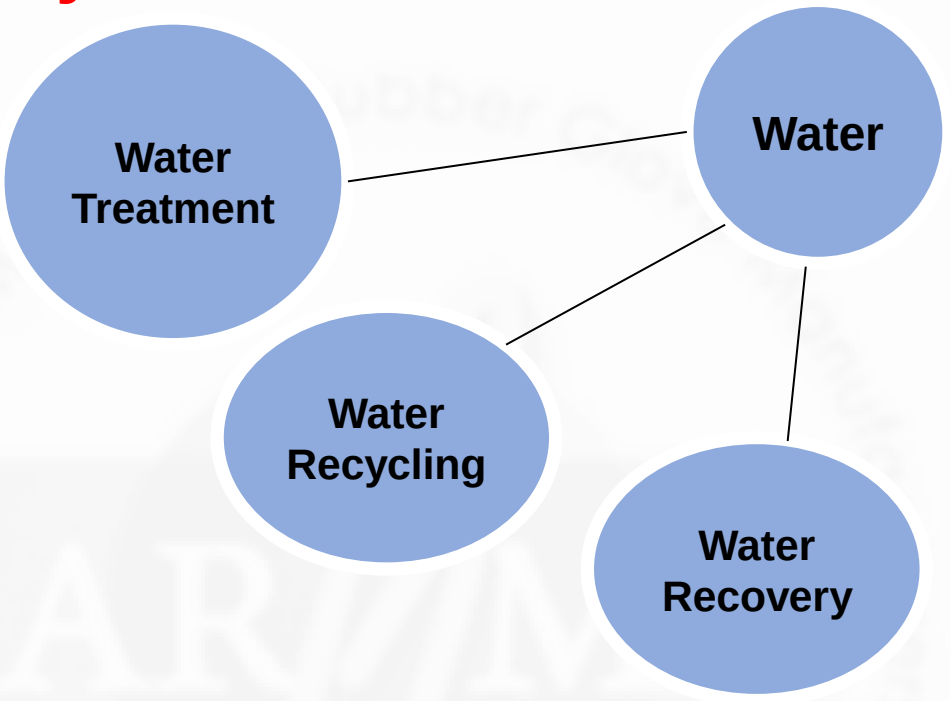


Pathogens Found on Marked Surfaces

The Industry uses plenty of water

Photo credit: http://www.chfourenergy.com/

Photo credit: http://www.wwf.org.my/



- Treatment of ground water as alternative to water supply
- Wastewater treatment
- Recycling water

Socially responsible ……13,300 pcs/sec

- ❑ Biodegradability of glove materials
- ❑ Treatment of effluent
- ❑ Solid waste treatment / reclaim process

Photo credit: https://www.videoblocks.com/

Energy constitutes 11% of our costs …Gas, Electricity

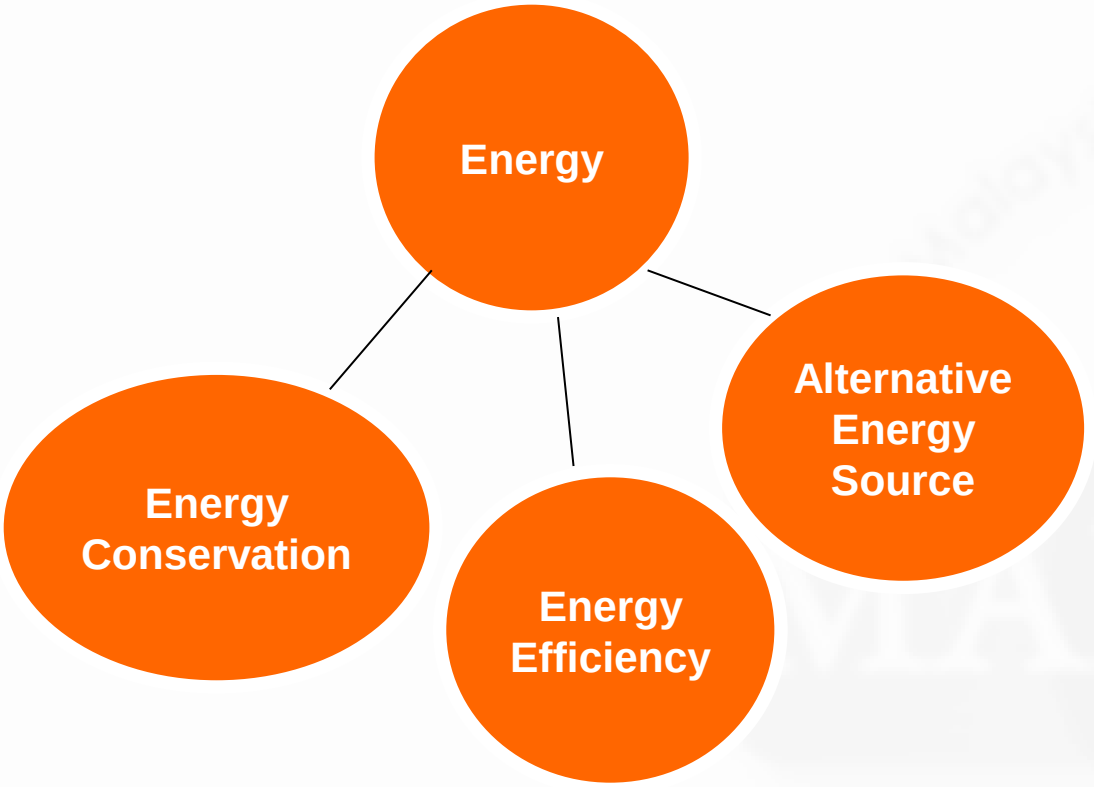


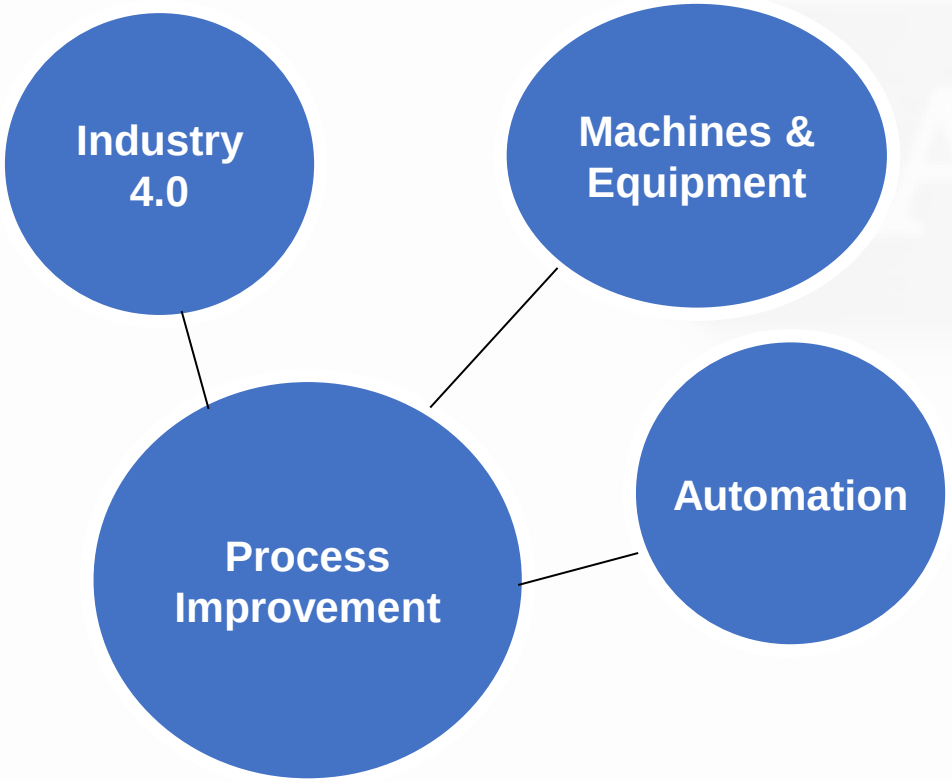
Photo credit: https://cqhdkj.en.alibaba.com/

Photo credit: https://www.pinterest.com/explore/solar-thermal-systems/

- Energy accounting for 11% of total glove production cost; alternative cheaper sources of energy are needed.
- Better Insulation of oven to reduce energy loss
- Better energy efficiency for oven

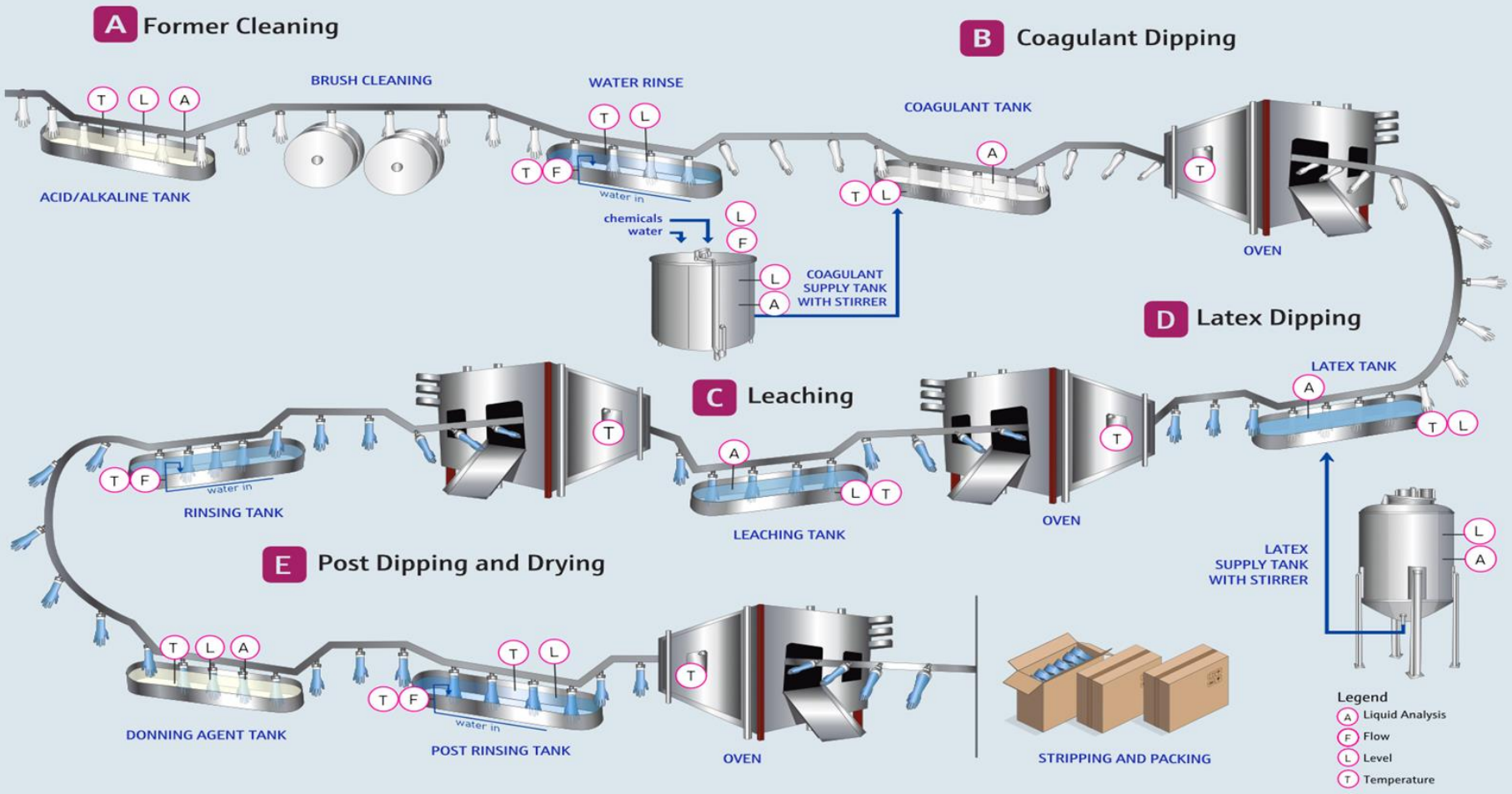
Mechanization, Automation, Robotics, Industry 4.0

- Increase automation, hence, reduces manual labour
- Defects detection and its elimination
- Industry 4.0



Graphics credit: https://www.primapower.com/us/industry-4-0/

Rubber Glove Manufacturing process



To make Malaysia a Global Hub for Gloves……

Market Intelligence

International Rubber Glove Conference and Exhibition

Constant seminars and updates for glove players

Being up the curve on R & D
5 to 10 years ahead!

Going green , sustainable

Standards & Conformance ISO, EN ASTM

Constantly managing ESG globally

The glove industry has evolved into fulfilling the needs of humanity

The current focus of this industry is

- ***Affordability via enhanced productivity***
- ***Green and biodegradability aspects***
- ***Social Compliances***
- ***Mitigating virus and bacteria onslaught***

Thank you!

Malaysian Rubber Glove Manufacturers Association

Units 1313 & 1311, 13th Floor, Block A, (Lift Lobby 4),
Damansara Intan, 1 Jalan SS20/27,
47400 Petaling Jaya, Selangor, Malaysia.
Tel: +603-7727 3197 Fax: +603-7727 3191
Website: www.margma.com.my
Email: contact@margma.com.my