Managing Wastes and Emissions from Manufacturing Industries & Building (Reduce, Reuse, Recycle and Recovery)

GrEEn Technologies: Making Profits-Committing to Sustainability

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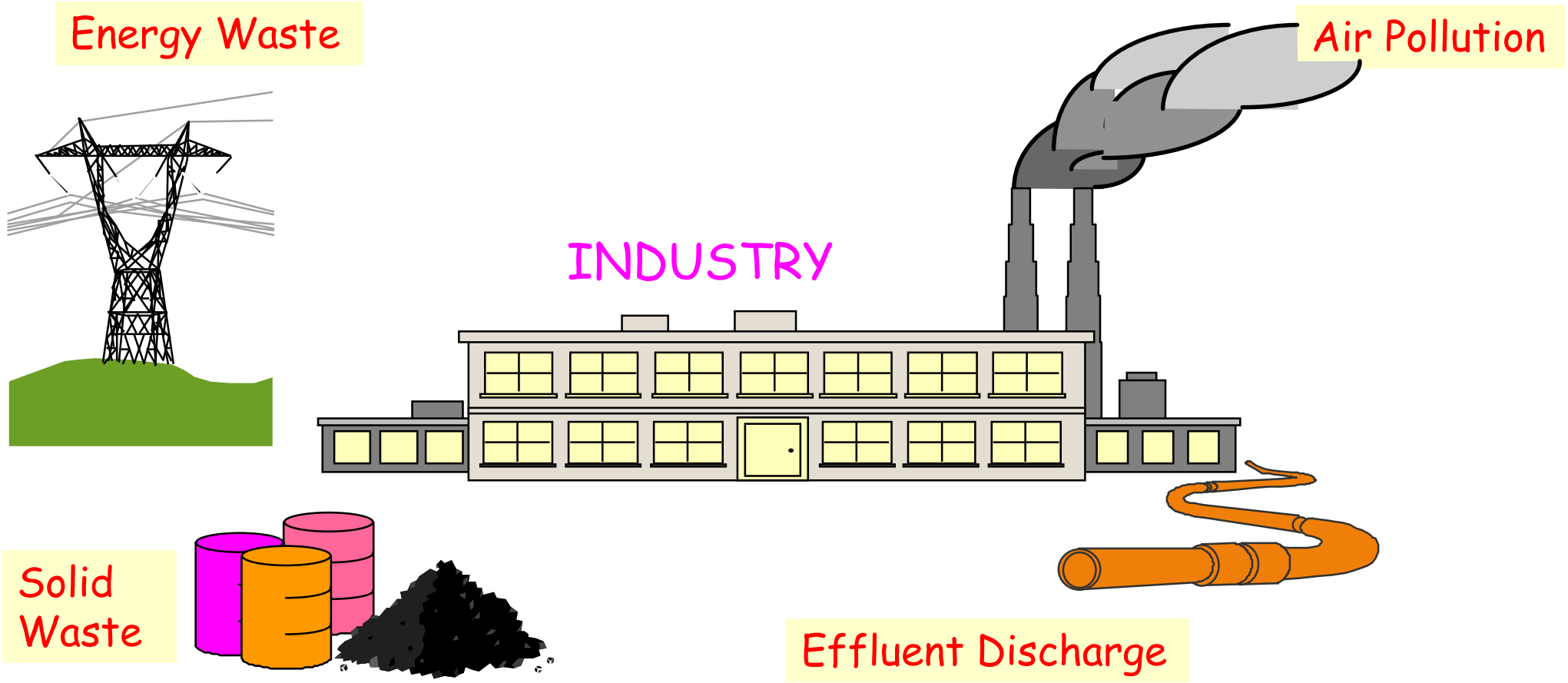
3Rs in Manufacturing Industries

Multimedia Waste Emissions from Industries

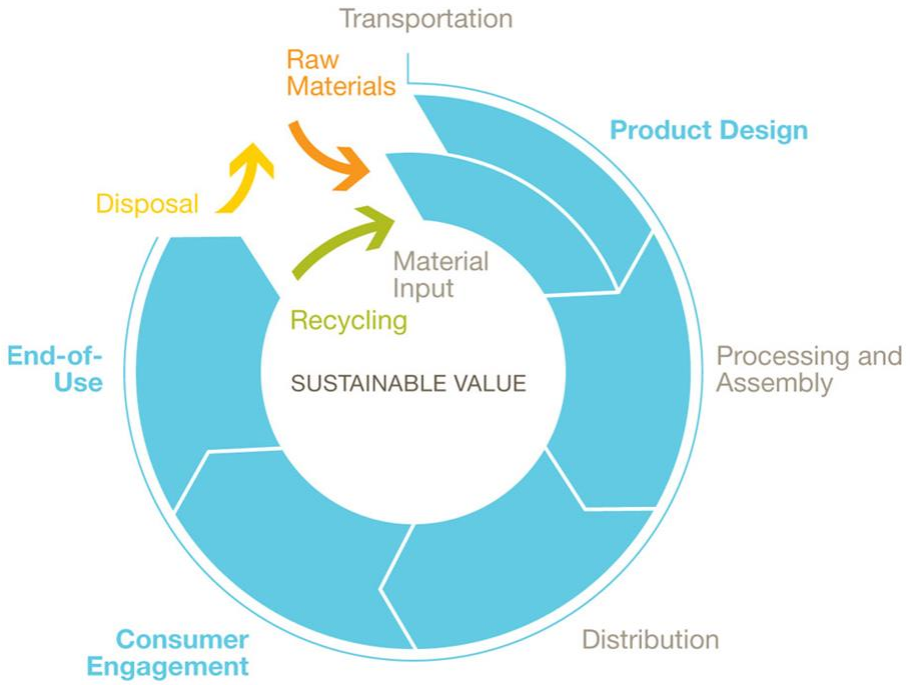


Why Sustainable Production?

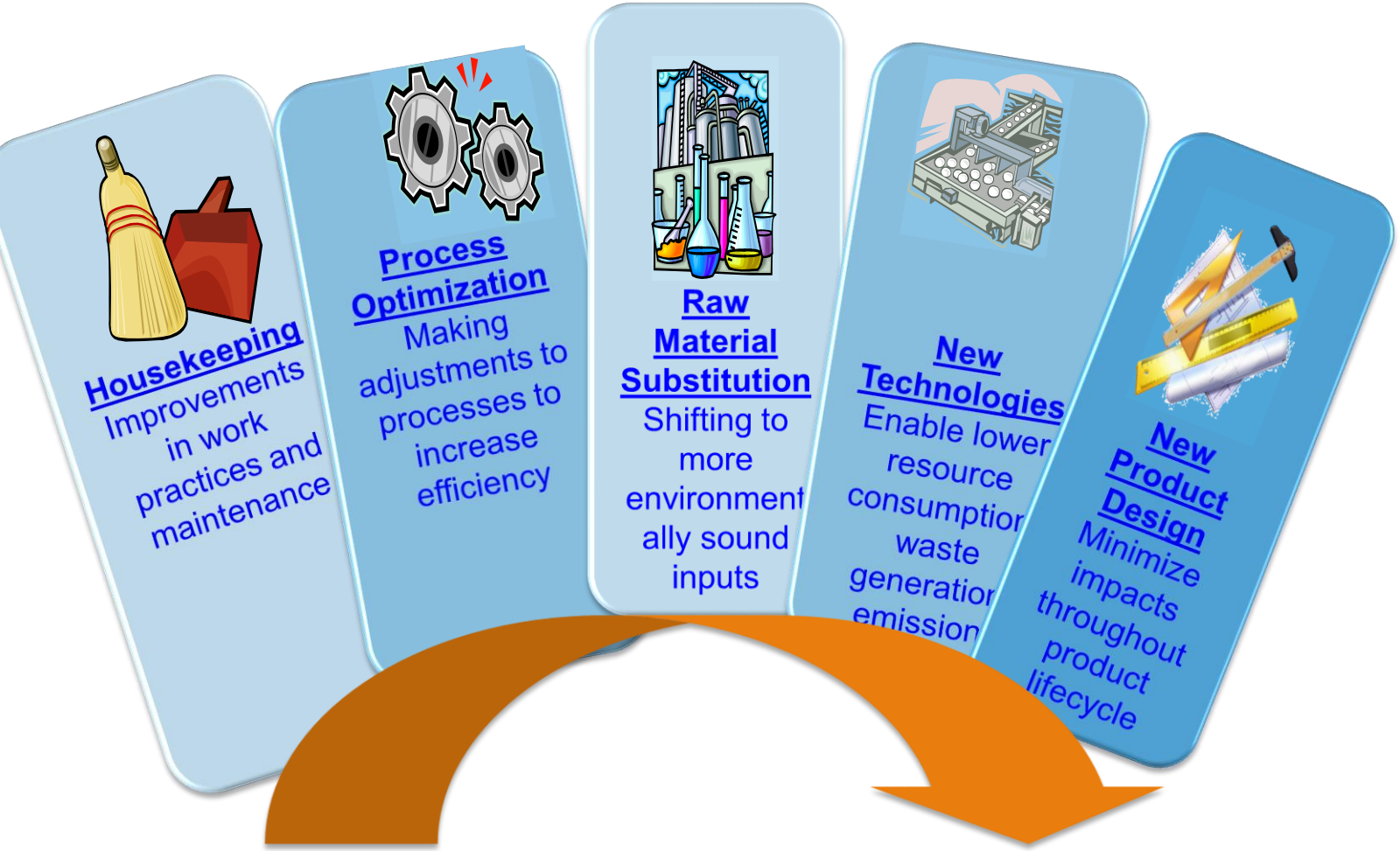
- Sustainable Production is the creation of goods and services using processes and systems that are:
  - Non-polluting (environmentally responsible)
  - Conserving of energy and natural resources (Energy and resource management)
  - Economically viable
  - Safe and healthful for workers, communities, and consumers
  - Socially and creatively rewarding for all working people
- Sustainable Production is a comprehensive approach to meeting sustainability objectives in all facets of your production, and turn sustainability challenges into business advantages through
  - **Product design:** using sustainability to guide design approaches to products from the earliest stages of conception and development
  - **Consumer engagement:** influencing what and how people consume
  - **End-of-use**: recapturing products at the end of their useful lives and converting them to serve as raw materials for other purposes

Cleaner Production & Sustainable Manufacturing

- The initial concepts of Cleaner Production were brought together during the mid-1980s, (the establishment of UNEP's Cleaner Production Programme in 1989)
- Cleaner production is an effective method to achieve business benefits such as lower costs, increase profitability, reduce waste and improve the image of the business environment and social responsibility
- It is intended to minimize waste and emissions and maximize product output
- Cleaner production has been a (green) technology promoter



Implementing Cleaner Production



Housekeeping:
better inventory management, better monitoring and scheduling of the production process, reducing loss from leaks, spillage, and drag-out, and making sure equipment is m

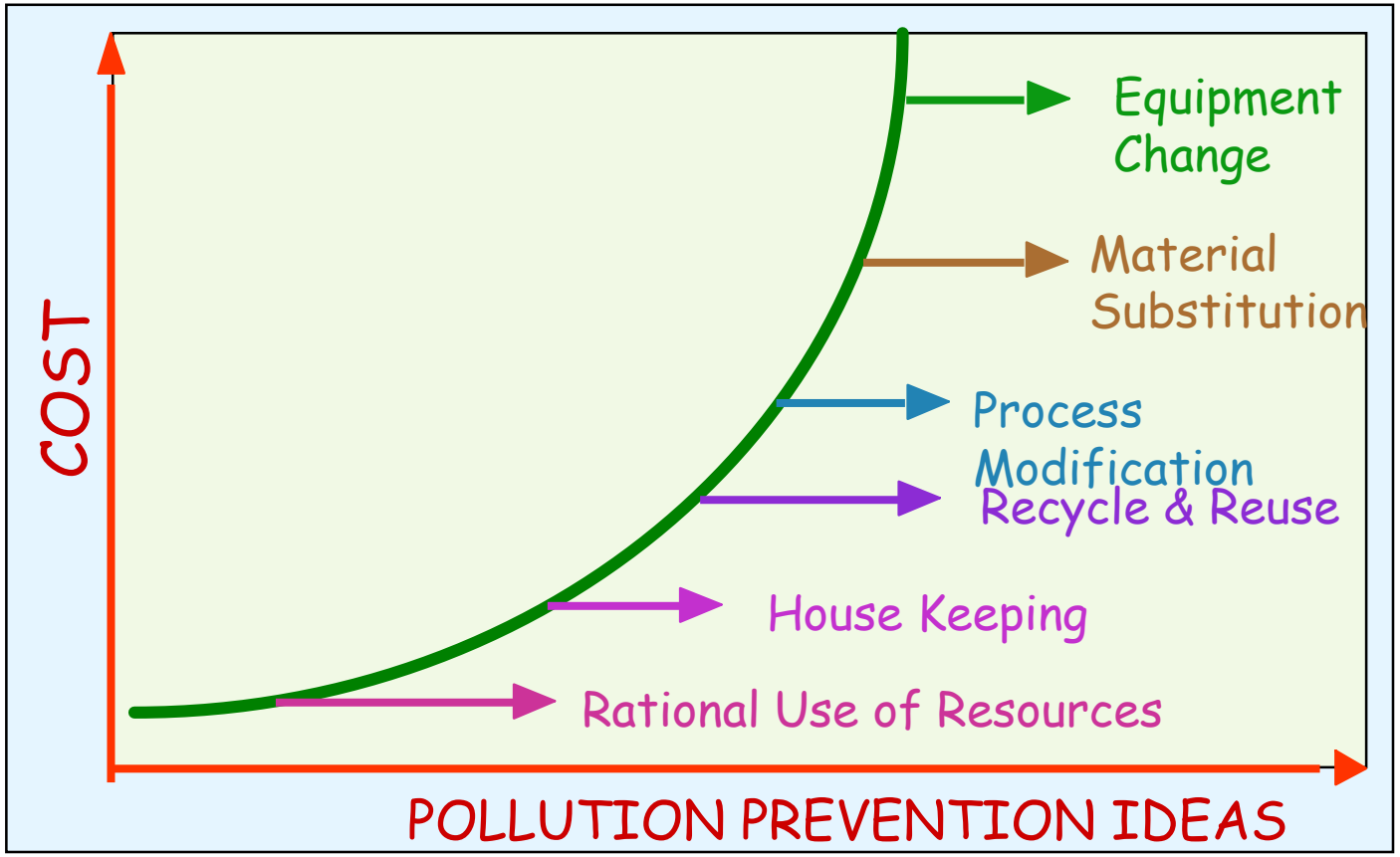
Process optimization:
changing the manufacturing process to minimize waste, conserve raw materials, and capture and reuse waste materials maintained properly

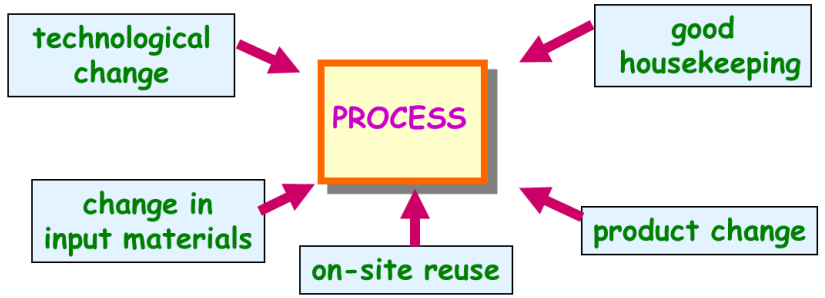
Raw material substitution:
find ways to substitute greener materials for hazardous materials, chemicals with high environmental or health impacts, materials that are non-renewable, or those that are scarce

New (Green) Technologies:
incorporating more environmentally responsible technologies

New Product Design:
Manufacturing green product using recycled and renewable materials, designing for easy disassembly, for recycling, or for remanufacturing, using less packaging and more recycled or recyclable packaging

Implementing Cleaner Production





POTENTIAL OF WASTE MINIMISATION	IMPLEMENTATION PERIOD	RANGE OF OPTIONS
20 - 30%	< 1 year	Good House keeping and Better Process Control
30 - 50%	1 - 3 years	Equipment Modification and/or technology changes, recycling
> 50%	< 3 years	Product and/or Process Change

CP Approach- Good House Keeping

SOFT OPTIONS: GOOD HOUSEKEEPING

Good housekeeping example:

- repair all leaks and avoid losses by closing water taps
- turning off equipment when not needed

CP Approach- Raw Material Substitution

Trivalent Chromium Plating
W Canning Materials Ltd, UK

Problems
Pollution due to Hexavalent Chromium laden wastes

Clean Technology
Electrolyte with lower concentrations of less toxic trivalent chromium ion.
Cr (III) oxidisation to Cr (VI), at anode avoided by membrane around the anode
Low deposition rate of Cr (III) was enhanced by specially designed organic additives

Advantages
safer working environment
reduced discharges of Cr (VI) from 80 to 3 ppm of Cr (III)
improved quality and uniformity
reduction of energy requirements to half

	conventional technology	Clean technology
Plating plant	£ 175,000	£ 135,000
Effluent Plant	£ 70,000	£ 52,000

CP Approach- Raw Material Substitution- Case of Micro plastics in Consumer Products

- Many consumer products sold in around the world contain microplastic particles as abrasives and exfoliants.

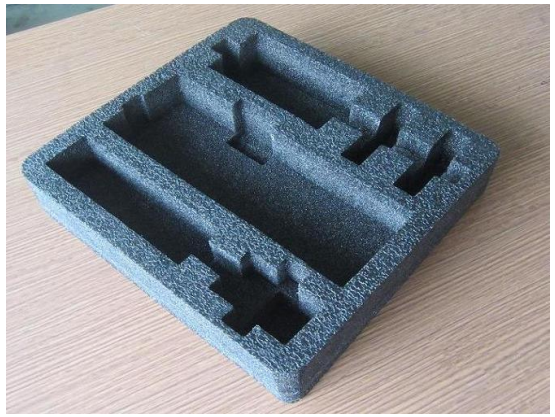
Sustainable Alternatives to MicroPlastic

- Over the years, microbeads have replaced traditional, biodegradable alternatives such as ground nut shells, and salt crystals.

- Other natural alternatives, like apricot shells and cocoa beans are being used successfully by many companies.

Changing Packaging

- Changing packaging can be just as important.
- The key word is to minimize the packaging and maintaining the protection of the product.
- One example is to use recycled cardboard instead of plastic foam for protection of fragile items.



Improving the Products

- Replace a painted metal shield with a RECYCLE plastic shield for a certain product, then the environmental problems and costs related to paint finishing could be avoided.
- Improved product design can result in large savings on material consumption and use of hazardous chemicals

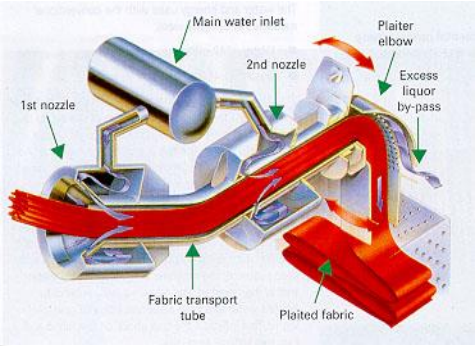
CP Approach: Technological Option- Equipment Modification

GHG Emission
CO_2 emission = 396 kg/Batch)

Conventional Jet Dyeing

Water for dyeing = 67 m^3/batch

Steam = 1,480 kg/Batch
(Energy Input = 4,191 MJ/Batch)



GHG Emission
CO_2 emission = 264 kg/Batch)

Advanced Jet Dyeing
Rapid

Water for dyeing = 30.4 m^3/batch

Steam = 980 kg/Batch
(Energy Input = 2,794 MJ/Batch)

Steam Requirements

Simple "Jet Dyeing" machines : 1,480 kg /batch: 396 t CO_2 per/batch

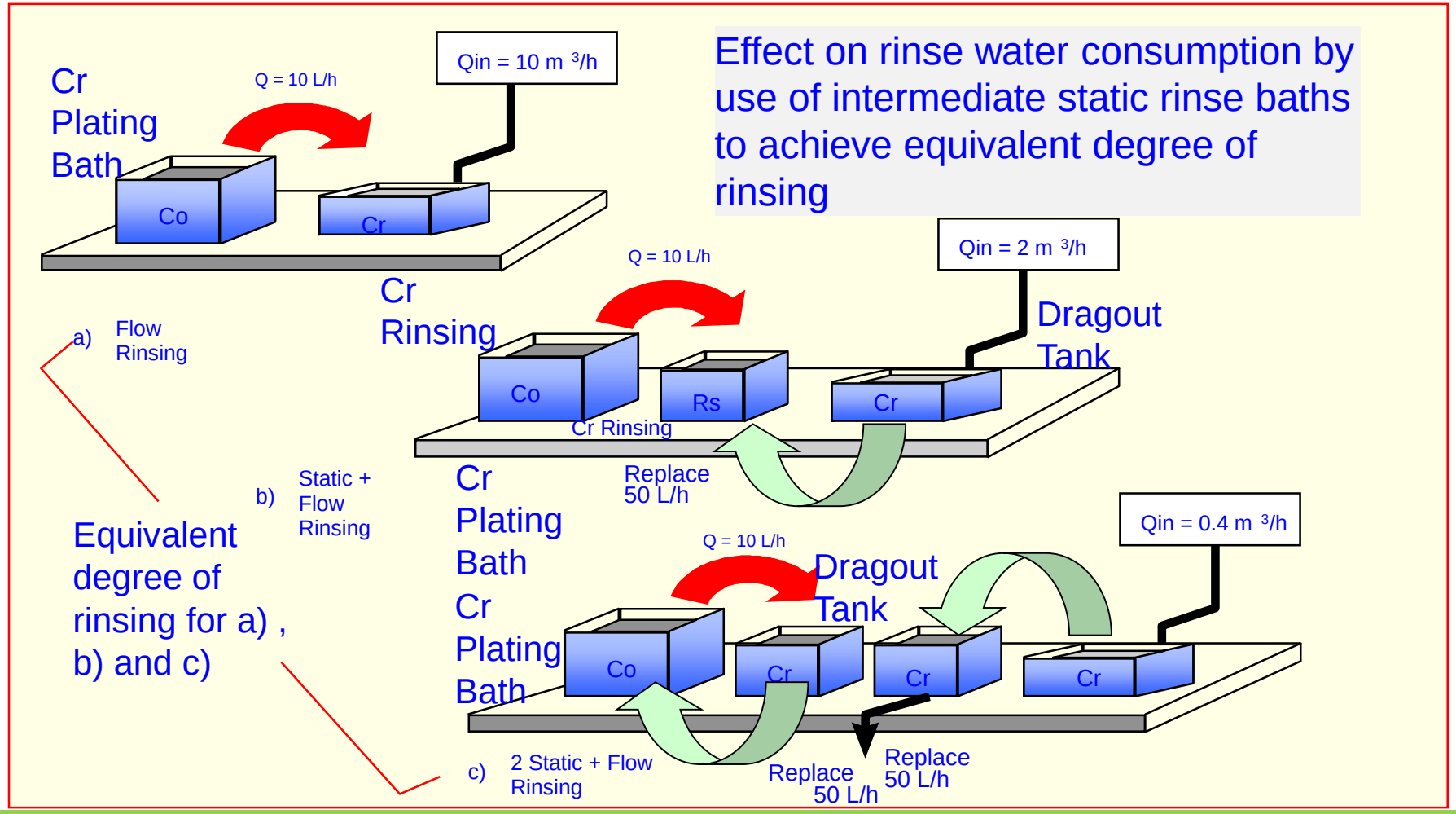
"Advanced Jet dyeing" units: only 980 kg/batch

33% reduction in GHG emission or air pollutants
(CO_2 emission = 264 tons per batch).

55 % reduction in water consumption

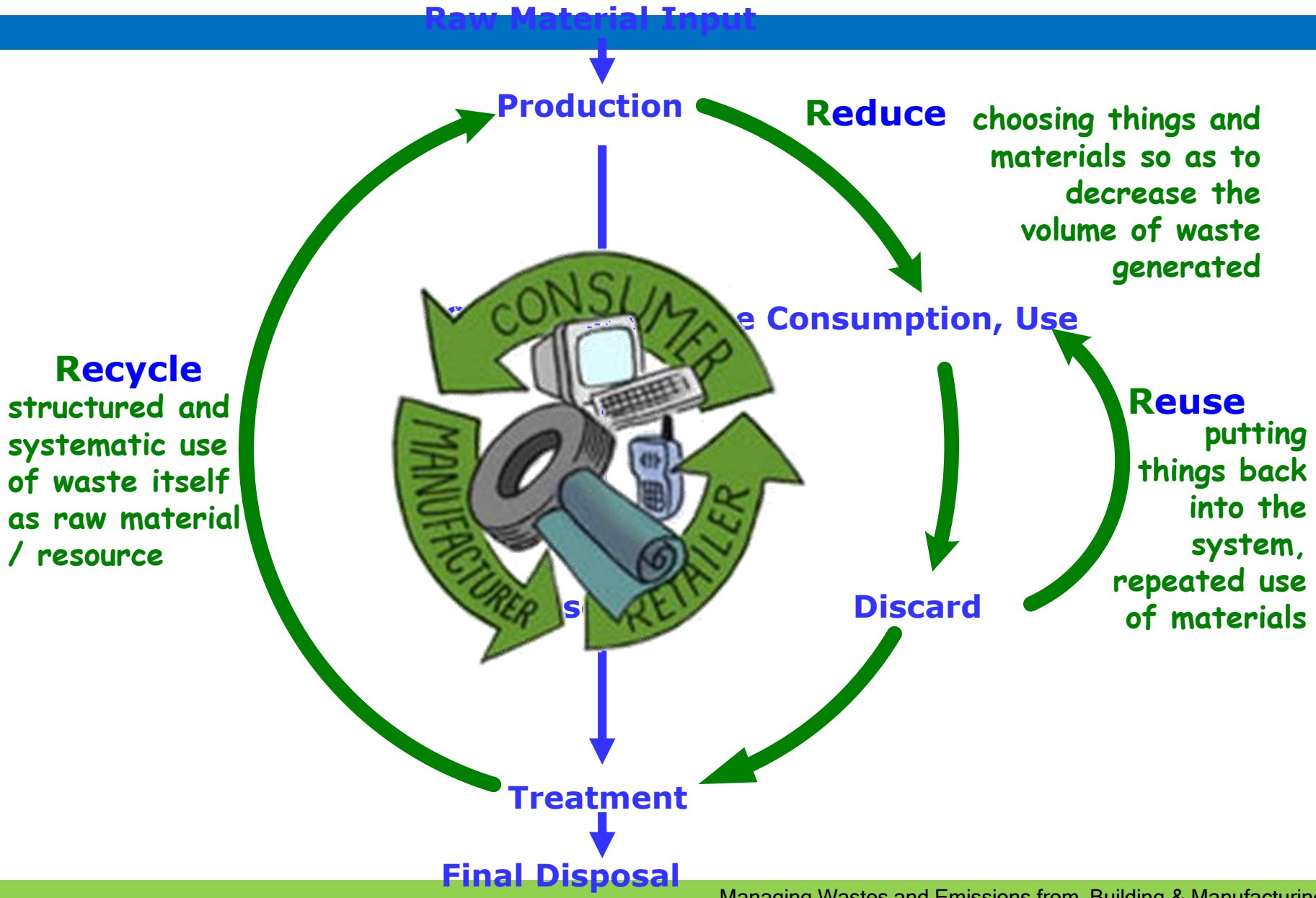
CP Approach: Technological Option- Process Modification

TECHNOLOGICAL OPTIONS: PROCESS MODIFICATION



Q= Total quantity,
Cr – Chromium,
Co - Cobalt

3R… is a cycle

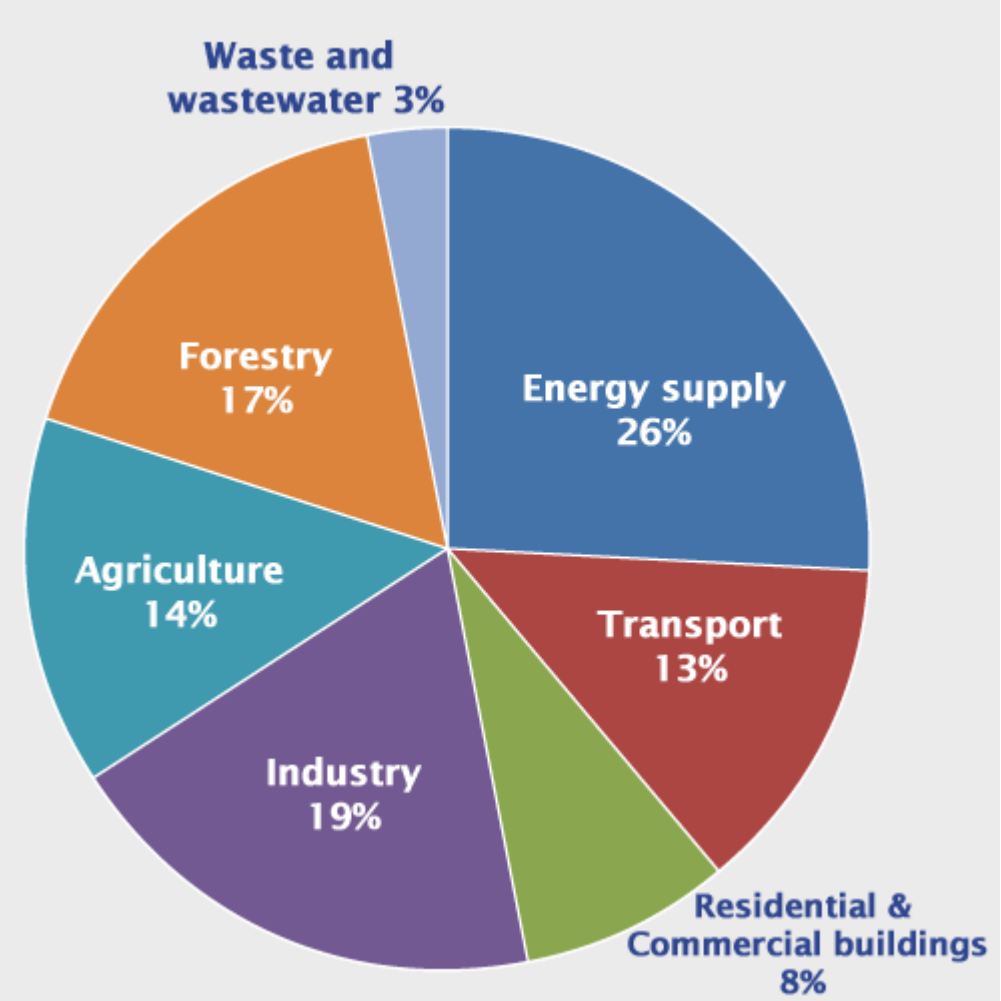

Raw Material Input
Production
Reduce
choosing things and materials so as to decrease the volume of waste generated
Consumption, Use
Recycle
structured and systematic use of waste itself as raw material / resource
Reuse
putting things back into the system, repeated use of materials
Discard
Treatment
Final Disposal
CONSUMER
MANUFACTURER
RETAILER

Wastes and Emissions From Buildings

GHG Emissions from Buildings

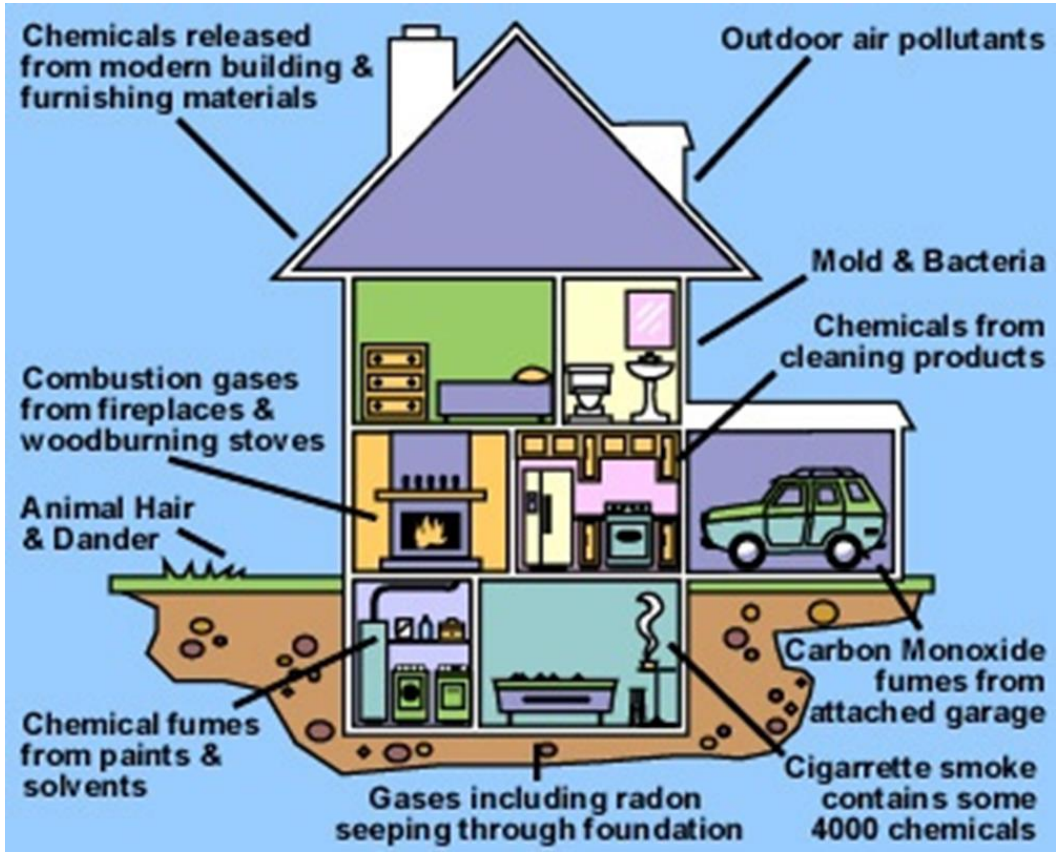
- The two most common sources of energy for buildings are purchased electricity and direct consumption of natural gas and petroleum for heating and cooking

- The quantity of greenhouse gas emissions from home depend on the types of fuel the power plant uses to generate the electricity



Gaseous Emissions from Buildings

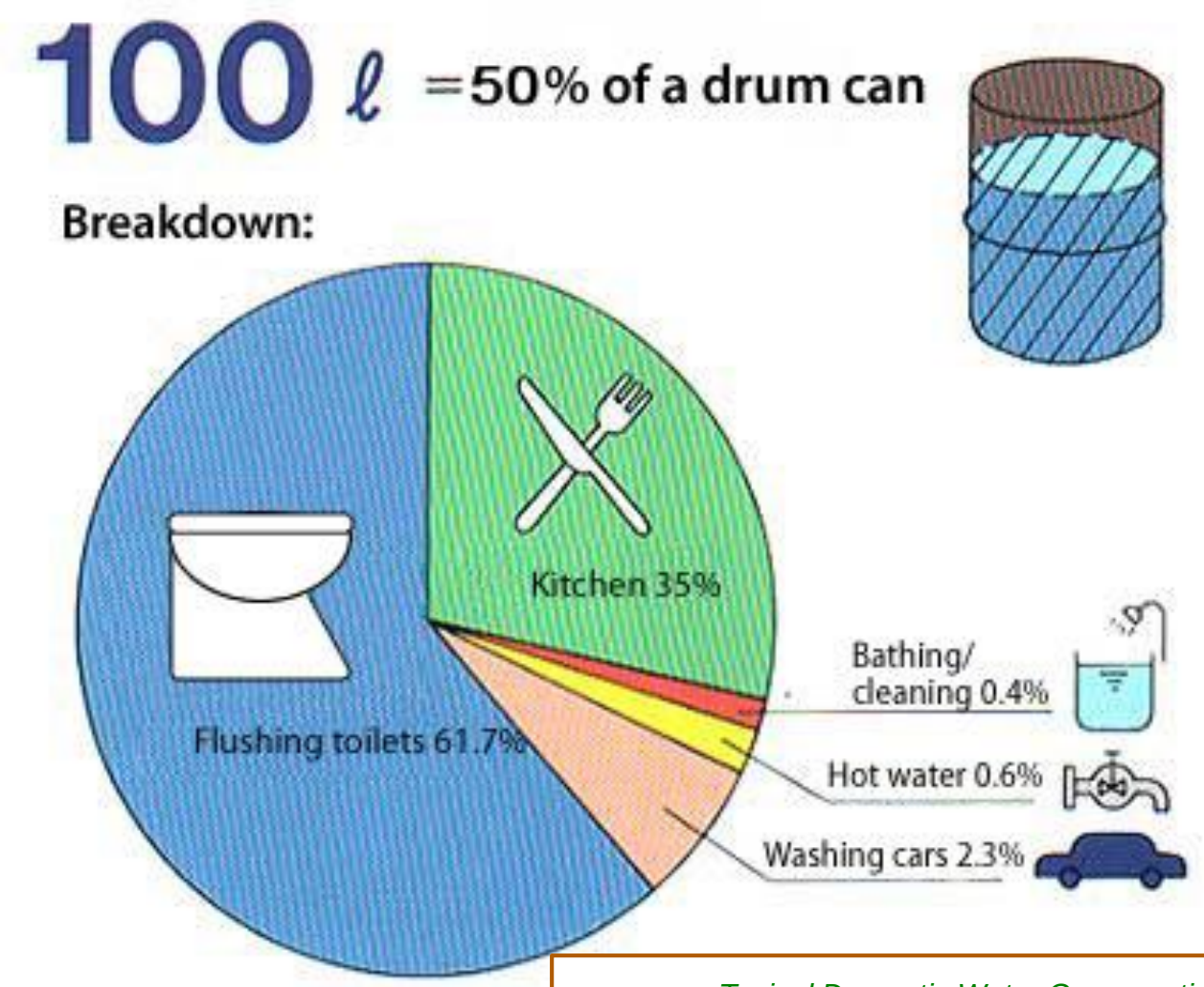
- **Indoor air pollution**, can be up to 10 times worse than outdoor air pollution because contained areas enable potential pollutants to build up more than open spaces do



Indoor Environmental Quality Maintenance

- Fresh filtered air, continuously humidified or de-humidified depending on climate conditions
- Year-round heating and cooling controlled by digital programmable thermostats.
- CO_2 monitoring equipment
- Have CO_2 monitoring equipment in central air system, by which it is sent to the individual rooms
- Vapor and air barrier minimizes random air infiltration
- Building materials and paints with low of no off-gassing
- 24/7 exhaust in every bath and kitchen

Water Consumption from Buildings



Typical Domestic Water Consumption

Water Use Reduction in Buildings

1. Water pricing/tariff:

- Ex. Water conservation tax (WCT) was introduced in Singapore to encourage water conservation efforts by users
- As a result of these efforts, there was reduction in per capita water use

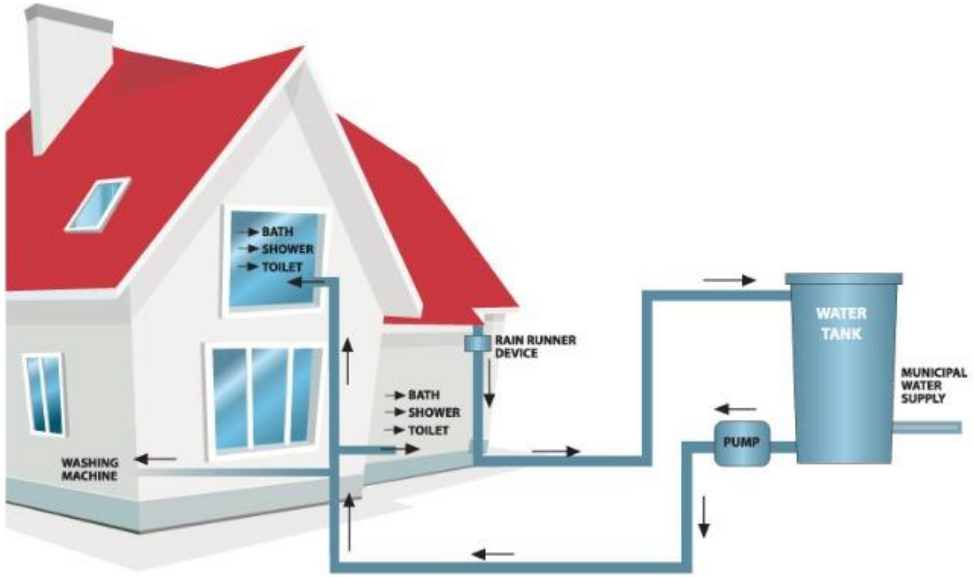
Year	per capita water consumption reduction (Liter/day)
2012	155
2020	147
2030	140

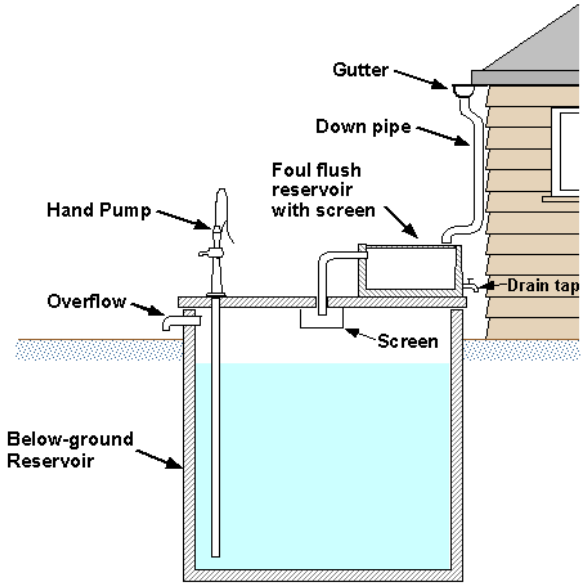
2. Water Saving Techniques:

Installment of water saving devices such as mandatory flow regulators

Water Reuse: Rain Water Harvesting

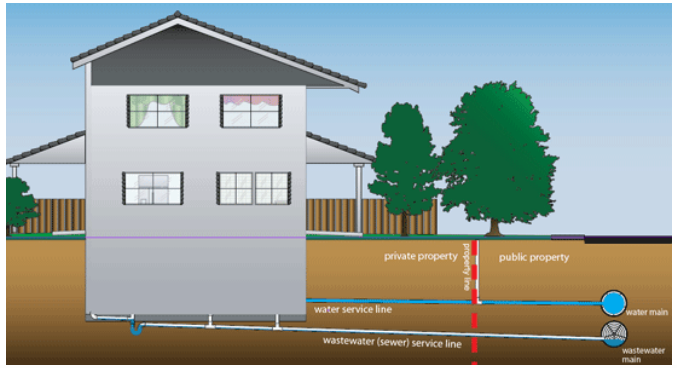
- Rain Water harvesting in Buildings
  - Used for non potable purposes such as toilet flush, watering in gardens, car wash etc
  - Also used as replenishing/rechargin g ground water resources

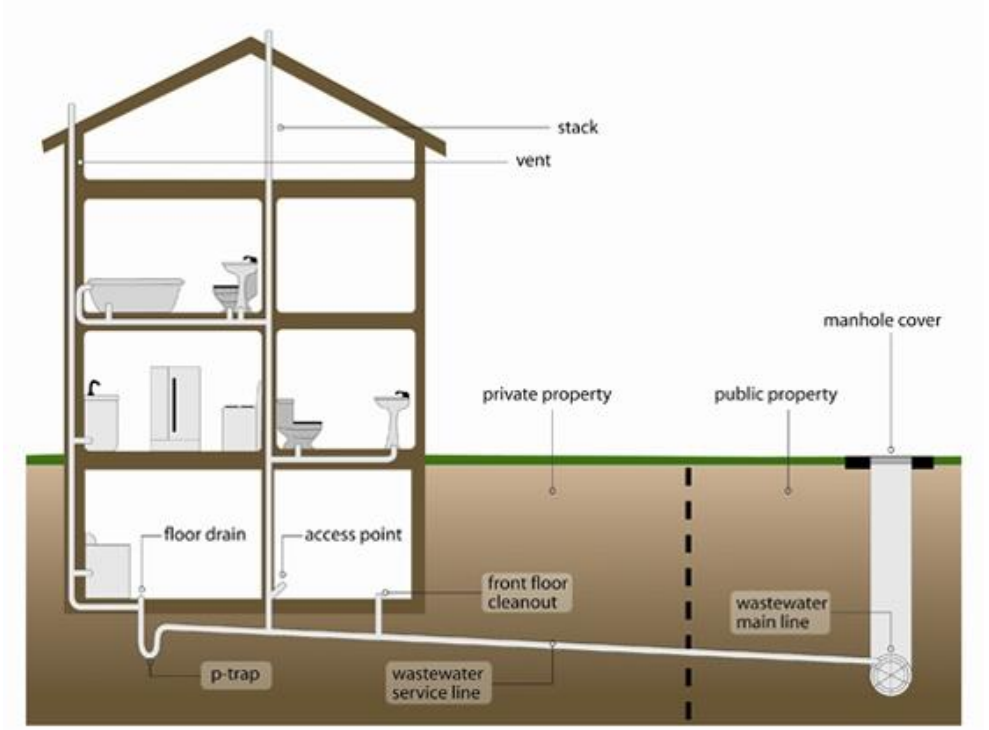




Wastewater from Buildings

- Wastewater from building can be classified into two categories:
  - Gray water: from kitchen, shower
  - Black water : toilet flush
- Many developing countries with least treatment faculties, release the wastewater into open sewerage and local water bodies.
- Some municipalities mix all domestic and industrial wastewater through a single sewerage network
- Domestic wastewater is collected by municipal sewerage line and treated in a centralized wastewater treatment plant, and some cities have plans for reuse of the treated wastewater.





Domestic Wastewater Recycling and Reuse

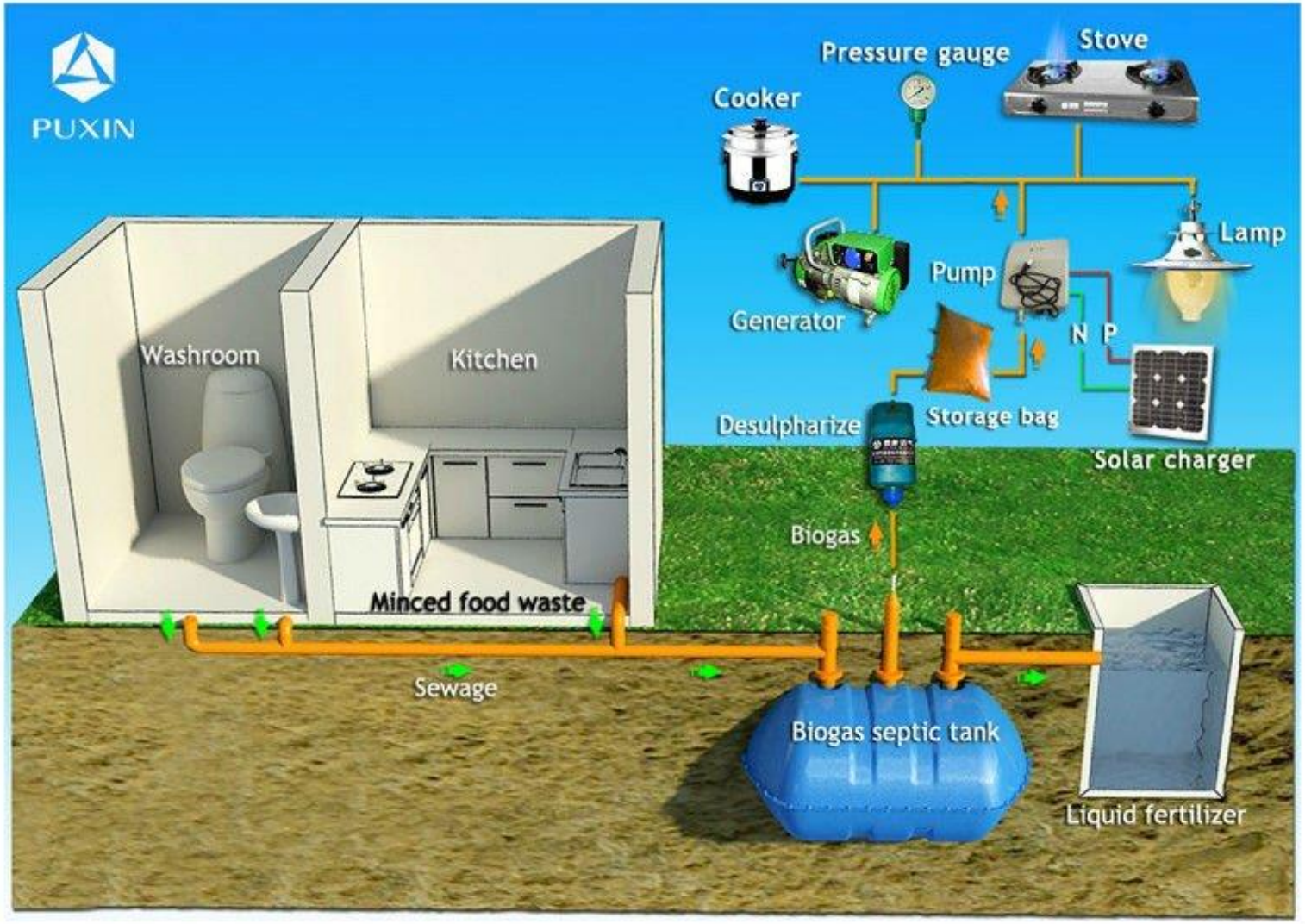
Domestic wastewater is treated and recycled into high-grade reclaimed water using advanced membrane technologies and ultra-violet disinfection, making it ultra-clean and safe to drink.

Example: 30 % of Singapore's (potable) water requirements is met by recycled water called NEWater

- Recycled water which is not fir for drinking purposes are also reuse in buildings through distributed through Dual water systems which features two separate distribution systems for potable and non potable water/recycled

- Usually, the purple pipeline and tap as "non-potable" water.

Domestic Wastewater Treatment into Biogas



Green Building: Reducing the Wastes and Emissions

- Green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by:
  - Efficiently using energy, water, and other resources
  - Protecting occupant health and improving employee productivity
  - Reducing waste, pollution and environment degradation

Water Savings at Solaire Apartment , USA

- Central water filtration system for entire building
- Refrigerators contain double filtered drinking water and ice dispensers with secondary filtration

Wastewater and storm water reuse system

- Wastewater recycling facility treat ~ 94.63 m^3/day
- Treatment plant uses an industry-leading filtration technology to separate waste from the water, providing a high-quality effluent.
- Recycling plant process includes,
  - Further treatment with hollow fiber micro-filtration membranes
  - Treatment with ultraviolet light to kill bacteria
  - Both oxygen-based and non-oxygen-based treatment to remove nitrogen to comply with New York's direct reuse standards.

50% reduction in potable water use vs. a traditional building of comparable size

Water Savings at Solaire Apartment , USA

- Treated water is reused,
  - ~ 34 m^3/day used to flush toilets, in the 293-unit apartment building
  - ~ 43.5 m^3/day for the cooling tower
  - ~ 22.7 m^3/day are used for landscape

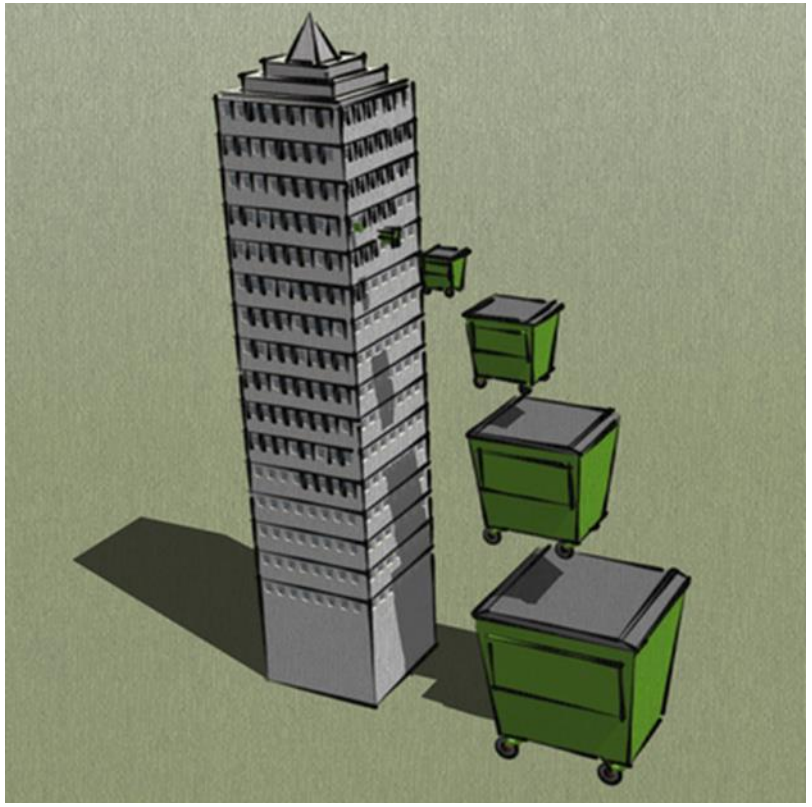
- Sludge is filtered off and piped to a New York City wastewater treatment plant.

Backwash Water Storage Tank


Control Panel

Solid Waste Generation from Buildings

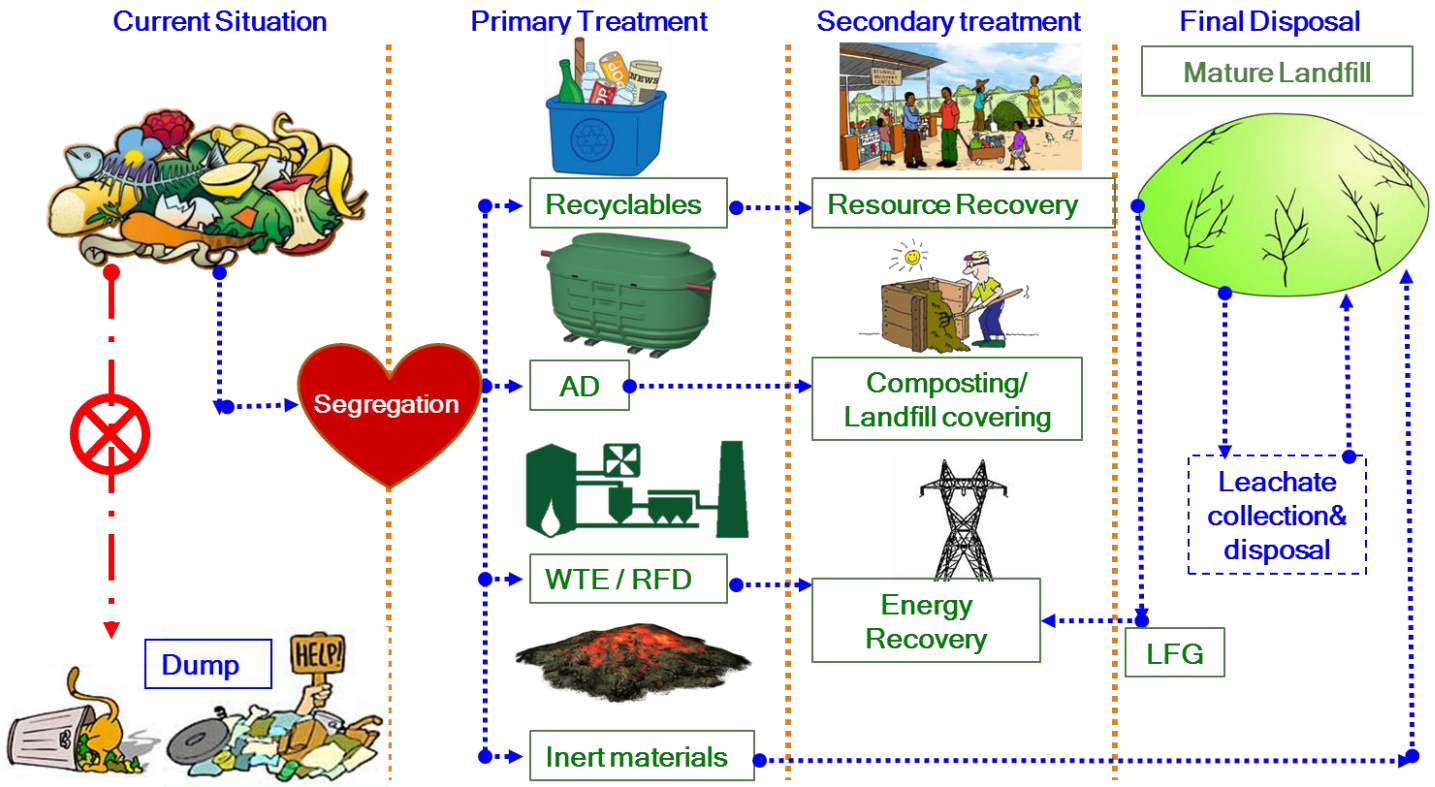
- Usually households generate **Wet wastes** (food waste, vegetable and fruit scraps etc), and **Dry waste** (paper, plastic, glass etc)
- Waste segregation at source is important but is mostly neglected in buildings
- Wastes generated by residents are usually collected and handled by municipality
- Waste reduction and reuse practices are less in urban modern lifestyles



"Designing in" efficient waste management systems that take into account the program, building type, geography, occupancy, and any other special circumstances of each individual building and its occupants

Waste Reduction

- "Pay as you throw", South Korea, EU
- Per Bag Trash Collection Fee (2000) Taiwan
- Mandatory Garbage Separation rule (2006), Taiwan
- On and off-sire waste recycling facilities



Segregation is the heart of the waste management system

Solid Waste Management in Buildings

Designing for Waste Management During Occupancy

- **"Designing in" efficient waste management systems that take into account the program, building type, geography, occupancy, and any other special circumstances of each individual building and its occupants**
- Establish baseline data by performing periodic waste assessments on all waste and recycling outputs of the building
- Design a program which allows for process improvement input from the maintenance, engineering and janitorial staff
- Identify methods for engaging with the building occupants and tenants to
  - obtain program "buy in", sharing of ideas and feedback
  - participate in waste recycling activities
  - Multi-colored bins for waste segregation

THANK YOU…