

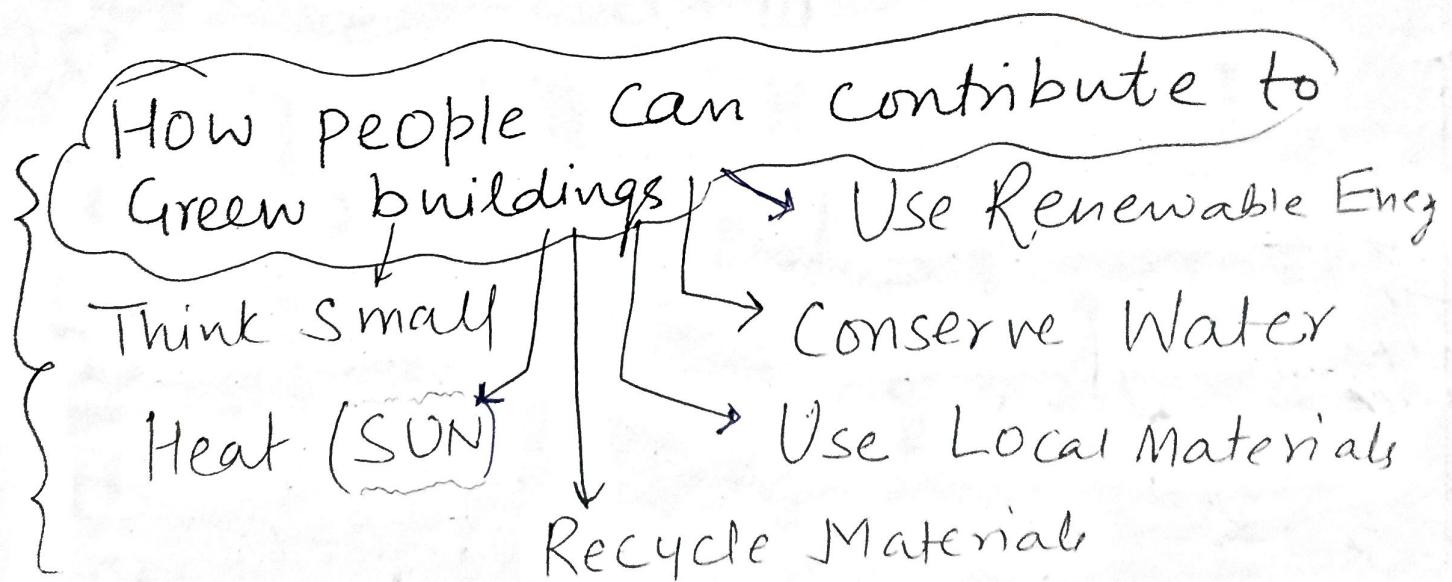
# Green Technology

Application of the EVS to  
Conserve the natural Env. and  
Resources by curbing<sup>controlling</sup> the negative  
impact on human involvment

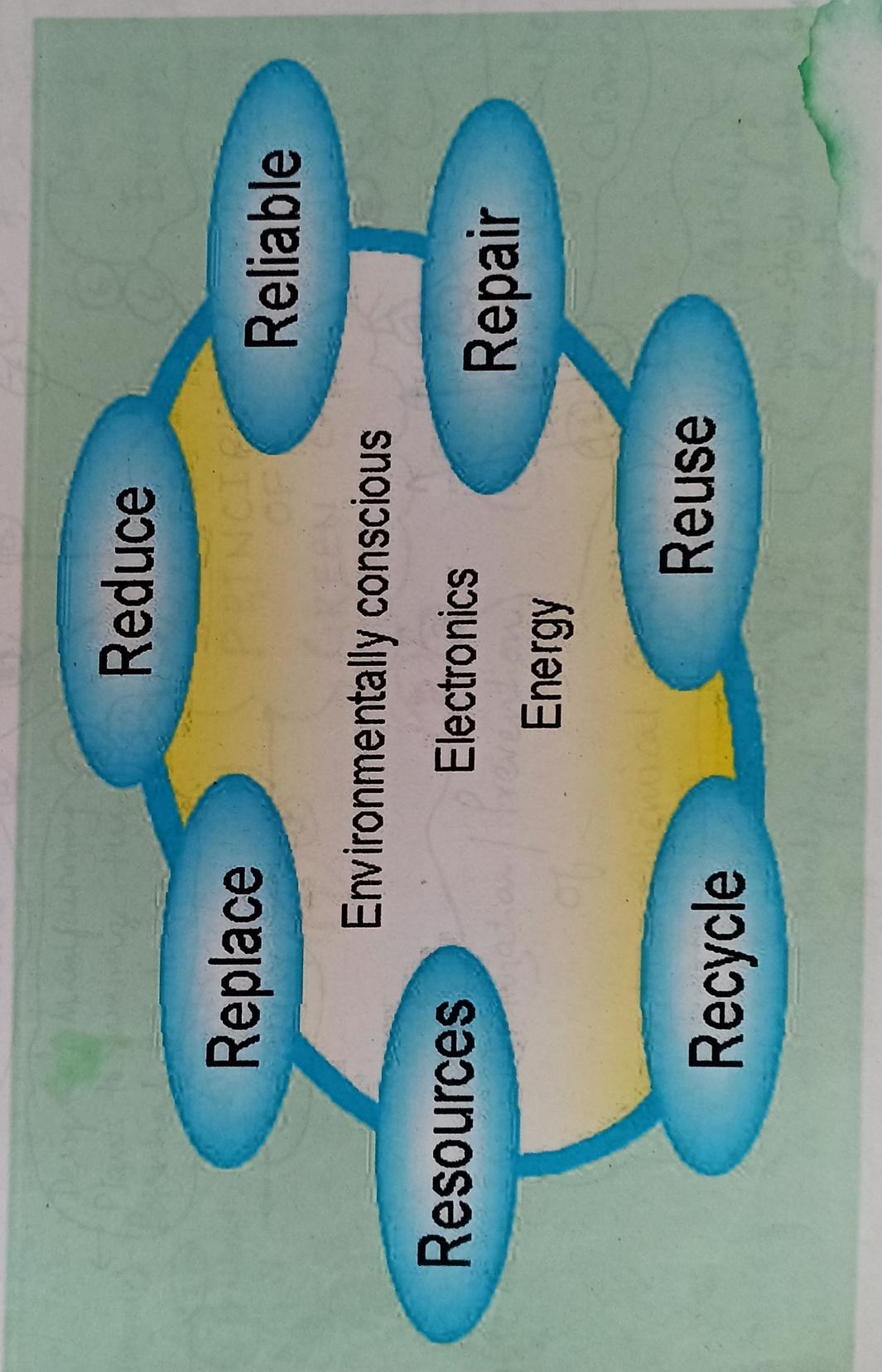
Reduce Carbon-Footprint

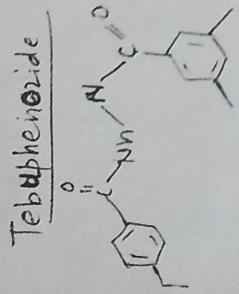
\$

Minimize waste



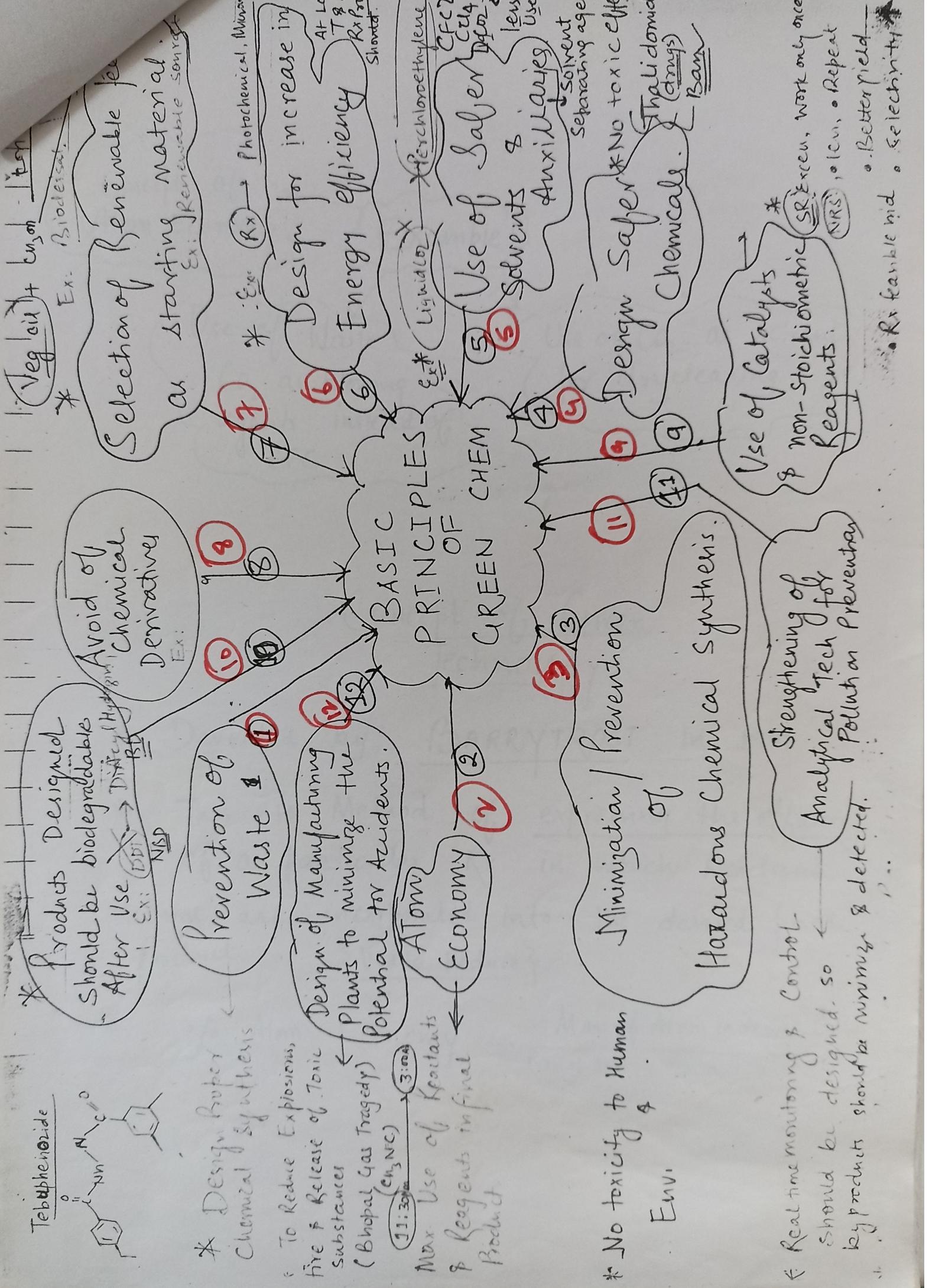
# The 7 R's of Green Technology:

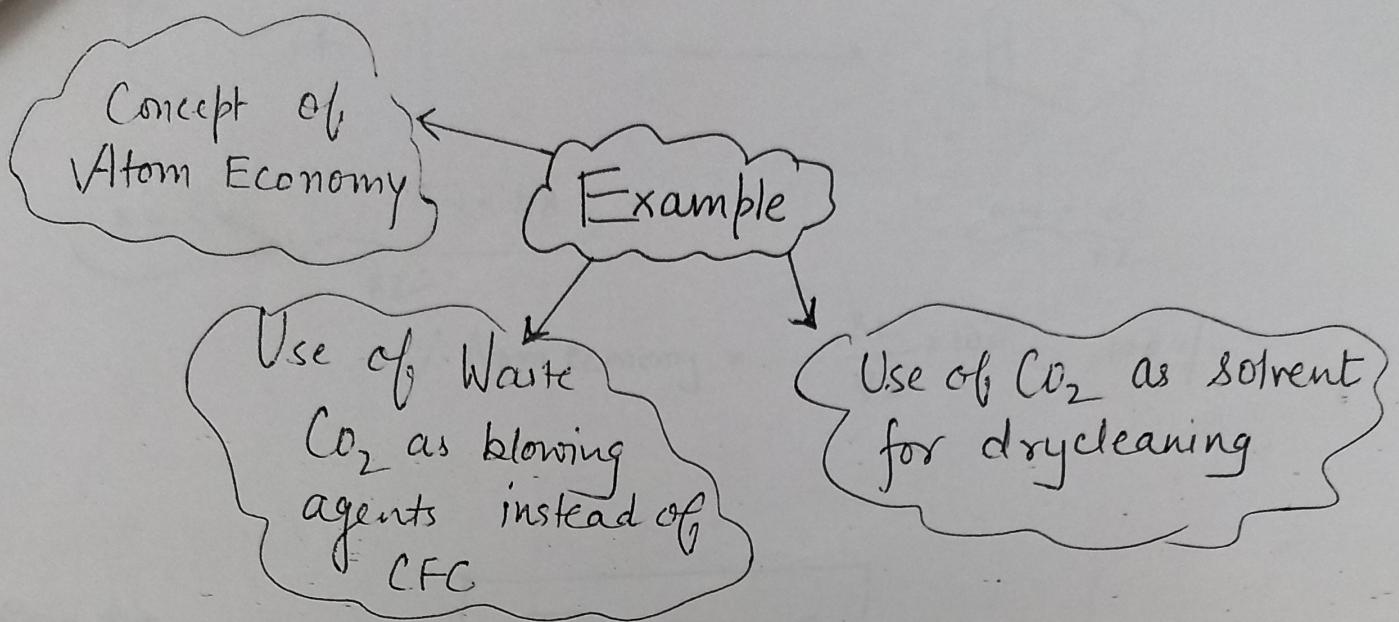




\* Products Designed  
Should be biodegradable  
After Use ~~Discard~~ → ~~Recycle~~ Reuse  
Ex: NIPD

Avoid of  
Chemical  
Derivatives  
Ex:

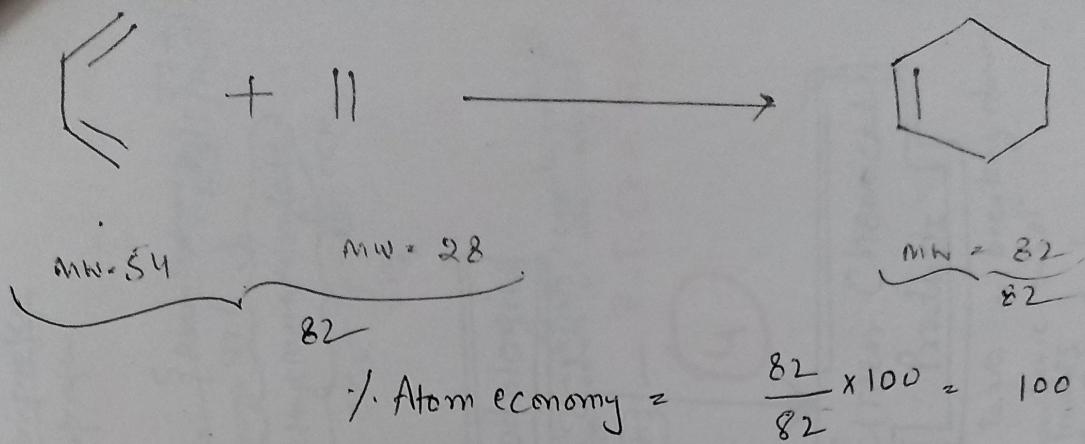




### Concept of Green Technology

- \* Developed by BARRY TROST in 1991
- \* This is Method of expressing the efficiency of a particular Rx. in which reactant atoms are incorporated into the desired final product. {Waste Reduce}
- \* % Atom Economy = 
$$\frac{\text{Mass of Atom in desired Product}}{\text{Mass of Atom in Reagents} \times 100}$$

Dick Alder



Main Aim:  
Reduce Toxicity

Objectives

### TOOLS OF GREEN CHEM

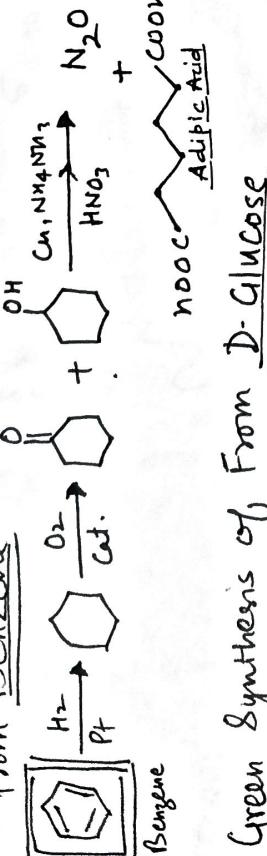
Tools

- ① Green Starting Materials
- ② Green Reagents
- ③ Green Rx.
- ④ Green chemical Products
- ⑤ Green Methodologist

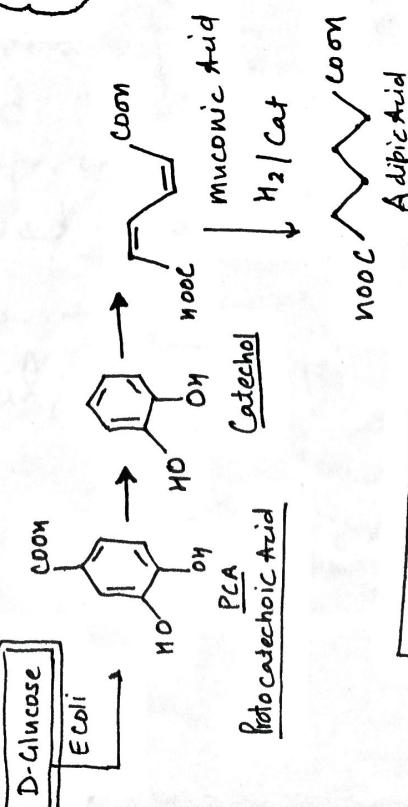
## Green Reactions

**① Green starting Materials**

Conventional synthesis of Adipic Acid from Benzene

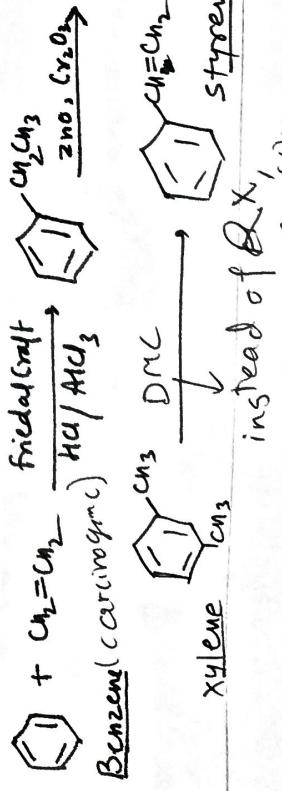


Green synthesis of D-Glucose



Green Reagent

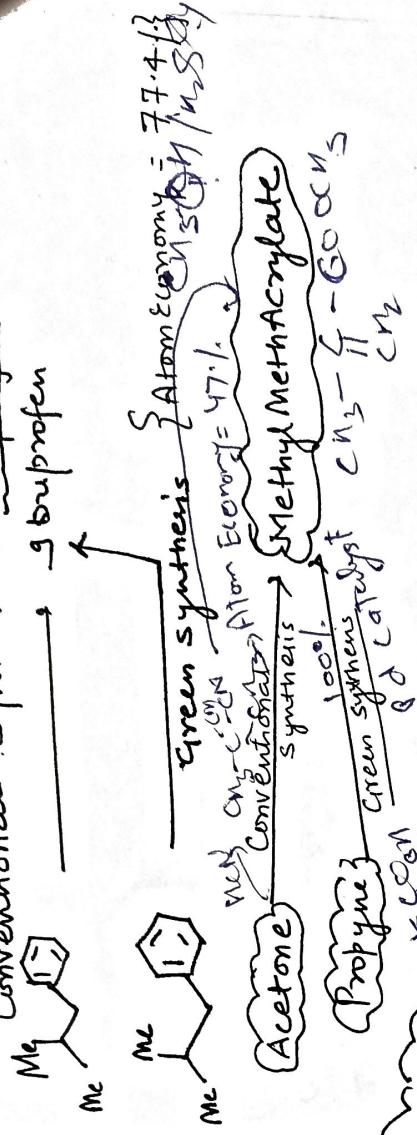
Regent → Non toxic, Max atom economy, renewable source  
Example: DMC : Dimethyl Carbonate



③

Based on "Concept of Atom Economy"

Conventional Synthesis of Ibuprofen



TOOLS OF GREEN CHEM

Green Methodologies

minimize Toxic starting materials, reagents, catalysts,  
by-products or intermediates

- P.T.O - Next Method

Oxidoreductases

Transferases

Green Chemical Products

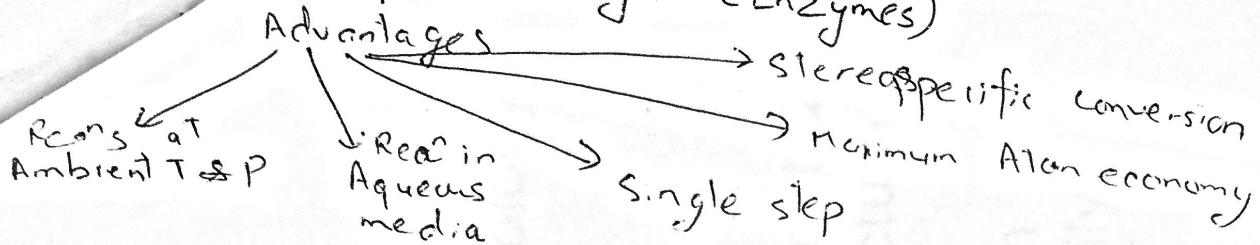
Less toxic or breaking down  
into non-toxic subst.

(e.g) DDT → food chain  
(organochlorine compds)  
organophosphates → less persistent

in environment  
readily decompose  
Non-persistent  
insecticides - DDT  
Hydrogenation

Ligases  
instead of  $\text{R}_2\text{X}$ ,  $\text{SO}_4^-$

## Use of Biocatalysts (Enzymes)

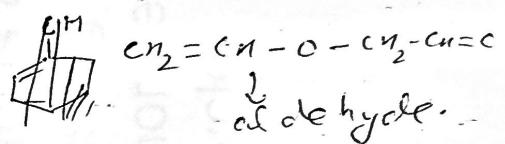


## II<sup>nd</sup> Method - Use of Aqueous Medium as Solvents

Solvent - H<sub>2</sub>O - available, cheap, safe, non-carcinogenic  
Highest value of specific heat.

Reac<sup>n</sup>s - i) Diels Alder reac<sup>n</sup>

ii) Claisen rearrangements



## Zero Waste Technology

essence of Green Chemistry

No by-products / Use of waste by-products as raw materials

Eg) C<sub>0</sub>2 - by-product from NH<sub>3</sub> manufacturing & natural gas units - used as blowing agent for making extruded polystyrene foam sheet.

Earlier CFC & HCFC used instead of liq. C<sub>0</sub>2.  
Advantages of supercritical C<sub>0</sub>2 (as blowing agent)

① by-product removed, no contributn to greenhouse techn.

② replaces CFCs - reduces O<sub>3</sub> depletn

③ C<sub>0</sub>2 - economical, easy to handle, neither forms smog.

# Green Nanotechnology

- ❖ It refers to the use of Products of Nanotechnology to enhance the Environment – Sustainability.
- ❖ It means ' to minimise the potential environment & human health risks associated with the manufacture & use of nanotechnology products & also to encourage replacement of existing products with new nano-products that are more environmentally friendly throughout their life-cycle.