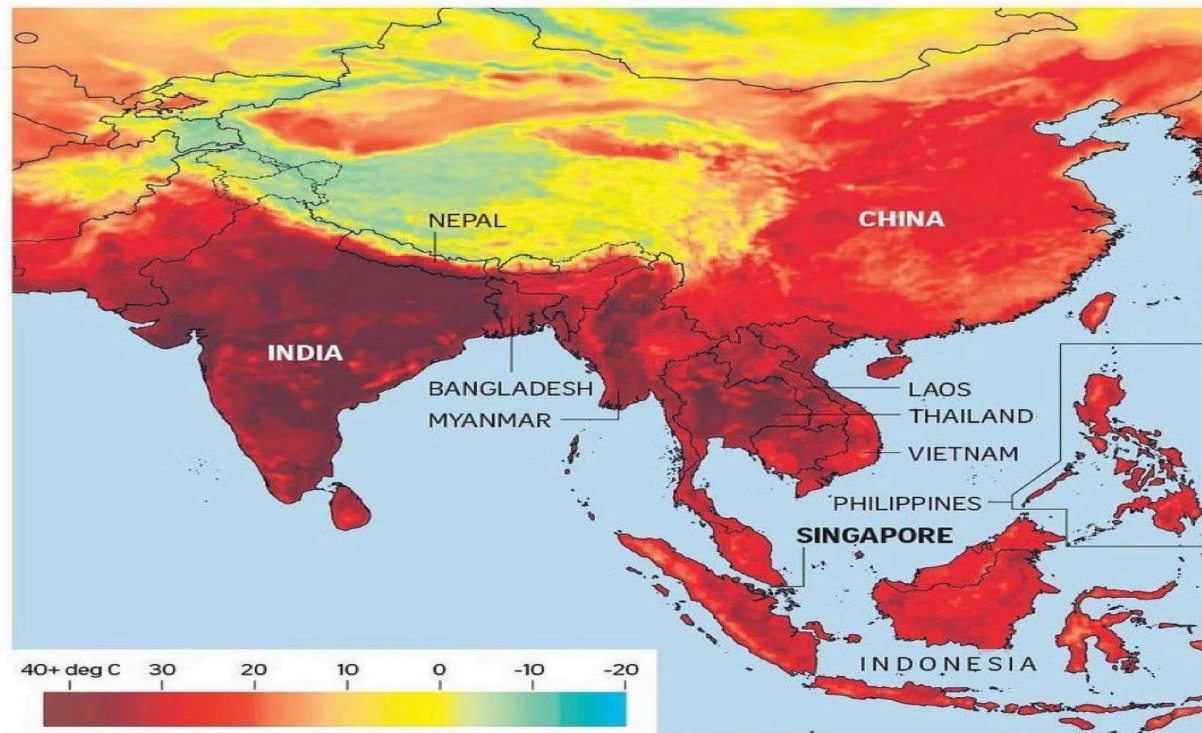
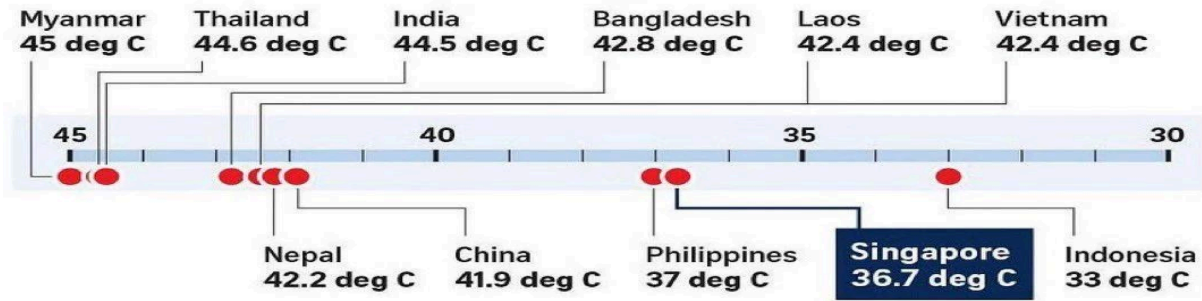


# Energy Transition

to steer earth away from climate-destruction

## *A Sri Lanka Opportunity*

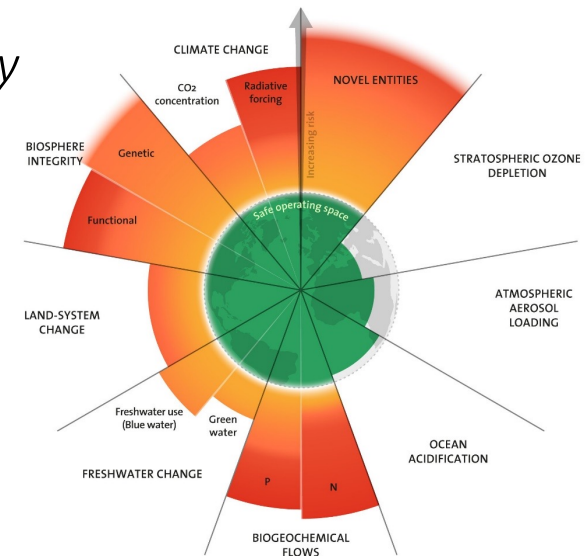
Ashok Jhunjunwala, Institute Professor, IITM  
ashok@tenet.res.in



# Is Our Earth in real trouble?

Planetary boundaries are the Earth's health indicators crossing these make the changes irreversible

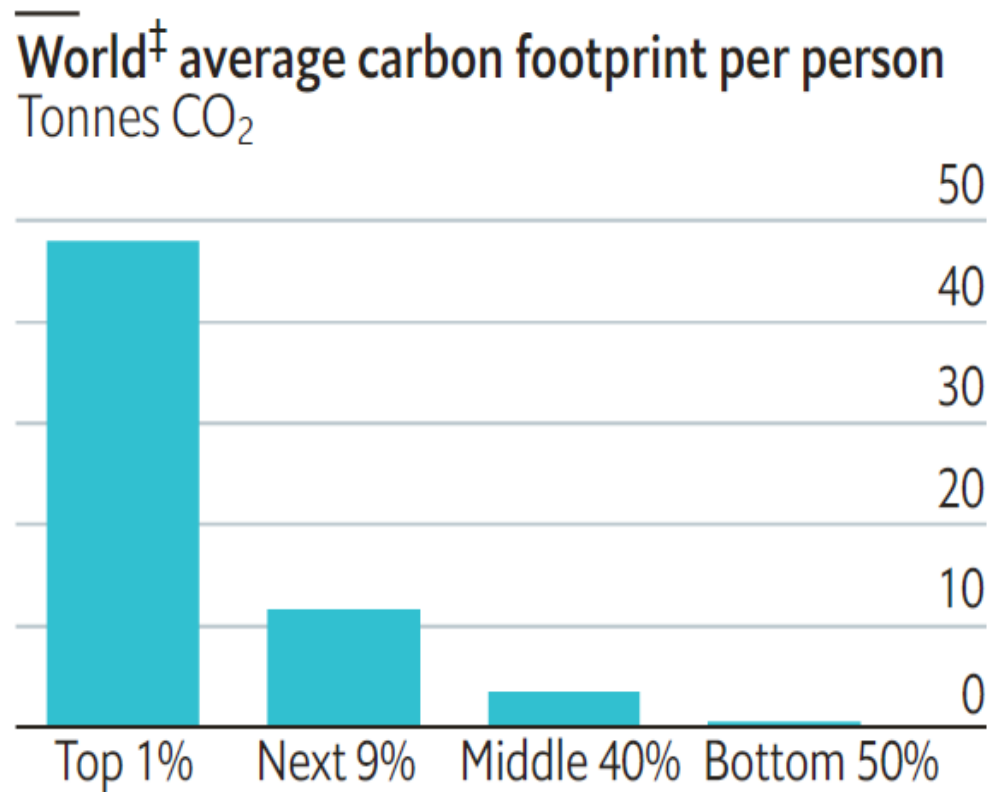
*six of nine already crossed*



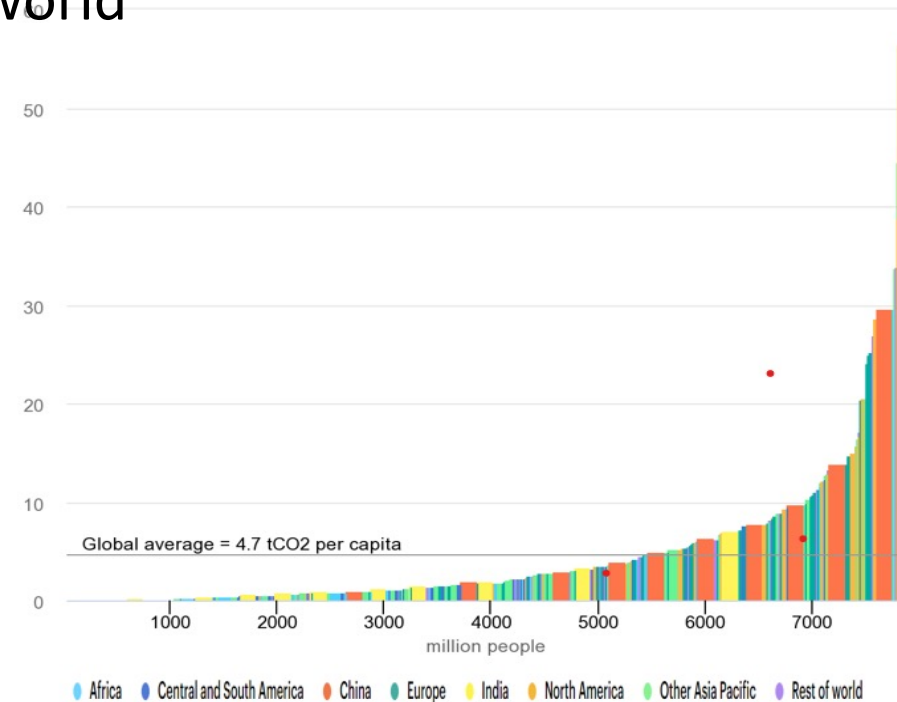
# Who contributes and who is most impacted?

The Rich and Poor Divide

# Global Warming: Who Contributes?



- And in every country, there are people who belong to top 1% emitters in the world

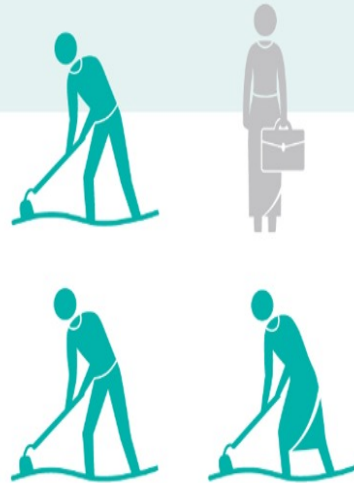




## Who is most affected by climate change?

**Climate change is a matter of life and death.**

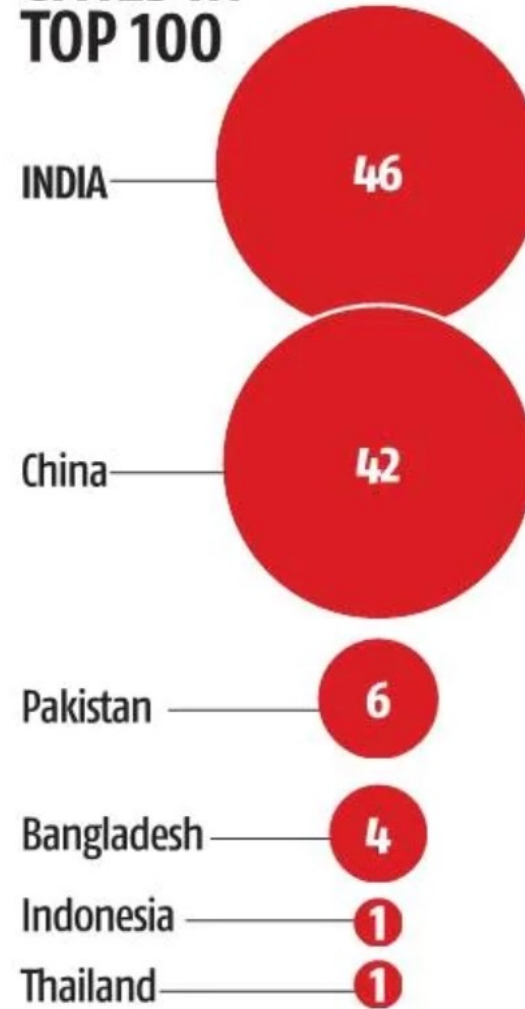
**3 out of 4 people** living in poverty rely on agriculture & natural resources to survive.



And India and the region already most affected by fossil-fuel based transport

Where does Sri Lanka Stand?

### NUMBER OF CITIES IN TOP 100



Source: The 2020 World Air Quality Report

### MOST POLLUTED CITIES 2020

The most polluted cities, according to the data aggregated from over 80K data points

1	Hotan (China)	110.2
2	Ghaziabad (India)	
3	Bulandshahr (India)	
4	Bisrakh Jalalpur (India)	
5	Bhiwadi (India)	
6	Noida (India)	
7	Greater Noida (India)	
8	Kanpur (India)	
9	Lucknow (India)	
10	Delhi (India)	

(PM 2.5 MICROGRAM/M<sup>3</sup>)  
With inputs from Al Jazeera

# Transition Pathways

- Fossil Fuels → **Green Energy and Green Electricity**
  - Moving all usage to Green Energy (Biofuels, Green Hydrogen as a fuel, Green Electricity via solar, wind, nuclear and bio)
- Using Energy more **efficiently**
  - Heating and Cooling, Electric Motors and Controllers, Green Buildings, Green Transportation
- Circular Economy
  - Recycling
  - Carbon Capture utilisation and sequestration
- Sustainable lifestyle



# Make Going Green financially viable

- Replacing use of fossil fuels with **Green** Electricity and enhancing **energy efficiency**
  - Will reduce GHG emissions
  - Will reduce pollution
- Challenge is to **develop** technology and commercialise
  - such that this will also save **money**

# Transition Approach

**making green technologies scale with commercial viability**

*over next 5-10-20 years, all technologies required can be made viable*

- Green Electricity: Solar, Wind **scaling** at ₹2 to 3 per unit (kWh) in India
  - Focus on solar panel manufacturing and next gen technologies
  - Wind: 120m → 150m; off-shore wind (larger turbines)
  - **Micro-nuclear** in tens of thousands to make it economically viable
  - Make bio-electricity viable
- Green Buildings
  - **75%** electricity consumed by commercial, industrial & HIG complexes in India
  - Make going Green financially viable
- Energy Storage
  - Batteries: short-term and long-term
  - **40%** of electricity in buildings used for cooling: Thermal Storage

- Green Transportation
  - **Electric Vehicles** already scaling
    - passenger vehicles commercially viable; long distance **buses and trucks still far away**
  - Urban Mobility: Overcoming 2+ hour home ↔ office commute in **Congested Cities** - HASHTIC
- **Green Hydrogen** usage in manufacturing of Ammonia, Cement, Steel, Aluminum, Glass -- **commercial viability to be realized**
  - Carbon Capture: lots to be done
- Heating and Cooling consumes **50% of energy** today with COP of 1.5
  - Driving COP to greater than **6 or more**
- Making motors and controllers more energy efficient
  - consuming **46% of world's electricity** today

# Sri Lanka Energy Strategy

Make a 5 year / 10 year / 20-year plan

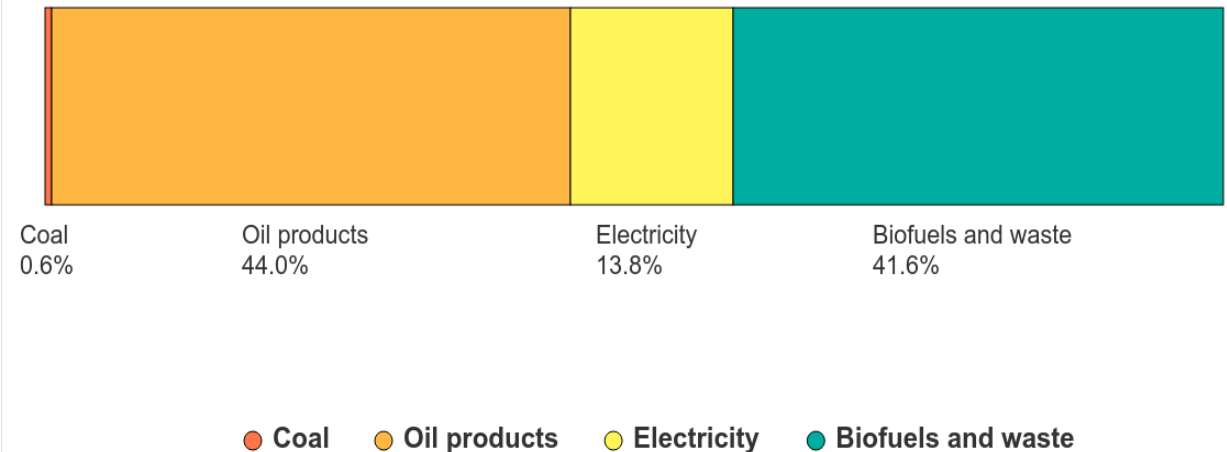


1. Convert fossil fuel usage to **Electricity**
  - Move **transport** to Electricity
  - Move **heating and cooling** (industry, commercial and domestic) to electricity and **maximise energy efficiency**
2. Move Electricity generation to **Green**
  - Balance Supply and Demand using **hydro, Storage and Grid**
  - **Connect** Sri Lankan Grid to Indian Grid
3. Reduce **Cost** of Energy Generation
4. **Recycle** Solar, Batteries and everything else
5. Develop / acquire Technology and carry out **local manufacturing**
6. **Nurture** Sri Lanka **young talent** to carry out technology development

# Converting fossil-fuel usage to Electricity

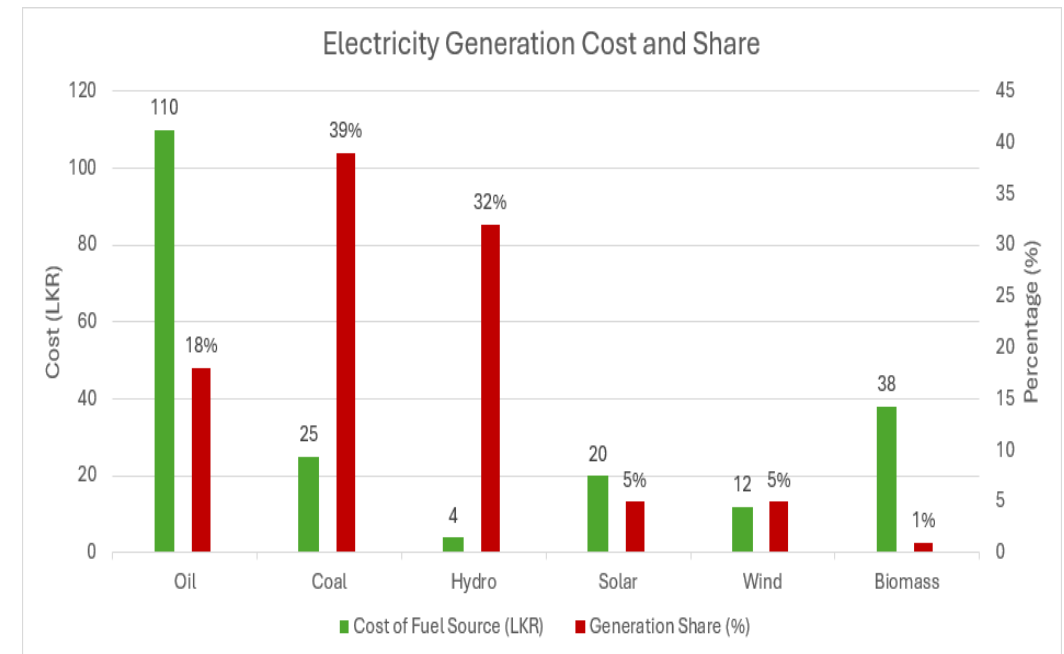
- Sri Lanka consumes 100 TWh of energy per year
  - About **45%** from imported **oil**
  - Contributes significantly to Sri Lankan GHG emissions
  - **Hurting** Sri Lankan economy badly
- Can Sri Lankan Energy Usage be all converted to **electricity**?
  - Will this enhance energy efficiency?
  - Will this be **economically** viable?

Total final consumption, Sri Lanka, 2021



# Move Electricity generation to **Green**

- Electricity from Renewable energy in Sri Lanka costs **less** than that from fossil fuels
  - Fossil fuel increases import bills
  - Has significant GHG emissions
- Demand can be matched to supply by **managing** hydro electricity generation
  - Can also use **pumped hydro** as storage
  - Develop **Battery** based energy storage
- **Connect** Sri Lanka Grid to India Grid to enhance RE usage



# Technology and Talent Development

- **Develop Technology to Recycle** Solar, Batteries and everything else
  - Set up recycling for a Circular Economy
- Develop / acquire Technology and carry out **local manufacturing for RE, battery, EVs, heating and cooling**
- **Nurture** Sri Lanka **young talent** to carry out technology development
  - Especially to mitigate climate change

# Sri Lanka Opportunity

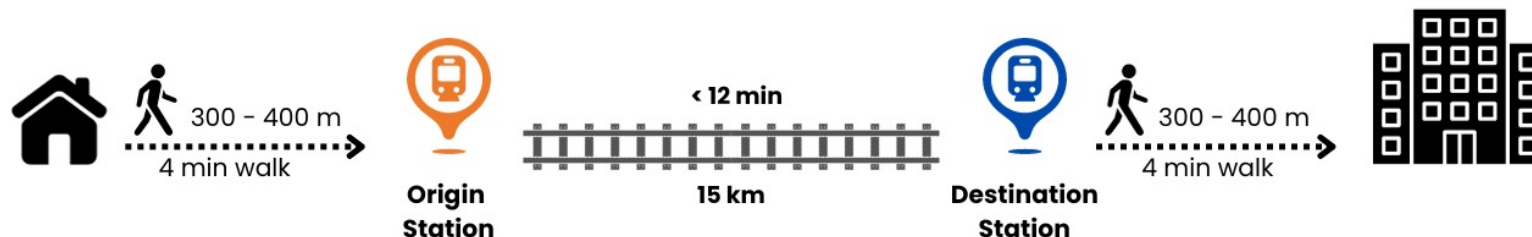
- **Reduce** Cost of energy while combating climate change
  - Reduce **import bill** considerably
- Opportunity to develop Sri Lanka **Talent and Technology**
- Opportunity for rapid and large **Industrial Growth**



# Examples of Innovative Technologies

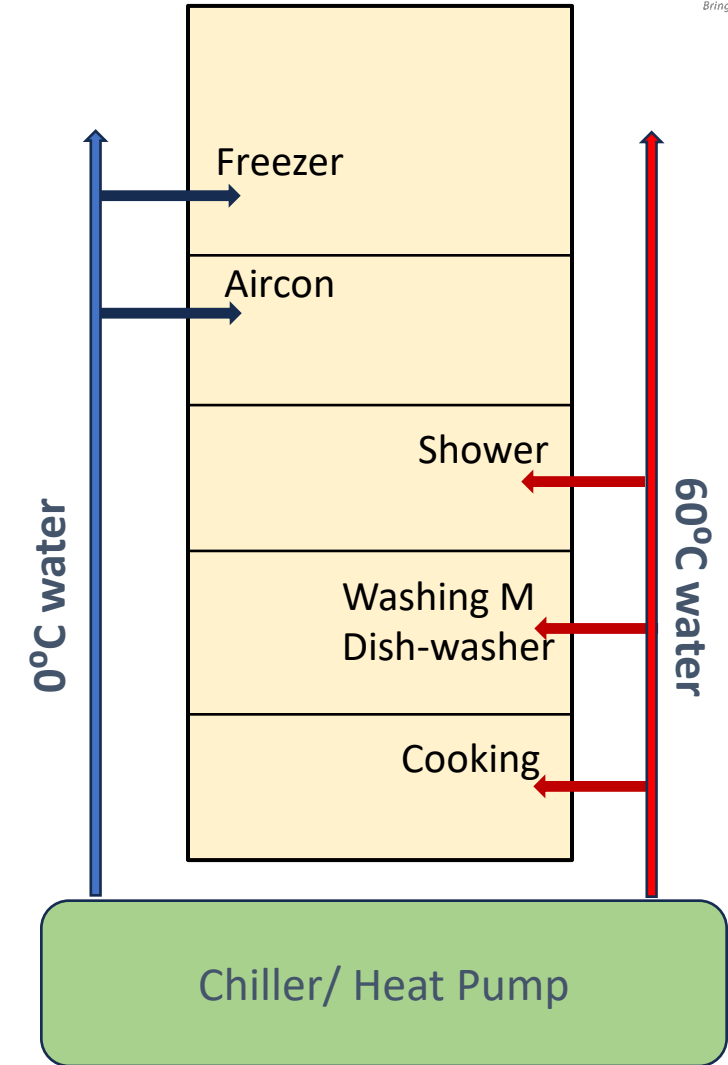
# Challenges that youngsters can take up: An Example

- Office  $\leftrightarrow$  Home Commute in Chennai often exceed an hour each way
  - Can we reduce travel time from 75 min. today  $\rightarrow$  **20 min.**
- Personalized Pod: Comfortable energy-efficient using green electricity
  - Built on existing city-infra, Affordable
- HASHTIC
  - Autonomous point-to-point public transportation system
  - Unidirectional and no Crossing  $\rightarrow$  avoids congestion
  - Large no of routes: chosen to keep POD moving at 75 kmph average



# District Heating and Cooling

- Heating and Cooling consumes 50% of world's energy
  - Fossil fuel based → highly inefficient
- Electric Heating/cooling: heat-pumps/chillers
  - 1 kWh electricity → 4 units of heat + 4 units of cooling (COP= 8)
- Hot and Cold-water pipes can be taken to each flat
  - Cold water for refrigerator, freezer and air-con
  - Hot water for Shower, Washing machine, dish-washer and cooking
    - 60°C water will help reduce cooking energy
    - LPG cooking → induction stove



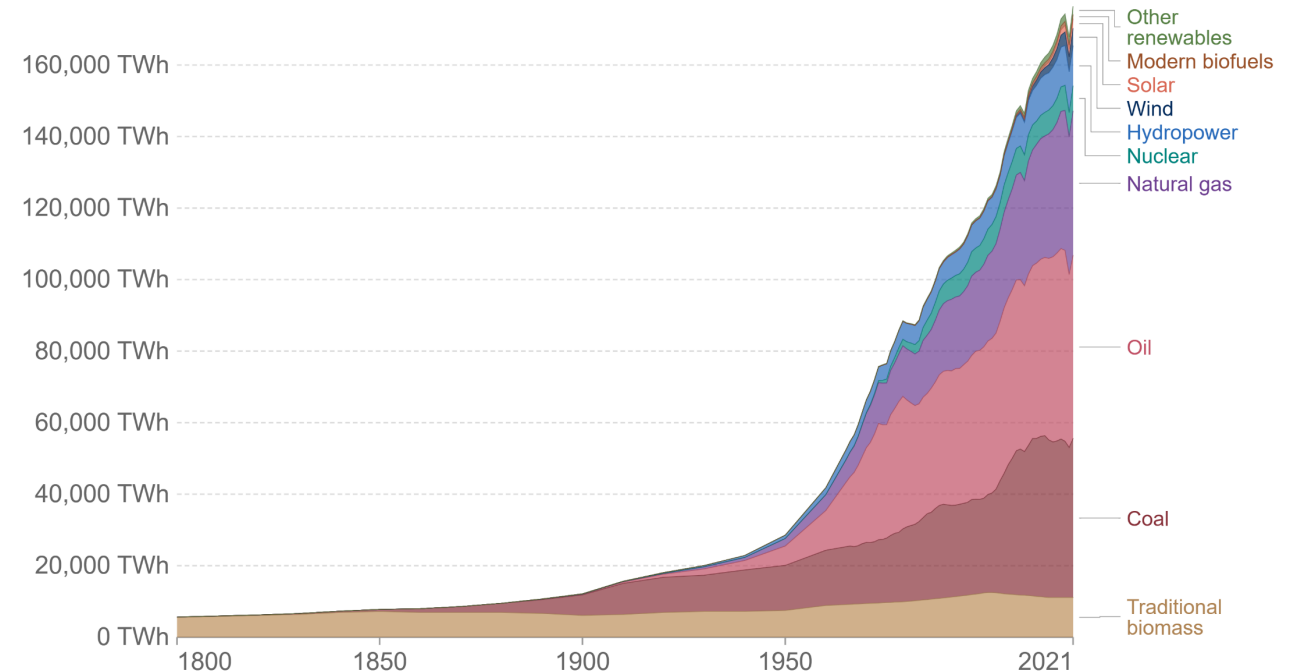
# But can technology alone save us?

- The world has enough for everyone's need, but not enough for everyone's **greed** — **Mahatma Gandhi**
- Can we be happy with simpler living?

## Global primary energy consumption by source

Primary energy is calculated based on the 'substitution method' which takes account of the inefficiencies in fossil fuel production by converting non-fossil energy into the energy inputs required if they had the same conversion losses as fossil fuels.

Our World  
in Data



Source: Our World in Data based on Vaclav Smil (2017) and BP Statistical Review of World Energy

OurWorldInData.org/energy • CC BY