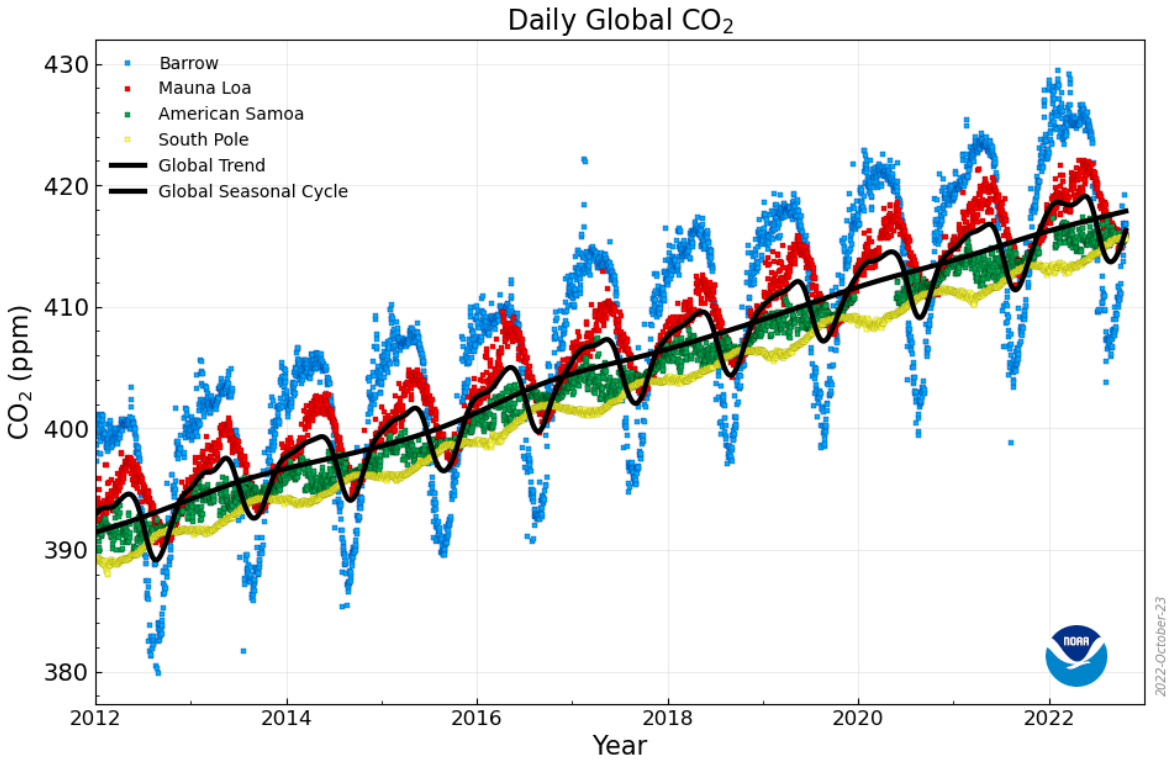
Energy Efficiency as a Necessary Element for Decarbonization

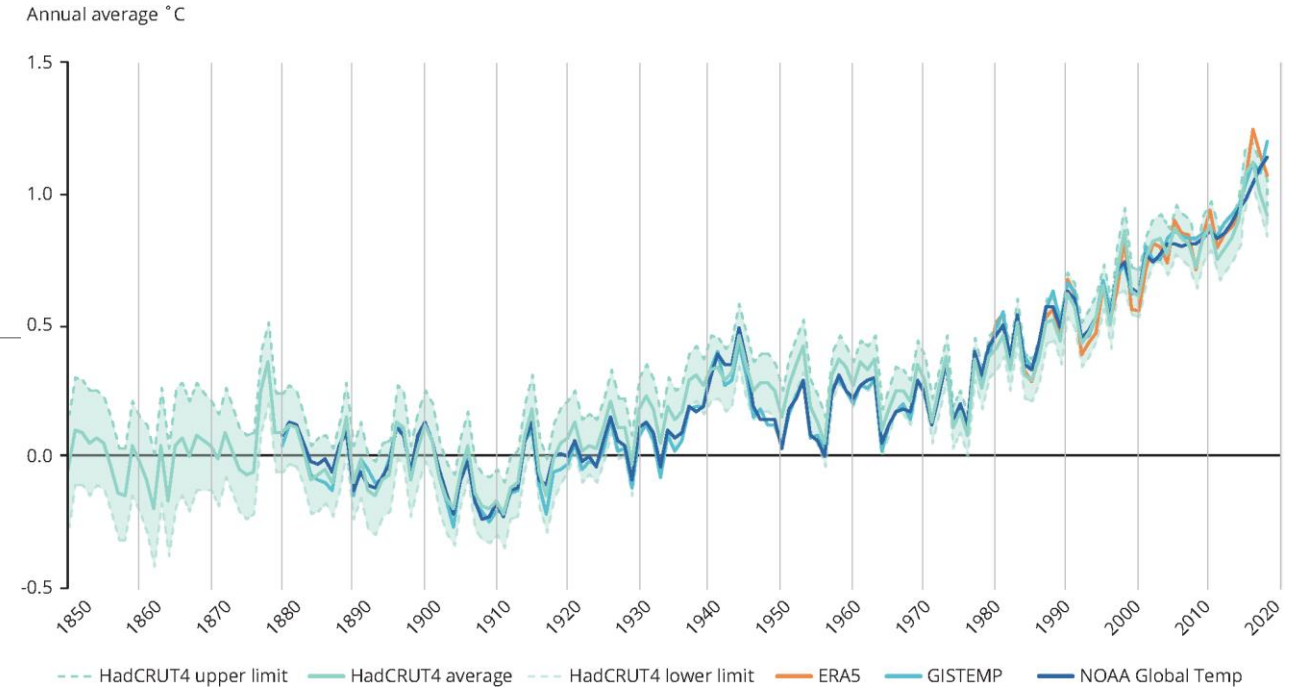
R A ATTALAGE

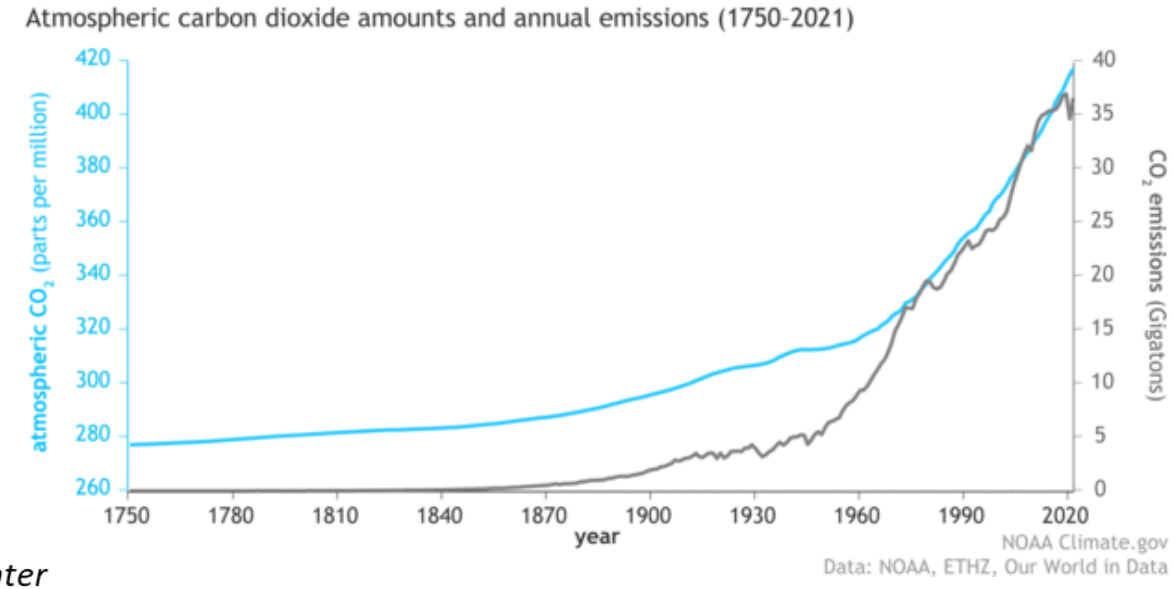
SRI LANKA INSTITUTE OF INFORMATION TECHNOLOGY

ACKNOWLEDGEMENT: E-SOURCES

Concerns/Issues





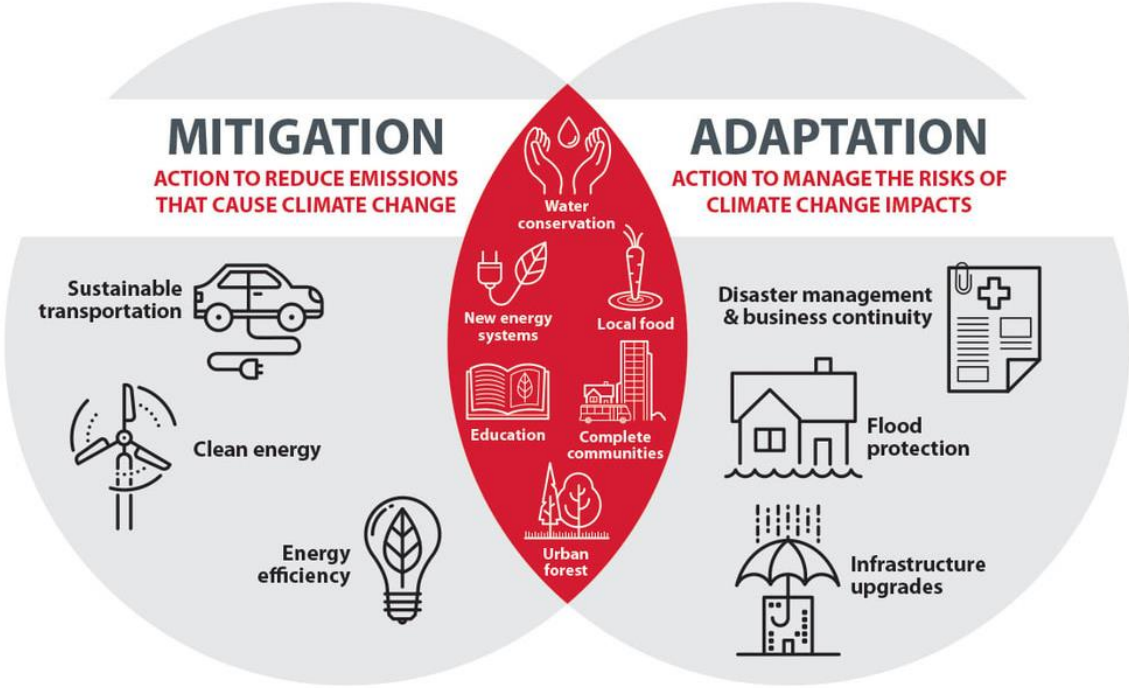


Source: Shared from National Cleaner Production Center

Responding Climate Change

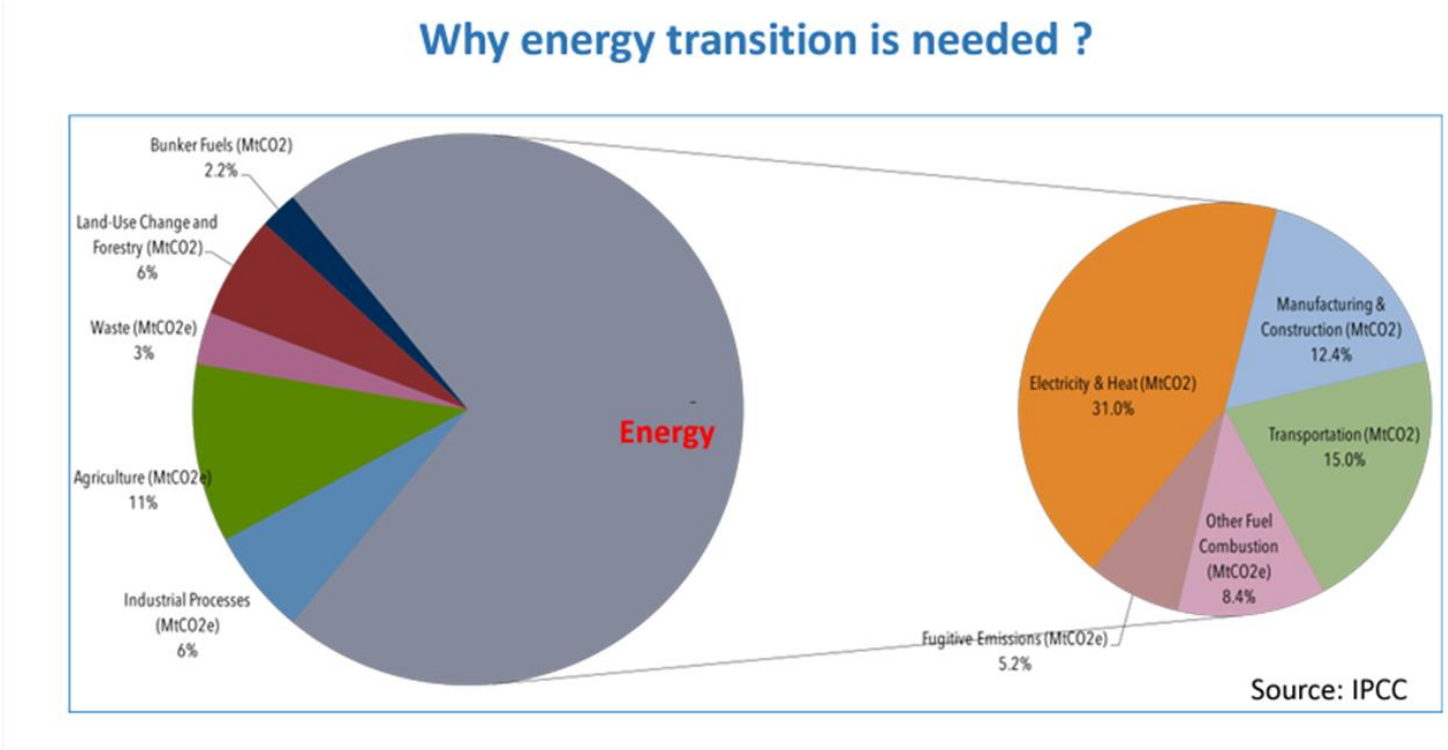
Climate Action

- Mitigation
  - Efforts to reduce emissions and enhance sinks
  - Reducing the flow of heat-trapping greenhouse gases into the atmosphere
- Adaptation
  - Taking practical actions to manage risks from climate impacts, protect communities, and strengthen the resilience of ecosystems
  - Involves adjusting to actual or expected future climate



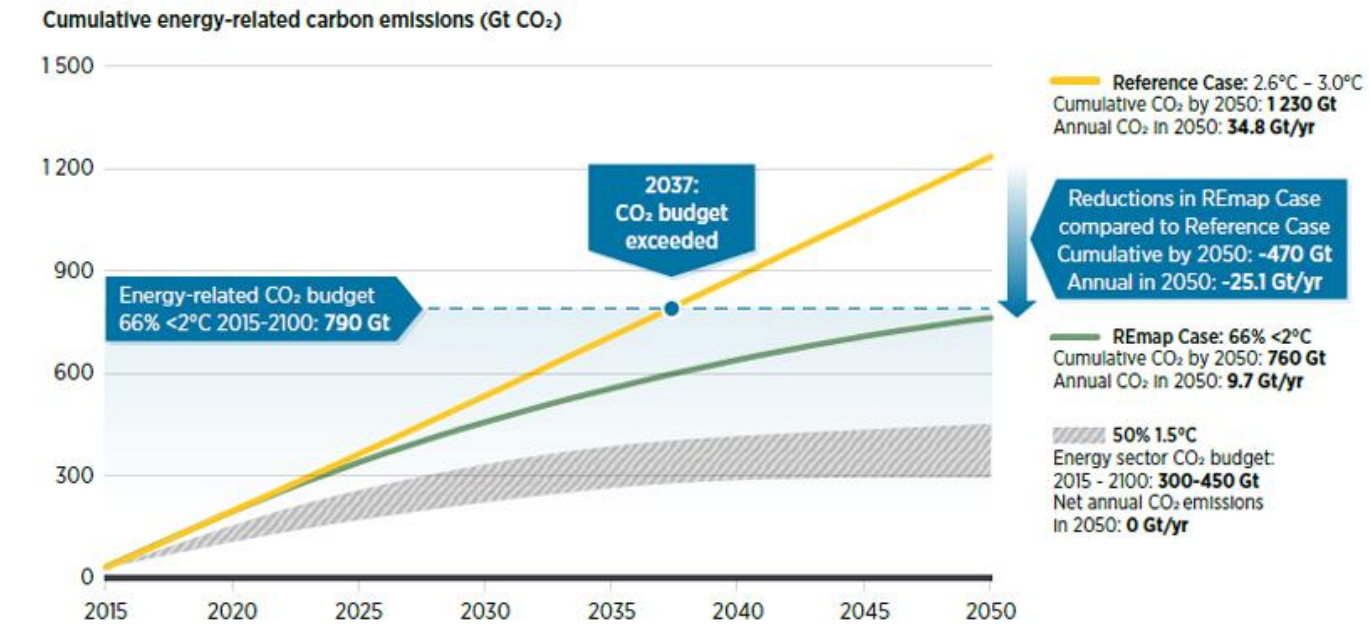
Source: Shared from National Cleaner Production Center

Need for Energy Transition



Energy is Responsible for around 72% of global GHG emissions

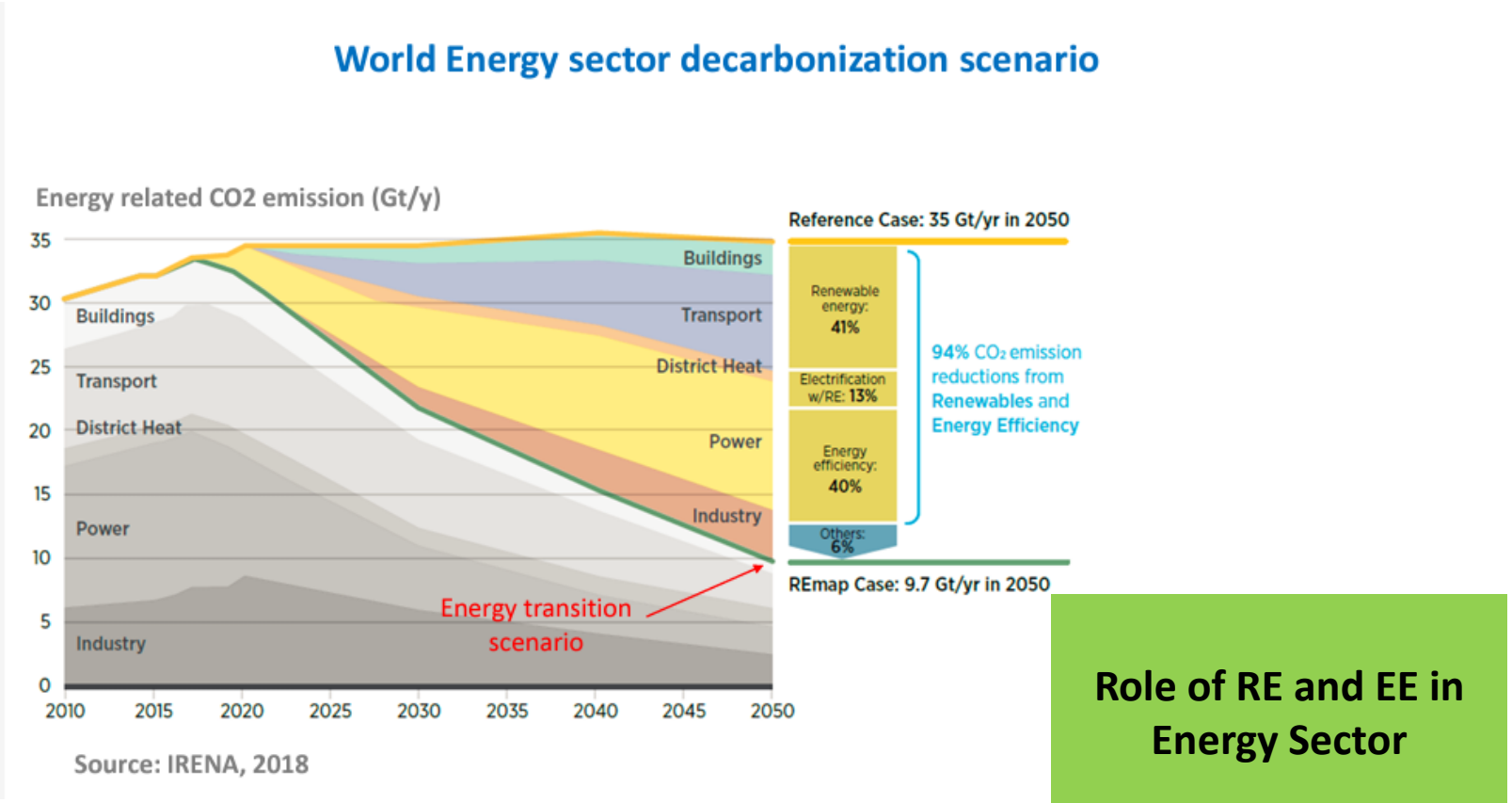
Need for Energy Transition



Source: IRENA, 2018

Committed Decarbonization Needed for 2°C pathway

Energy Sectors Decarbonizing Scenario

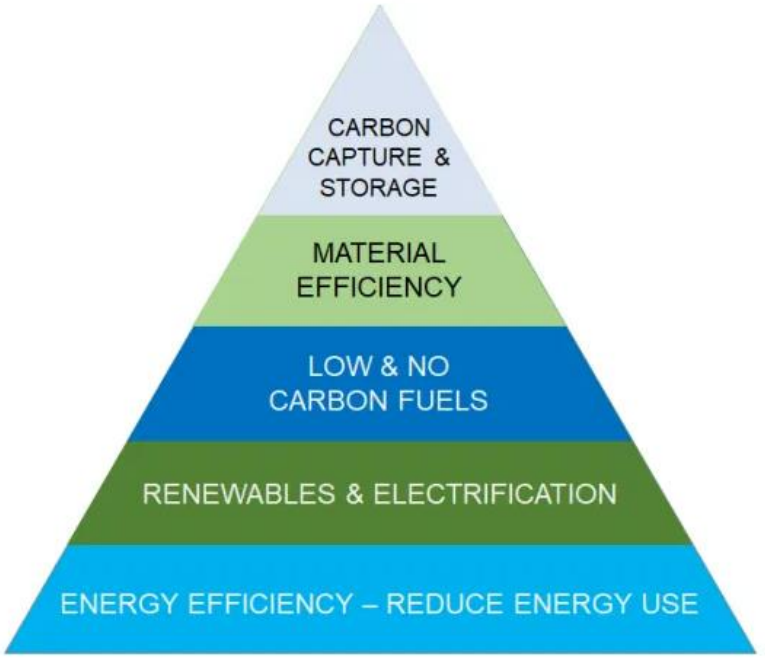


Role of RE and EE in Energy Sector

Main Drivers in Energy Decarbonization

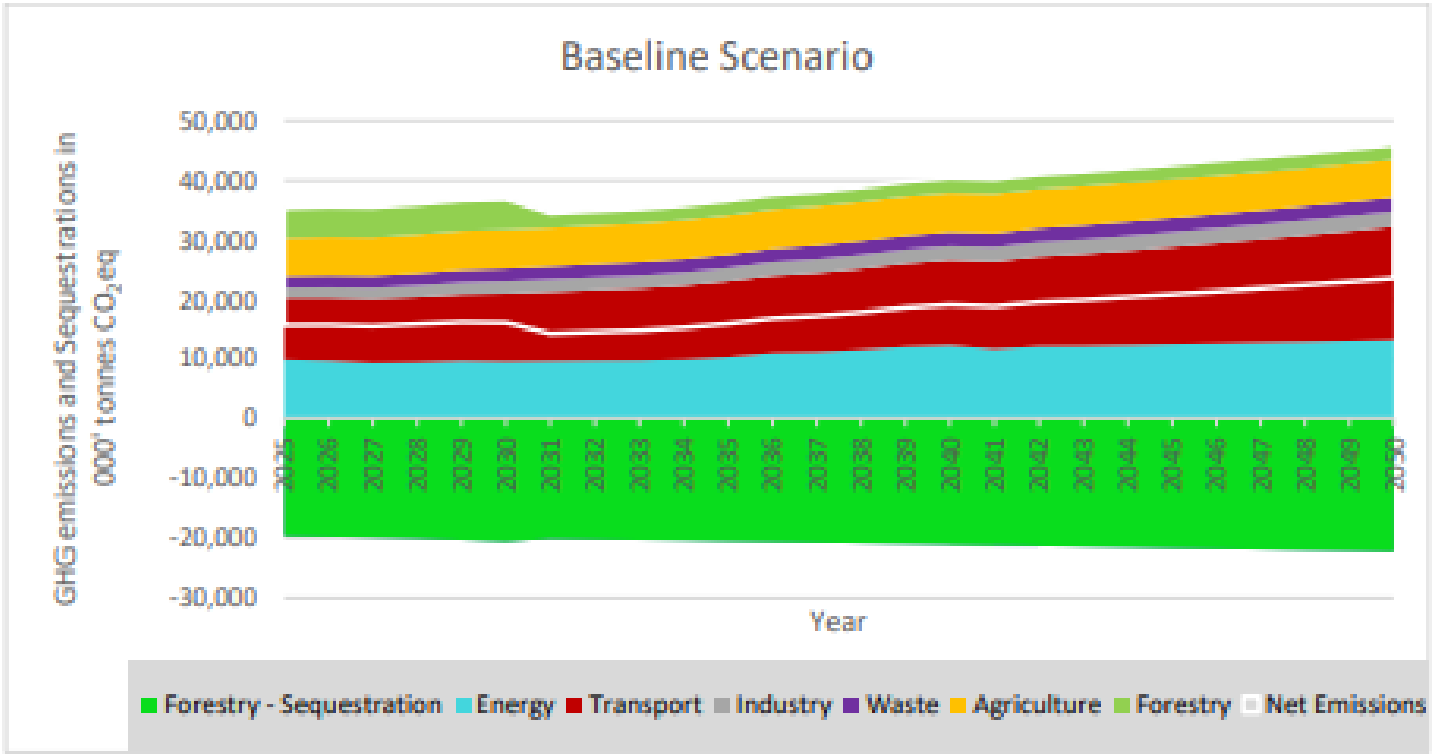
Sectors	Main drives energy decarbonisation in economic sectors
Transport	• Modal change: rail way, collective transport, soft transport, etc.) • EE in cars and all transport means • Massive introduction of electrical vehicles • Electrification of rail ways
Industry	• Energy efficiency in process • Efficiency of utilities (motors, compressed air, heat, cold..) • Thermal use of RE (Solar and biomass) • Electrification of uses
Buildings	• Energy efficiency of envelop and appliances • Solar thermal and biomass for heat (when available) • Electrification of residential use (heat pumps, etc.)
Agriculture	• Efficiency improvement of agriculture machineries • Solar thermal use • Electrification of water pumping
Power sector	• Losses reduction • Power generation specific consumption improve • Massive RE integration in the Power System

Source: e-Source



Energy efficiency is the foundation for other decarbonization strategies

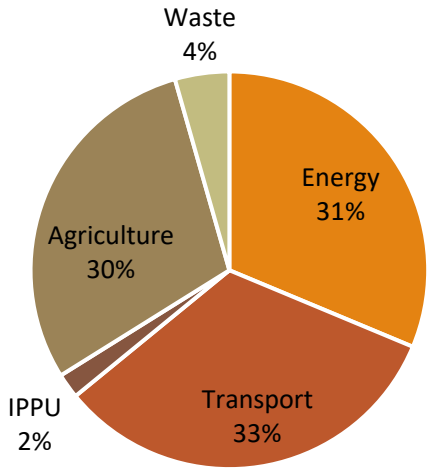
Cumulative Emissions & Sequestration – Baseline Scenario SL

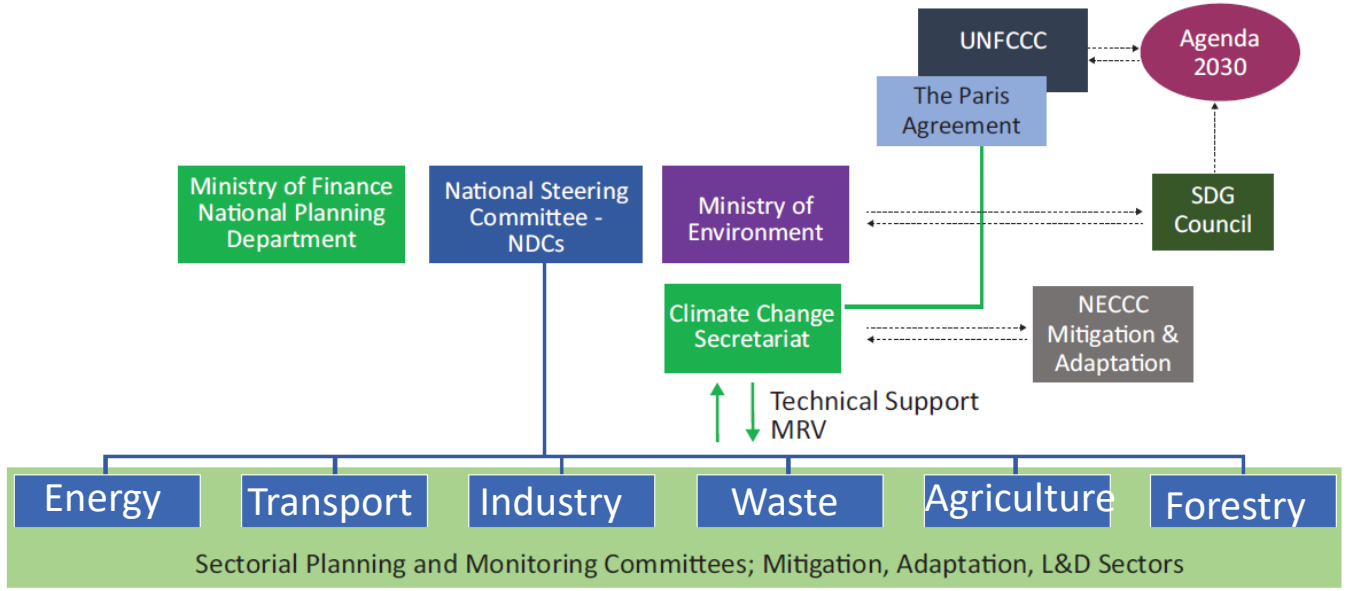


Source: Roadmap 2050 SL

Figure A: The Cumulative Emissions and Sequestration for the Baseline Scenario

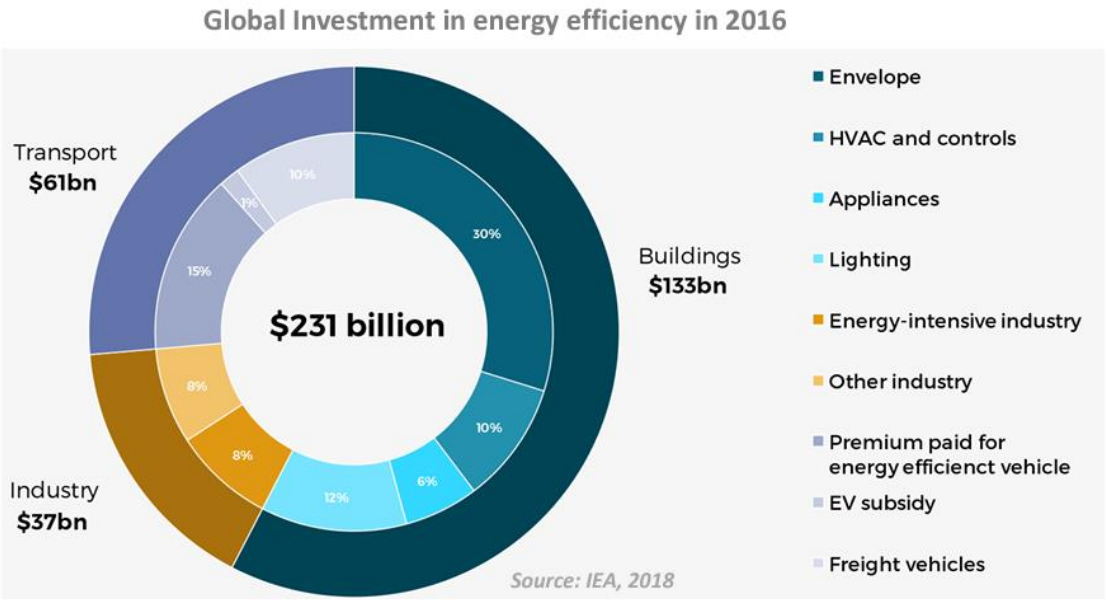
NDC Approach



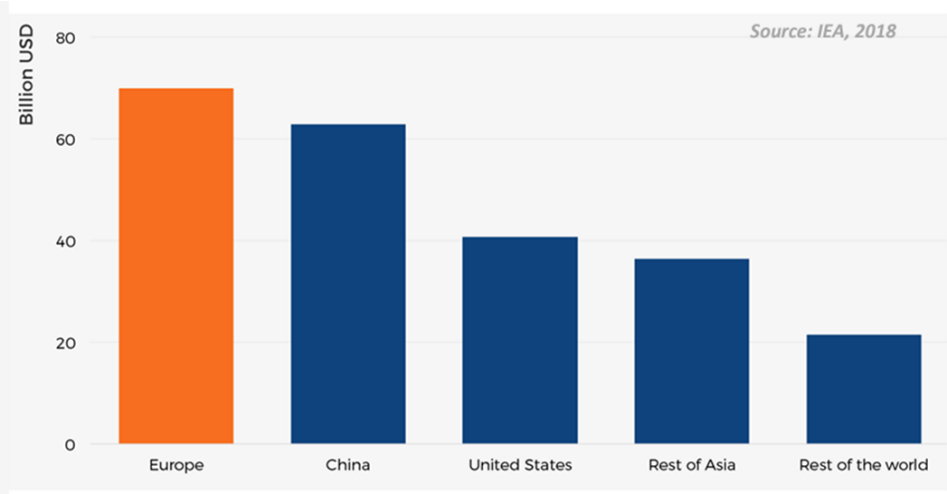


Source: Shared from National Cleaner Production Center

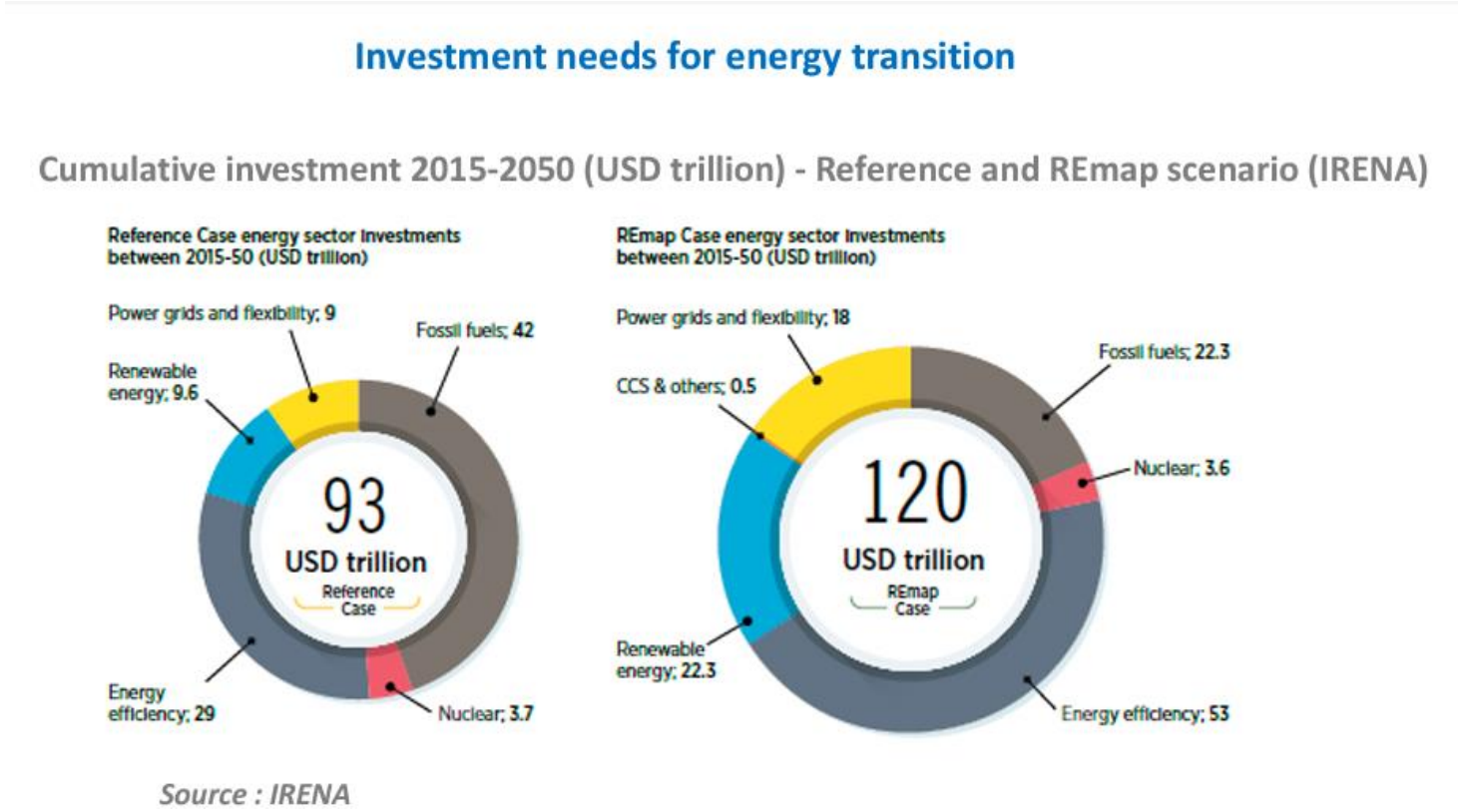
Global Investment in EE



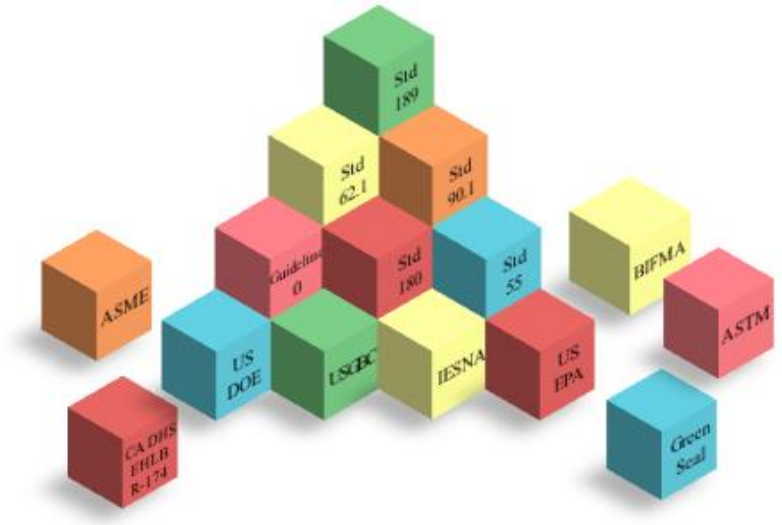
Regional Investment in Energy Efficiency 2018



Cumulative Investment 2015-2050



Energy Efficiency

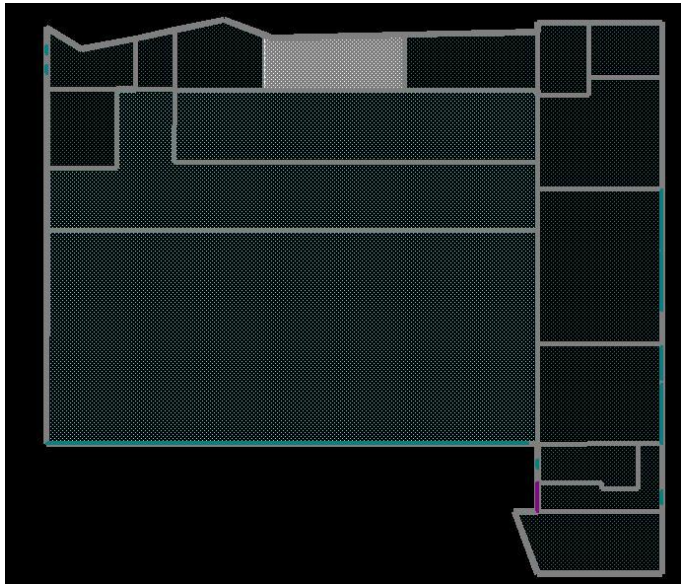


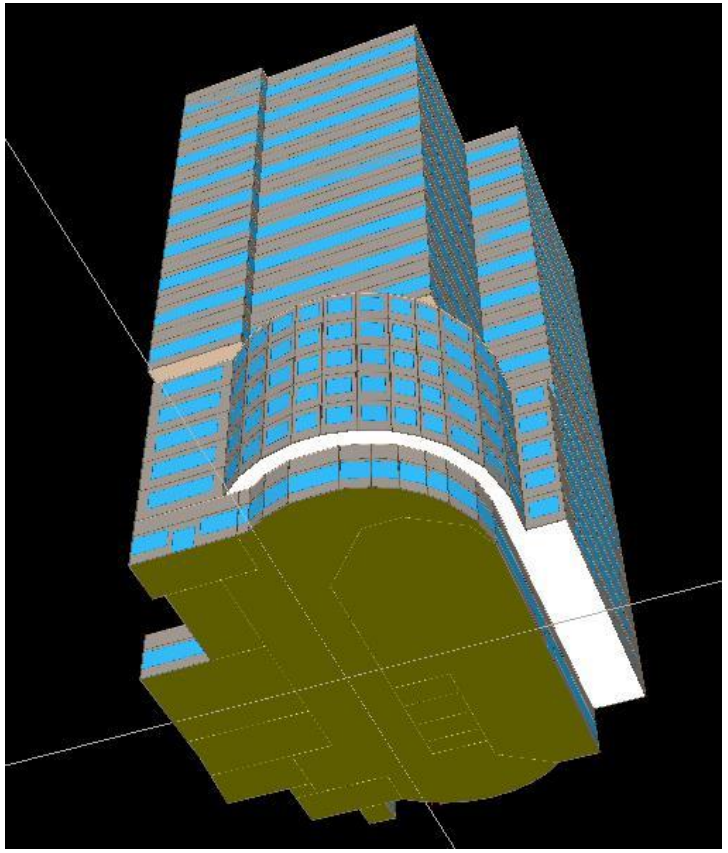
Source: e-Source

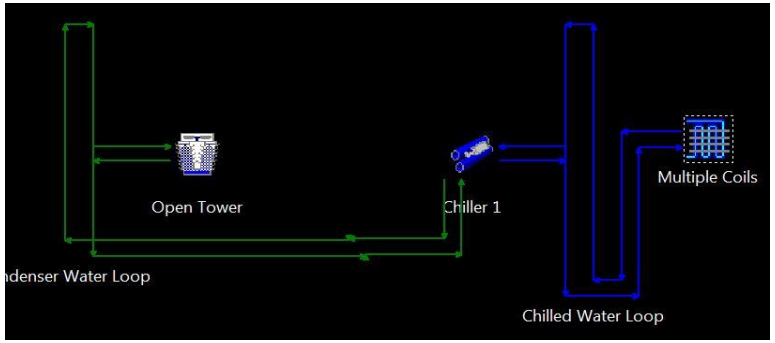
EE Implementation Landscape

- Energy Management and Government role (Codes & Standards, Labelling; ISO 50001, Policy & Regulatory mechanisms, MEPS)
- Policy and regulatory framework and enforcement
- Financial Incentives and Funding (grants, funding, loans, funding models)
- Risk assessments and service providing models
- Capacity, Capability development and Information compilation (capacity mobilization & building, dissemination of info), EE marketing
- Monitoring and Verification (International protocols IPMVP, measurement protocols)

Case Study – Energy Efficient Office Building







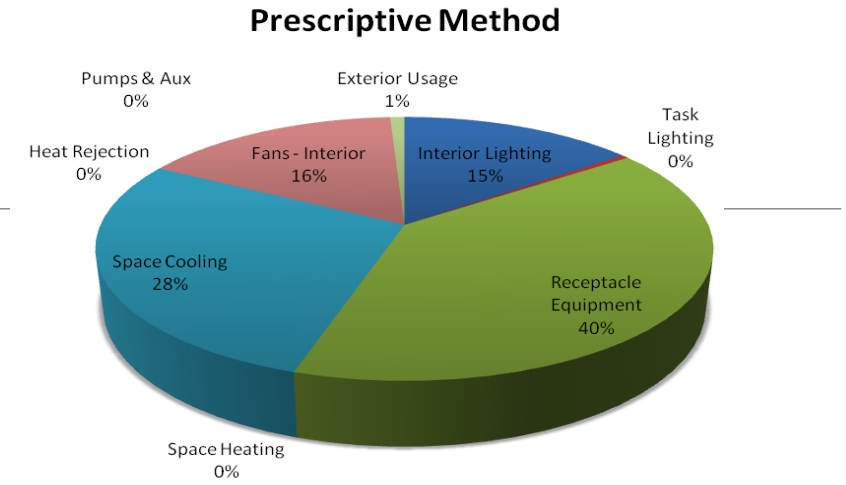
Source: Attalage et al, Commercial Building EE Project

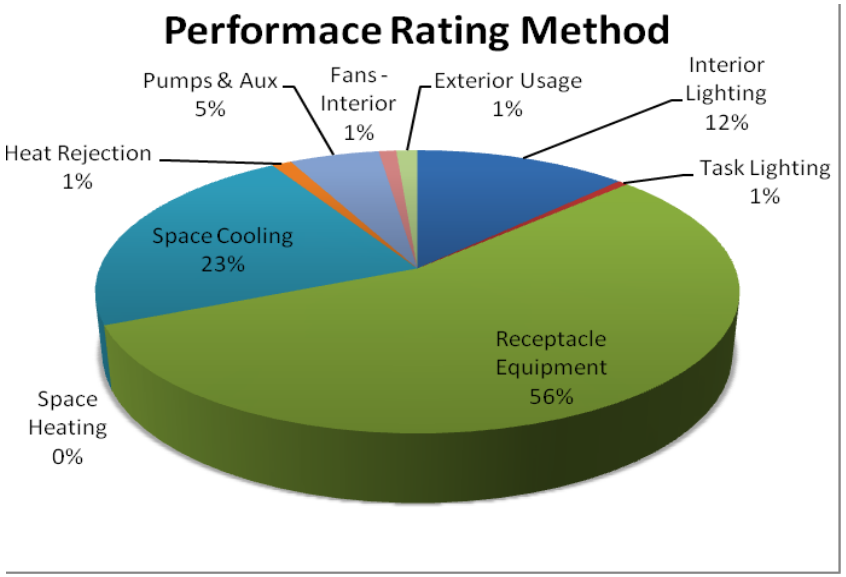
Case Study – Energy Efficient Office Building

Base Case – Prescriptive Method
Actual Case – Performance Method

	Energy Consumption p.a. [kWh]		
End Use	**Prescriptive Method (BC)**	**Performance Rating Method**	**Percent Energy Savings p.a.**
Interior Lighting	48,474	29,611	39%
Task Lighting	1,430	1,430	0%
Receptacle Equipment	131,461	131,461	0%
Space Heating	0	0	
Space Cooling	92,890	53,506	42%
Heat Rejection	0	2,740	
Pumps & Aux	0	12,531	
Fans - Interior	53,377	2,435	95%
Exterior Usage	2,935	2,935	0%
Total	**330,566**	**236,649**	**28%**

Source: Attalage et al, Commercial Building EE Project





Case Study – Biomass Based Vapor Absorption Air Conditioning Retrofit for Vapor Compression 300RT

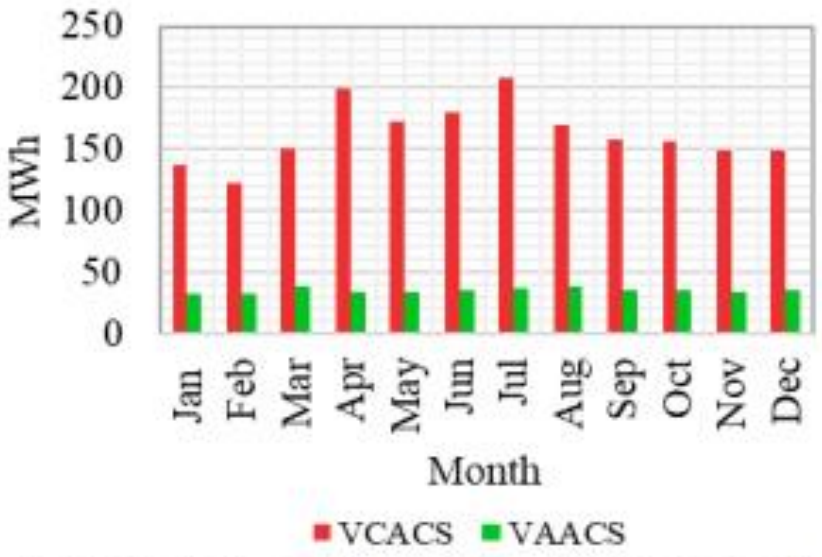


Figure 1: Annual energy consumption of VAACS and VCACS.

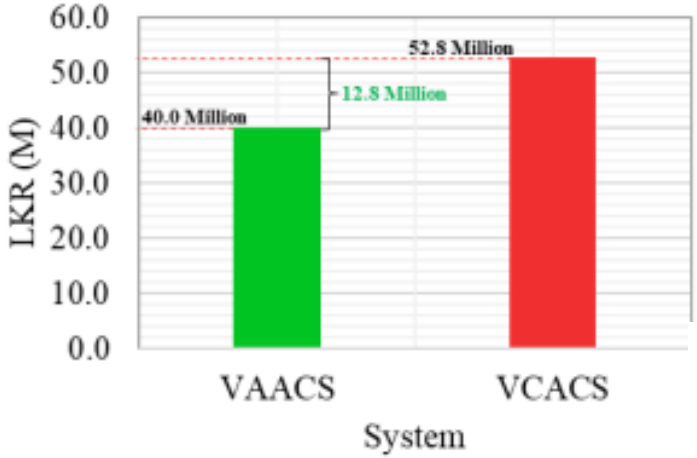


Figure 2: Annual operational cost savings baseline scenario (BS).

Source: SKM Rajapakshe, Project Report 2023 Curtin University

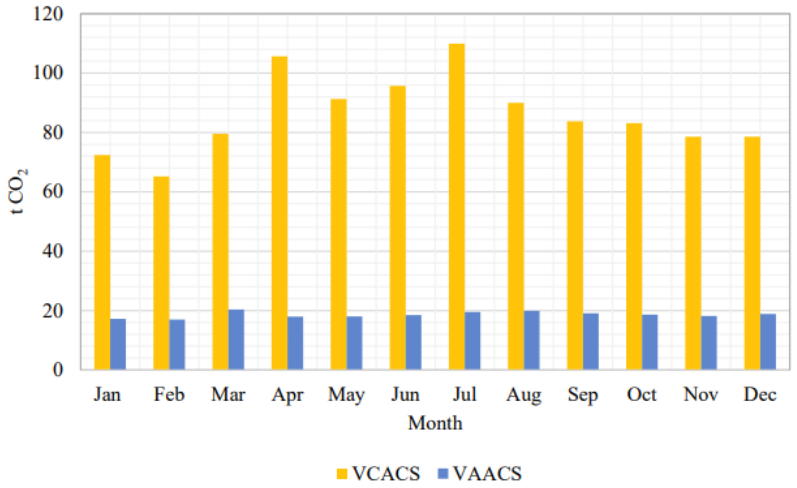
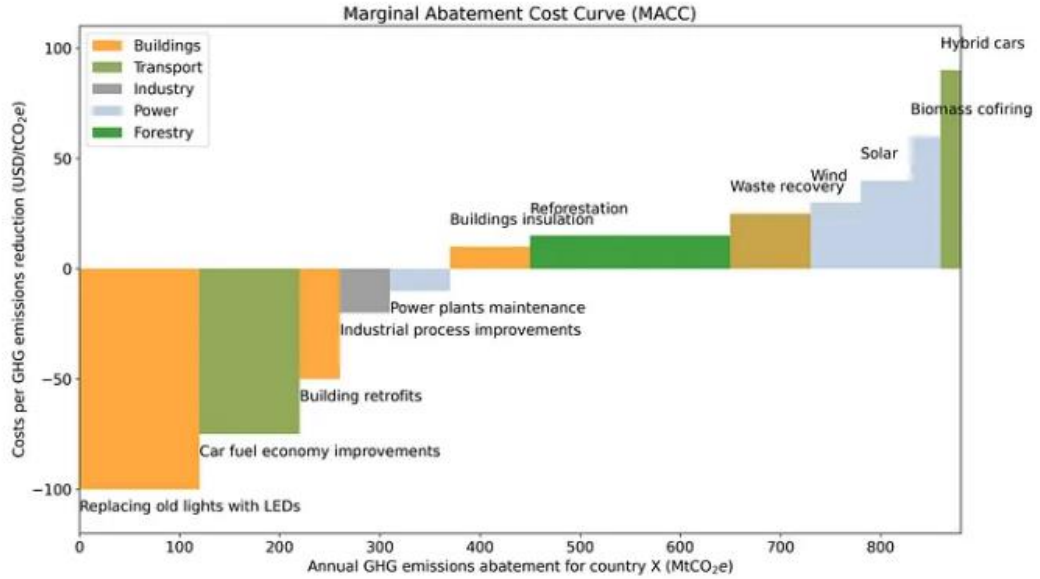


Figure 3: Annual CO2 emissions VAACS and VCACS

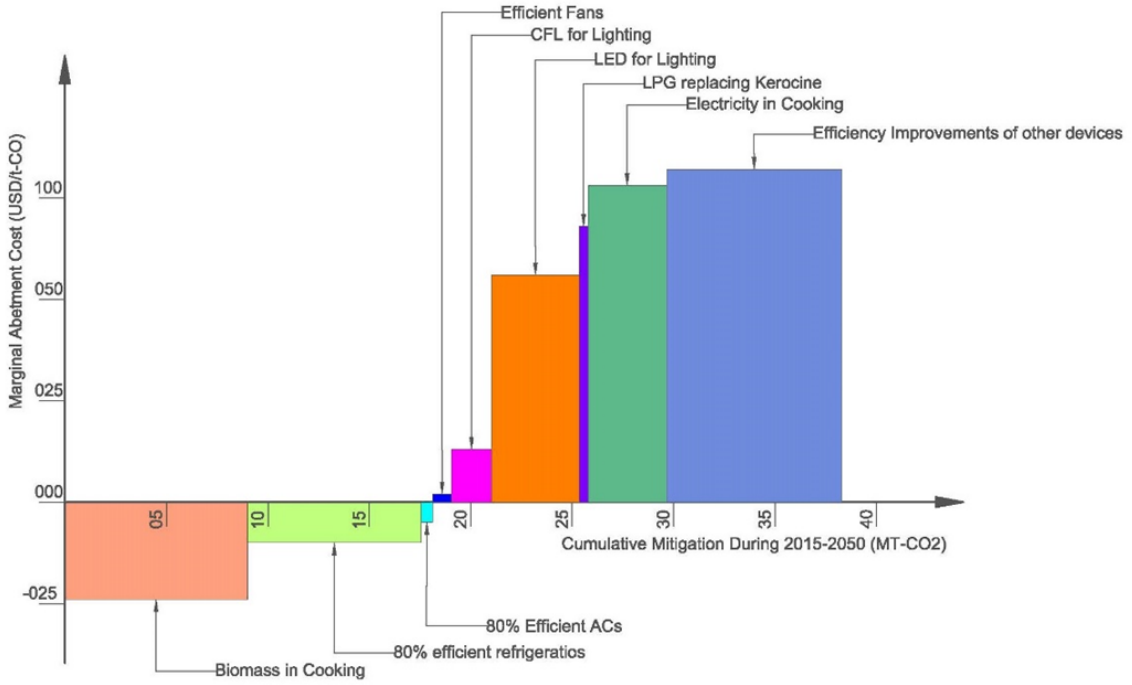
Marginal Abatement Cost Curve (MACC)



Source: e-Source

Source: Towards Data Science 2021

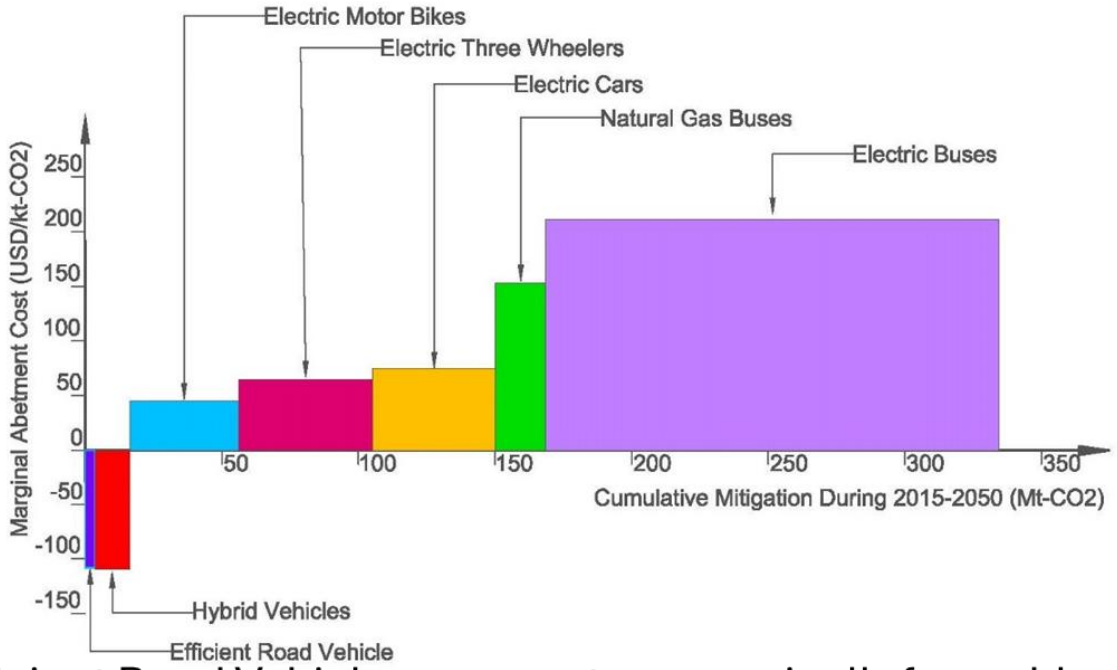
MAC Curve Sri Lankan Residential Sector



Source: G. Fernando, PhD Thesis, 2024

- Biomass in cooking and efficient refrigerators are the most cost-effective.
- LED for lighting and electricity in cooking produce significant mitigation in CO2 emissions.

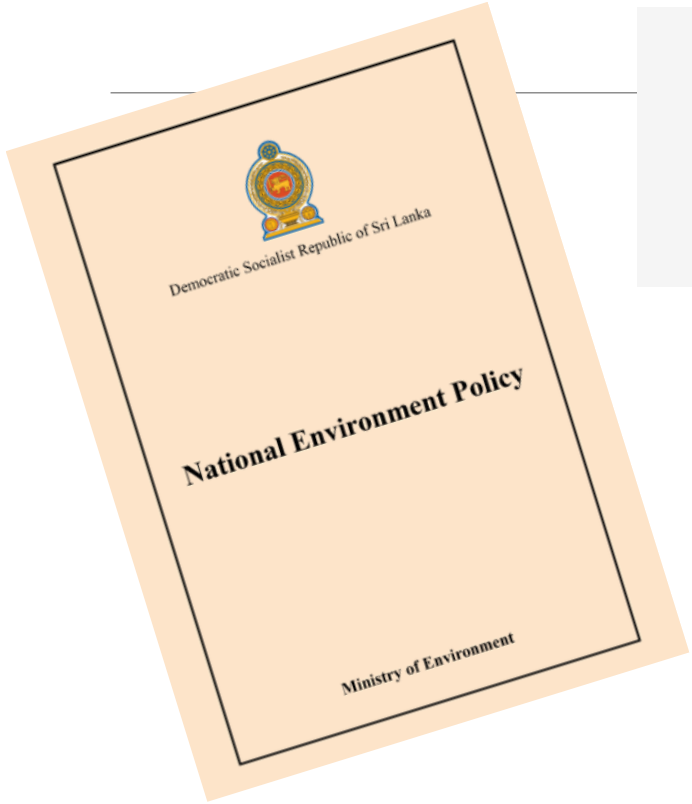
MAC Curve Sri Lankan Transport Sector



Source: G. Fernando, PhD Thesis

- Hybrid Vehicles and Efficient Road Vehicles are most economically favorable.
- Electric buses, costing 211 USD/tCO2, offer the highest quantity of CO2 emission mitigation in the transport sector.

National Environment Policy – Roadmap and Strategic Plan 2025



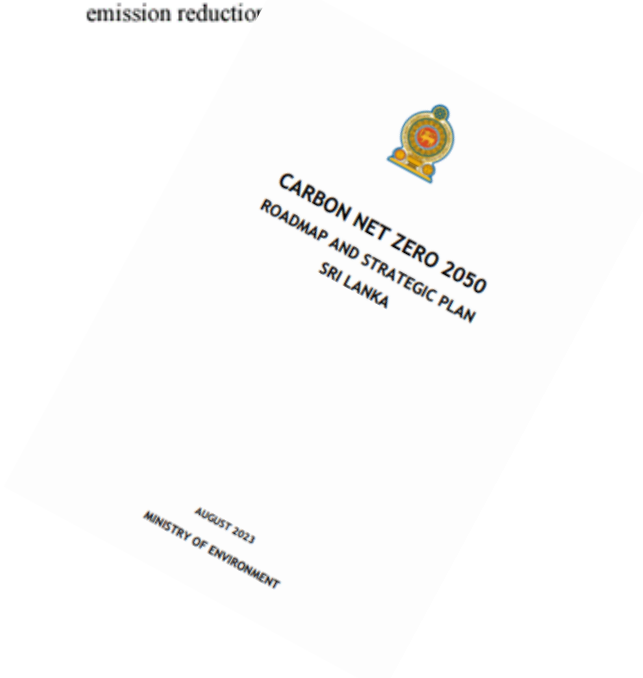
NEP 2022

2.3. Goals

The policy goals of the NEP are key aspirational statements that will lead Sri Lanka to achieve the above vision and mission. These goals form the basis of the policy objectives of the NEP. The table below lists the thematic policy goals.

Policy Goal	Relevant PTA
The country will be placed in a path of low-carbon development by implementing appropriate mitigation measures in the priority sectors of Energy, Transport, Industry, Waste and Agriculture-Forestry-Other Land Use (AFOLU) with high Greenhouse Gas (GHG) reduction potential.	Climate Change and Global Environmental Challenges
Innovative practices of green development and production such as eco-friendly agriculture, resource-efficient cleaner production, green building, eco-tourism and nature-based tourism will be mainstreamed in key economic sectors such as agriculture, industry, construction, transportation, tourism and energy.	Built Environment and Green Development

4.5.1.7. An integrated system for Measurement, Reporting and Verification (MRV) of GHG emissions at national, sector and facility levels will be established to enhance the planning of mitigation efforts and facilitate the repo ting of GHG emissions and emission reductio



Roadmap and Strategic Plan 2050

Source: Roadmap 2050 Sri Lanka

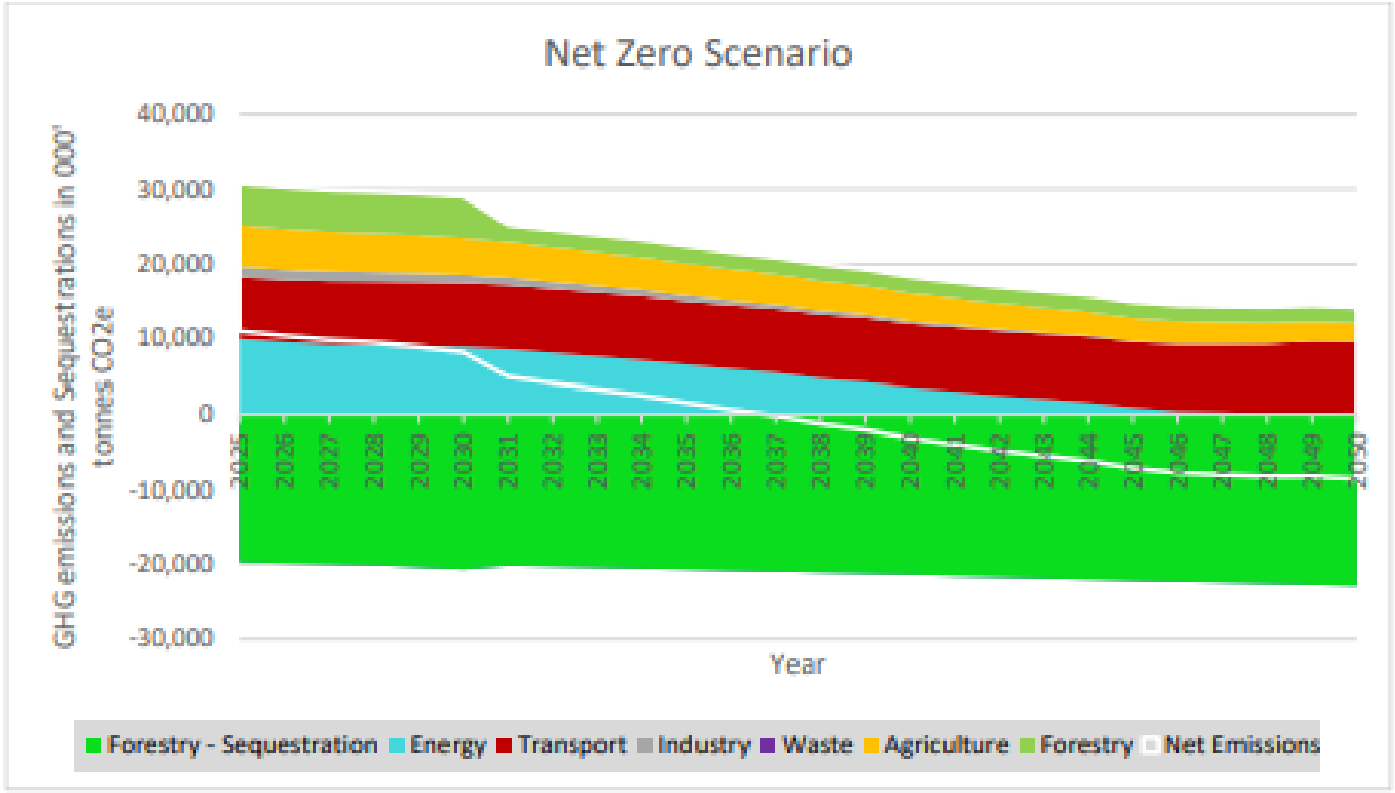
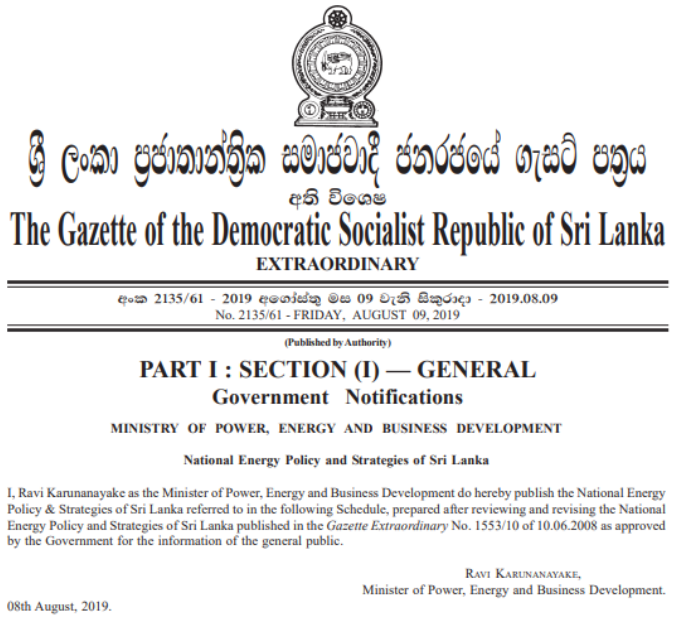


Figure B: The Cumulative Emissions and Sequestration for the Mitigation (Net Zero) Scenario

National Energy Policy & Strategies (2019)



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The Gazette of the Democratic Socialist Republic of Sri Lanka
EXTRAORDINARY

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No. 2135/61 - FRIDAY, AUGUST 09, 2019

(Published by Authority)

PART I : SECTION (I) — GENERAL
Government Notifications

MINISTRY OF POWER, ENERGY AND BUSINESS DEVELOPMENT

National Energy Policy and Strategies of Sri Lanka

I, Ravi Karunanayake as the Minister of Power, Energy and Business Development do hereby publish the National Energy Policy & Strategies of Sri Lanka referred to in the following Schedule, prepared after reviewing and revising the National Energy Policy and Strategies of Sri Lanka published in the *Gazette Extraordinary* No. 1553/10 of 10.06.2008 as approved by the Government for the information of the general public.

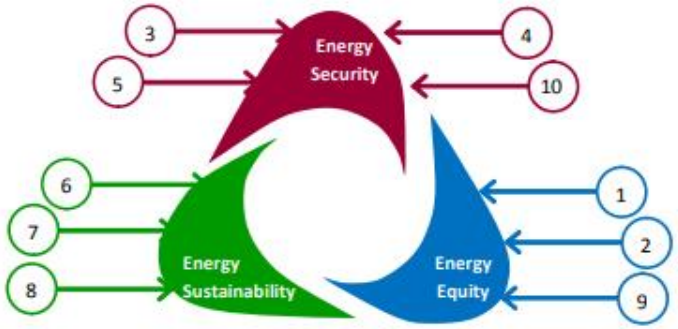
RAVI KARUNANAYAKE,
Minister of Power, Energy and Business Development.

08th August, 2019.

Key Pillars

1. Assuring Energy Security
2. Providing Access to Energy Services
3. Providing Energy Services at the Optimum Cost to the National Economy
4. Improving Energy Efficiency and Conservation
5. Enhancing Self Reliance
6. Caring for the Environment
7. Enhancing the Share of Renewable Energy
8. Strengthening Good Governance in the Energy Sector
9. Securing Land for Future Energy Infrastructure
10. Providing Opportunities for Innovation and Entrepreneurship

This approach is graphically depicted below:



Source: National Energy Policy & Strategies for SL, 2019

National Energy Policy & Strategies (2019)

4.4 Improving Energy Efficiency and Conservation	Responsibility
Energy systems will be efficiently managed and operated while ensuring efficient utilisation and conservation of energy. The following targets and milestones will have to be met by the institutions to which responsibilities are assigned.	
4a Specific energy use in end-user activities will be reduced by 10% of 2015 level by 2023as part of the national energy efficiency improvement and conservation programme, saving 1,243GWh of grid electricity generation by 2023.	SEA
4b Minimum energy performance standards for LEDs and energy labelling for air-conditioners, personal computers, refrigerators, ceiling fans, linear fluorescent lamps/ballasts and induction motors will be enforced by mid-2020.	SEA
4c Penetration of efficient, low smoke, low soot biomass cook stoves will be increased to 10% of households by 2022. Processed, commercialized biomass-based fuels used in such stoves will be made widely available across the retail market by creating an enabling environment.	SEA
4d 'Energy Manager' scheme will be implemented on a mandatory basis by end 2019to designated users and extended to the remaining institutional users by 2020.	SEA
4e Reduced duty and taxation of efficient equipment supported by an accelerated depreciation scheme will be offered to building renovation and retrofitting industry to improve the energy efficiency of the existing building stock by 2020.	SEA

Source: National Energy Policy & Strategies for SL, 2019

Key Strategies:
- EE improvement in residential, commercial & Industrial
- MEPS, Labelling and Green Procurement in state & non state
- EE at home level
- Taxation to support a market for EE technologies
- Expert energy advisory services through service providers
- Recognize water resource as valuable energy resource
- EE in power generation
- EE Street lighting
- Automated demand response technologies & DSM
- Virtual offices & communication
- Transport energy use improvement
- Towards lower logistic costs

Energy Sector NDCs

- **NDC 1 - Enhance renewable energy contribution to the national electricity generation mix** by increasing Solar PV, Wind, Hydro and Sustainable Biomass based electricity generations (Target: Develop an additional capacity of 3,867 MW renewable energy over the RE capacity considered in Business-As-Usual scenario, out of which approximately 950 MW are on an unconditional basis and 2,917 MW on a conditional basis)
- **NDC 2 -Implement Demand Side Management (DSM)** measures by promoting energy efficient equipment, technologies and system improvements in a national energy efficiency improvement and conservation (EEI&C) programme
- **NDC 3 – Conversion of existing fuel oil-based combined cycle power plants to Natural Gas (NG)** and establishment of new NG plants as conditional measures (once the necessary infrastructure is available).
- **NDC 4 – Transmission and distribution network efficiency improvements** (Loss reduction of 0.5% compared with BAU by 2030) as unconditional measures (Target – Approximately 1,848 GWh energy savings between 2021-2030)
- **NDC 5 – Conduct R&D activities to implement pilot scale projects for NCRE sources** that have not yet reached commercial maturity and develop other grid supporting infrastructures as conditional measures

Source: Shared from National Cleaner Production Center

EE Implementation Challenges

- Obtaining relevant, accurate and comprehensive data and information
- Mobilizing capability to identify EE technologies including DM
- Developing project documents of “Bankable” quality, assessing risks
- Accessing appropriate instruments for M & V
- Mobilizing capability to conduct M & V
- Securing relevant financing

END