

Virudhunagar's Path to Decarbonisation



Virudhunagar's path to decarbonisation hinges on electrified transport, clean energy, and enhanced sequestration with additional scope to decarbonise hard-to-abate industries.

Total Net Emissions (2022): 2,620 ktCO₂e

- Annual Growth in Emissions (2005 to 2022): 3.7%
- Per Capita Emissions (2022): 1.21 tonnes CO₂e per capita
- Emission Intensity Reduction in 2022 w.r.t 2005: 57%

INDUSTRIES

AMP: 748 ktCO₂e
21.19% of Gross Emissions

Shifting from the current ~87 MW fossil-based captive power generation to an equivalent 105 MW renewable energy capacity by 2040

AMP: 146 ktCO₂e emissions

Replacing fossil fuel-based heating with electricity-based heating by 2050

AMP: 602 ktCO₂e emissions

- Adopting material substitution (LC3 and fly ash) to reduce process emissions without compromising cement strength
- Exploring carbon capture utilisation (CCU) systems

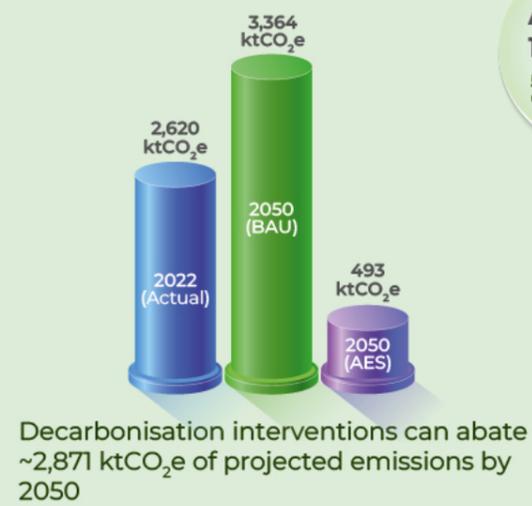
TRANSPORT

AMP: 376 ktCO₂e
10.64% of Gross Emissions

100% penetration of electric 2W and 3W by 2035, electric 4W and bus by 2040, and 80% of electric trucks and trolleys in new sales by 2050

Installation of ~475 charging stations and development of allied infrastructure such as metering and grid infrastructure, to support fleet electrification by 2050

Stock of EVs in 2050



AMP: 194 ktCO₂e
5.49% of Gross Emissions

AGRICULTURE

- 90% balanced rationing and 75% methanogen inhibiting feed additives for livestock by 2050 **AMP: 93 ktCO₂e**
- Increase multiple aeration water regime from 20% to 77% for rice cultivation by 2050 **AMP: 42 ktCO₂e**
- Replace existing ~330 diesel pumps with off-grid solar pumps by 2030, and electrifying ~3000 tractors and tillers by 2050 **AMP: 35 ktCO₂e**
- Replace synthetic nitrogen fertiliser and urea with 75% organic fertiliser and 25% nano-urea by 2050 **AMP: 24 ktCO₂e**
- 39 mini weather monitoring stations (rainfall and temperature)
- Capacity building to promote sustainable modernisation

ELECTRICITY

AMP: 4,384 ktCO₂e
(Scope 2)

Electricity consumption: 2,278 GWh (2022)

Led primarily by:



Deep electrification is expected to increase electricity demand by three-fold from 2,278 GWh (2022) to 7,488 GWh (2050)

Potential assessment for integration of additional ~3GW renewable energy capacity and installation from 2040 onwards, till 2050

WASTE

AMP: 179.27 ktCO₂e
5.07% of Gross Emissions

- Improved wastewater treatment by 2040 **AMP: 91 ktCO₂e**
 - Urban: 171 MLD centralised sewage treatment and 100% UGD connection
 - Rural: Twin pit septic tanks for 1.9 lakh households and 39 FSTPs at Firka level
- Biogas plant (livestock waste) of 30,000 m³/day by 2050 **AMP: 64 ktCO₂e**
- Generate electricity through a 3 MW biodegradable waste-to-energy plant by 2030, **AMP: 14 ktCO₂e**
- Setting up of ETPs and continuous treated effluent monitoring system for 2 MLD industrial wastewater by 2050 **AMP: 9 ktCO₂e**
- 100% segregation at source and processing of municipal solid waste with zero landfilling through 39 rural and 15 urban recycling centres and 15 urban composting units **AMP: 1.27 ktCO₂e**

BUILDINGS

AMP: 195 ktCO₂e
5.52% of Gross Emissions

Urban green cover, reflective roofing, and cool surfaces can reduce ambient temperatures by 1-2°C and lower cooling energy demand by 5 - 15%

Residential	Cooking	Commercial
<ul style="list-style-type: none"> Replace existing incandescent, CFL with 11 lakh LED bulbs, 7 lakh BLDC fans and other EE equipments (by 2030) Adopt ~7.5 lakh 3-5 star ACs by 2030 Save 7-12% electricity demand for space cooling against inefficient electrical system 	<ul style="list-style-type: none"> Transitioning from LPG to PNG, and gradual adoption of ~1.7 lakh electric cook stoves Save: 60% cooking emissions by 2050 	<ul style="list-style-type: none"> 100% electrification of the service sector including replacement of high-speed diesel (HSD) in commercial DG sets (by 2035)

- ### Restoration of Sanjeevi Malai
- Plantation of mixed species and assisted natural regeneration
 - Encourage social forestry, participation of local communities, regular maintenance and monitoring

ASP: -1,428 ktCO₂e
40.4% of Gross Emissions

CARBON SEQUESTRATION

- Repurposing 1,40,653 ha of barren/fallow lands to horticulture, agro/social forestry **ASP: -1,237 ktCO₂e/yr by 2050**
- Enhance carbon stock density by 5% from the existing ~82.25 tCO₂/ha to 86.76 tCO₂/ha through reforestation/afforestation and sustainable forest management **ASP: -19 ktCO₂e/yr by 2050**
- Maintaining the current rate of forest cover increase and existing carbon stock density **ASP: -171 ktCO₂e/yr**

Increasing green spaces through climate resilient bioparks, urban forests and floating gardens can help reduce the heat stress

*AMP stands for annual mitigation potential

**ASP stands for annual sequestration potential

Scope 2 emissions are indirect GHG emissions from purchase of energy (electricity, steam, heat etc)

Why Should Virudhunagar Transition Towards a Low-carbon, Climate Resilient Future?



DISTRICT HIGHLIGHTS

~41,000 MSMEs
Concentrated in textile, fireworks, paper and paper products and cement manufacturing



Fireworks and matches manufacturing hub



47% of GDDP is contributed by the service sector, and 29% by industries



CLIMATE PROFILE

1,243 mm
Annual rainfall

18.9°C to 37.6°C
Annual temperature range

0.2°C to 2.8°C
Projected increase in maximum summer temperature by 2090

Drought, Heat-stress and Forest Fire Risks

Projected increase in rainfall by 2090
10% – 43% in SW monsoon
18% – 51% NE monsoon rainfall

GHG EMISSIONS (2022)

2,791 ktCO₂e
Gross emissions

2,620 ktCO₂e
Net emissions

Key Contributors % of gross emissions

37%
Cement production (IPPU)

21%
Industrial energy

17%
Road transport

(-171) ktCO₂e
Annual sequestration

TRANSFORMATION POTENTIAL

Blended Finance and Community-Ownership Models

Robust Public Transport Ecosystem for sustainable and shared intra-city mobility

(-1,428) ktCO₂e
Annual sequestration potential

1,614 ktCO₂e Annual Mitigation Potential

Electrification of Heating Processes

Climate-resilient Multifunctional Green Spaces

Low-Carbon Interventions and Ecosystem-Livelihood Co-benefits



Blue-Green Ecosystem

-1,428 ktCO₂e*

Intervention

- Enhance the carbon stock density of existing forest cover
- Agroforestry in waste/fallow lands
- Restoration of Sanjeevi Malai

Resilience & Co-benefits

- Strengthens heat and drought resilience.
- Enhances water security and soil health
- Promotes biodiversity conservation and ecological balance
- Enables integrated water and agriculture efficiency management

Economics and Livelihood Improvement

- Promotes green jobs and local entrepreneurship
- Strengthens farmers' institutions and support market access.
- Supports livelihood opportunities for women and youth



Industrial Decarbonisation

749 ktCO₂e*

Intervention

- Electrify heating processes in industries
- Replace all diesel and coal based captive power plants with renewable energy

Resilience & Co-benefits

- Boosts energy access and health outcomes
- Improves air, water and soil

Economics and Livelihood Improvement

- Improves efficiency & operational performance
- Minimises supply chain disruption
- Skilling and reskilling of workforce for RE based O&M



Sustainable Public Transport

99 ktCO₂e*

Intervention

- Addition of 2000 intra-city electric buses by 2050
- Promotion of non-motorised transport and public bicycle sharing infrastructure

Resilience & Co-benefits

- Resilient transport access
- Cooler cities and cleaner air

Economics and Livelihood Improvement

- Boosts sustainable mobility
- Green jobs, especially for women
- Better health, last-mile access

NMT: Non-motorised Transport; PBS: Public Bike Sharing; * denotes mitigation potential

What Does Climate-resilient Development Deliver?

Reduced heatstress risks and improved health infrastructure.

Strengthened market access for climate-smart and low carbon produce.

Decent work and improved health outcomes, especially for factory workers

Supports climate-informed planning and governance

Enables water management through restoration, rejuvenation of water bodies and efficient urban and industrial water management.

Bankable green projects | Access to global climate finance | Green jobs | Livelihood security