

Structure and Growth Pattern of Energy Sector in Kerala and Policy Challenges

Prof. P L Beena

Dr.Hrushikesh Mallick

Dr.Ritika Jain



Centre for Development Studies

Structure of the Presentation

- Motivation of the Study and Stylised Facts on Kerala
- Growth scenario of the Energy sector in Kerala
- Energy and climate Policies in Kerala



Motivation:

- Nearly 70 percent of Kerala's total power comes from the rest of India, which is mostly coal-based power.
- Kerala can face shortage of cheap power supply from neighbouring states when all states adopt a low carbon pathway.
- So, the state needs to explore its potential for non-fossil fuels in power generation.
- Needs to explore the new **unconventional renewable energy sources** like **waste to energy, offshore wind farm, floating solar farms** on water bodies.



Contd...

- Adoption of **low carbon pathway** not only implies augmentation of the capacity of **non-fossil-based power** use, but also increased **energy efficiency** in all the sectors of the economy as increased gain in energy efficiency leads to energy savings and thereby lower carbon footprint.
- Therefore, understanding the **feasible policy choices** and the **financial implications** are a must for adopting the right policy interventions for transition towards a low-carbon pathway.



Stylised Facts on Kerala

- The state accounts for about **1.2 per cent of the total geographical area** of the country, But as per Census 2011, a little over **3 per cent of the country's population** reside in the state. It is a densely populated state, with **860 people residing per square kilometre** of area, which is **2.25 times higher than the national average**. However, in the decade 2001-2011, the population in Kerala **grew at the rate of 4.91 per cent**, which is **much less than the national average (17.7 per cent)**.
- As per Census 2011, **52.28%** of the population lives in **rural** areas, while **47.72 %** lives in urban areas. **Literacy rate** is very high in Kerala (**94 per cent** as compared to **73 per cent for India**).
- The latest published **poverty** ratio in 2011-12 is **7.4 per cent** which is much less than the **national average (21.9 per cent)**.



Stylised Facts on Disaster in Kerala

- Kerala frequently experiences flood and landslide, coastal erosion, loss of biodiversity and air pollution in recent years due to heavy rainfall.
- 13 out of 14 districts were affected by flooding in 2018; Hill districts such as Idukki and Wayanad were severely affected by landslides.
- Kerala Post Disaster Needs Assessment of Floods and Landslides (a collaborative study by GoK 2018) suggests that the worst-hit districts were Alappuzha, Ernakulam, Idukki, Kottayam, Pathanamthitha, Thrissur, and Wayanad.
- Kerala also had another flood of a lower intensity in the subsequent year, 2019. It was the northern districts that were adversely affected in 2019.

Contd..

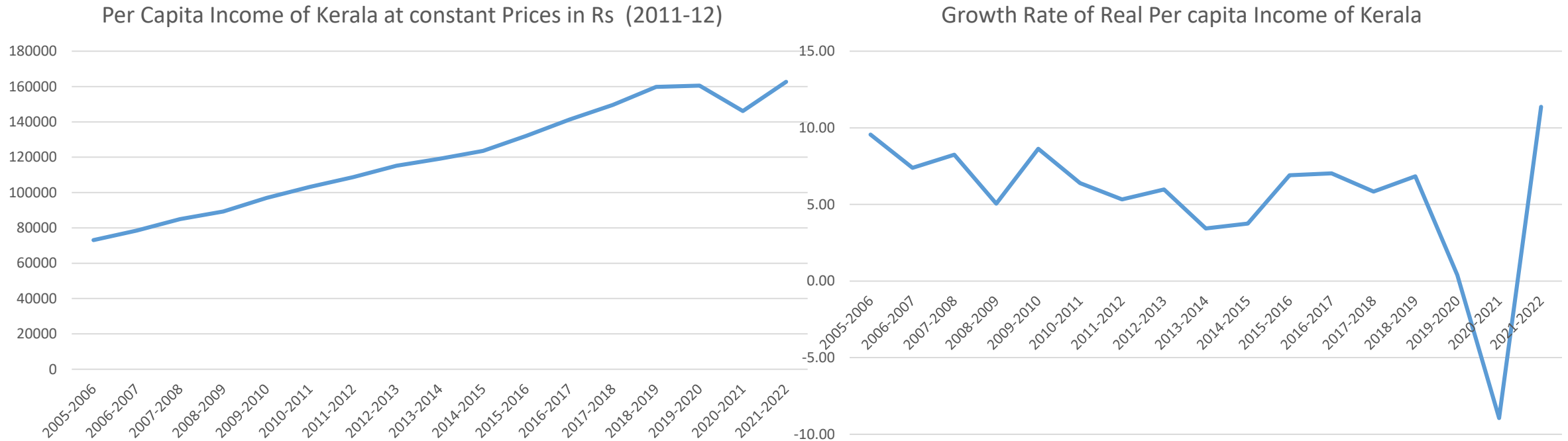
- The recurring floods in the state is an aftermath of high-carbon emissions. Madhav Gadgil says that the aerosol effect produced by high carbon emissions is what creates the precipitation causing floods.
- It results in loss of property, lives and livelihood.
- Floods and landslides affected 5.4 million people, displaced 1.4 million people, and took 433 lives (22 May–29 August 2018). The total Loss and Damage was Rs.7,191 crore, of which Rs. 6,410 Crore was in Housing, Land and Settlements alone.
- Additionally, there was a total Loss of Rs. 19,527.9 crore in the different economic sectors.
- In aggregate, there was resource need for recovery of Rs. 31,000 Crore for the state economy.



Contd..

- Therefore a low carbon pathway is essential for Kerala to mitigate the impact of climate change, reduce green house and gas emissions and ensure sustainable development.
- It can protect the state's unique biodiversity and address environmental challenges such as extreme weather and rising sea levels etc.

Per Capita State Domestic Product in Kerala and Its Growth



- **Per capita State Domestic Product** at constant prices with 2011-12 base is **Rs. 1,62,752** in **2021-22**, which is higher than the **national average (Rs. 1,15,745.86)**. Covid-19 had affected the economic activities in 2019-20. Per capita income grew at -8.95% and GVA at constant prices grew at -9.95% in 2020-21 over 2019-20.
- Economy made a recovery in 2021-22 and growth rate became 12.09% over 2019-20.



Stylized facts: Sectoral Growth Performance

- The industrial output growth is the most volatile along with agricultural output growth. The transportation sector which has dominant share in gross emissions, initially used to grow at a faster pace has been slowed down in its pace in recent couple of years.
- Most other sectors are growing at a lesser rate mostly since the covid-19 or even from prior years.
- In terms of output shares, service sector has the highest output share followed by industry and agriculture sectors. In 2021-22, share of primary sector (agriculture and allied activities, Mining and quarrying) in GSVA at constant prices: 9.33%,
- Secondary sector(manufacturing, electricity, gas and water supply, construction): 26.8%
- Tertiary Sector(trade, repair, hotels and restaurants, transport, storage and communication, financial, real estate, ownership of dwelling, professional services, public administration and other services): 63.8%
- By examining individual sub-sectors in the GSVA in 2021-22, Real estate, ownership of dwelling and profit (17.77%) has the highest share followed by Trade and repair services(14.58%) and Other services(13.71%), Construction (13.19%), Manufacturing(12.12%), and agriculture (9%) etc.



Agriculture Sector in Kerala

- **Agriculture is one of the most critical sectors in Kerala.** The share of agriculture and allied activities in gross value added was 9.5 per cent in Kerala in 2020-21 (16.27 percent in India) and became 9% in 2021-22. This is major employment sector.
- Share of employment in Agriculture, livestock, forestry and fishing constitutes 22.56 % in 2020-21. There were 670253 Cultivators (Main and marginal) and 1322 850 Agricultural labour (Main and marginal) in Kerala in 2011.
- Out of the total geographical area of 38.86 lakh ha, **the total cultivated area is 25.23 lakh ha (64.92 %), and the net area sown is 20.29 lakh ha (52.22 % in India).**
- Forest Area is 1152 thousand hectares in Kerala, which is 27.8 % of total geographical area.
- Food crops consisting of rice, pulses, tapioca, ragi, small millets, sweet potatoes and other tubers constitute 10.51 % of the gross cropped area in 2021-22, while cash crops including cashew, rubber, pepper, coconut, cardamom, tea, and coffee comprise 65.8 %.
- Production of Principal Crops in Kerala in 2021-22: Rice (559.3 metric tonnes, Rubber (556.60 metric tonnes), Coconut (5535.00 million nuts) etc.
- Percent of Consumption of Electricity for Agricultural Purposes: **1.56% in 2019-20** in Kerala (All-India: 20.08%).
- Share of employment in trade, repair, hotels and restaurants is 18.03%.
- These sectors are heavily dependent on climate variability, so also it affects the lives and livelihood of large population dependent on these sectors.



Growth rate of Gross State Value Added by Economic Activity at constant prices and sectoral composition across years (2017-18 to 2021-22)

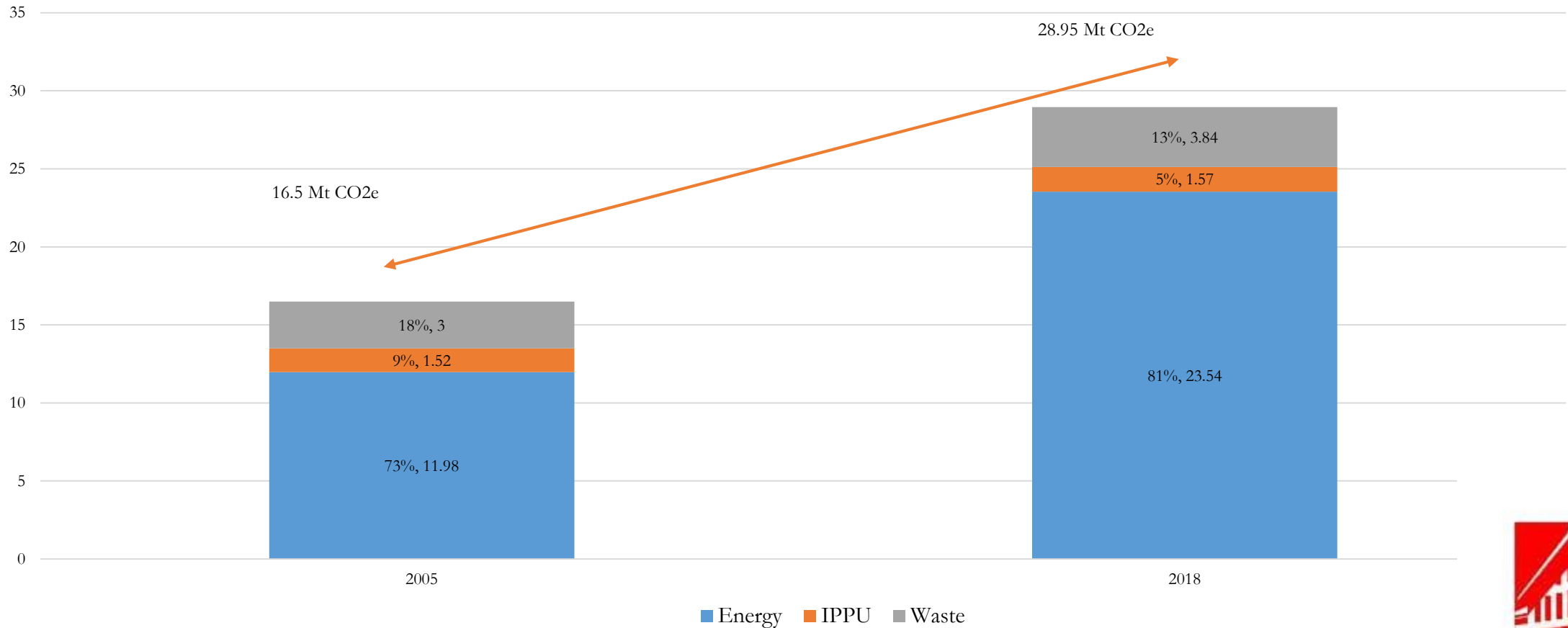
Items	Growth rate of Gross State Value Added by Economic Activity - at constant prices					Share of sectors in Gross State Value Added (at constant prices)				
	2017-18 over 2016-17	2018-19 over 2017-18	2019-20 over 2018-19	2020-21 over 2019-20	2021-22 over 2020-21	2017-18	2018-19	2019-20	2020-21 (PE)	2021-22 (Q)
Crops	1.52	-4.69	-1.63	0.46	3.63	5.11	4.67	4.47	4.99	4.61
Livestock	1.8	-2.35	-1.82	2.04	0.1	2.6	2.43	2.32	2.63	2.35
Forestry and Logging	-2.27	3.83	6.09	1.25	0.33	0.92	0.92	0.95	1.07	0.96
Fishing and aquaculture	11.14	6.55	-16.67	-7.35	30.59	0.98	1	0.81	0.83	0.97
Mining and quarrying	29.72	-17.27	-25.21	12.14	-4.61	0.73	0.58	0.42	0.52	0.44
Manufacturing	6.06	-5.28	-0.98	2.39	3.63	13.18	11.98	11.53	13.11	12.12
Electricity, gas, water supply and other utilities	27.02	22.96	1.57	-4.67	20.92	1.14	1.34	1.32	1.4	1.51
Construction	3.22	4.05	3.75	-6.94	2.44	13.87	13.84	13.96	14.43	13.19
Trade and repair services	8.15	11.1	6.5	-25.07	15.93	15.35	16.36	16.94	14.1	14.58
Hotels and restaurants	2.52	3.31	8.82	-58.76	114	1.44	1.43	1.51	0.69	1.32
Railway	20.13	-7.62	-13.97	-21.71	4.22	0.37	0.33	0.27	0.24	0.22
Road transport	-8.2	5.42	-1.17	-22.16	21.22	4.85	4.91	4.72	4.08	4.41
Water transport	10.34	27.72	-4.13	-9.47	16.56	0.06	0.07	0.07	0.07	0.07
Air transport	-6.86	-49.1	74.72	-67.45	74.94	0.22	0.11	0.18	0.06	0.1
Service incidental to transport	20.54	3.3	-2.58	-32.95	19.58	0.29	0.28	0.27	0.2	0.21
Storage	8.03	88.41	-1.8	1.69	-4.67	0.01	0.02	0.02	0.02	0.02
Communication and services	-2.16	5.23	11.01	0.8	-0.47	1.79	1.81	1.95	2.19	1.94
Financial service	0.77	19.55	2.29	3.81	4.87	4.76	5.42	5.39	6.21	5.81
Real estate, ownership of dwelling and profit	9.32	6.88	3.15	-1.21	8	16.34	16.76	16.81	18.44	17.77
Public administration	10.99	3.24	-3.59	-13.75	27.55	3.64	3.61	3.38	3.24	3.68
Other services	9.84	2.36	7.76	-18.62	33.83	12.35	12.13	12.7	11.48	13.71
Total	5.83	4.23	2.86	-9.95	12.09	100	100	100	100	100

Emission Profile of Kerala

- According to the GHG Platform India (a civil society initiative providing an independent estimation and analysis of India's Greenhouse Gas (GHG) emissions across key sectors i.e. Energy, IPPU, AFOLU and Waste), **the net emission from Kerala in 2021 is 1.21 Mt CO₂e**, which is 0.04 per cent of India's emission.
- Per capita emission is also low for Kerala, only 0.09 tCO₂e per capita, as compared to the national average (2.24 tCO₂e per capita).
- Considering emission from sectors namely, Energy sector (Fuel Combustion- from Public Electricity Generation, Transport, Captive Power Plants, Industries, Agriculture, Commercial, and Residential categories and Fugitive Emissions - from Fuel Production); **Agriculture, Forestry and Other Land Use (AFOLU)** sector; **Industrial Processes and Product Use (IPPU)** and **Waste sectors**, the overall emission in Kerala was moderated from 2017 due to significant enhancement of sinks.
- One of the reasons of low emission in Kerala as compared to India is the low share of power generation sector in total emission.
- This is mainly because of two reasons: (a) Kerala meets its energy demand by purchasing power from other states. Power generation in Kerala in 2021-22 is 10888.01 MU, while energy sales in Kerala is reported to be 24991.46 MU in 2021-22. Majority of the power consumed in Kerala is purchased at delivery point in Kerala.



Sector-wise contribution to emission and percentage share in overall GHG emissions (excluding AFOLU sector) in Kerala in 2005 and 2018



Contribution to emission

Energy sector is the major contributor of emission in Kerala (81 per cent in 2018 excluding AFOLU) .

The emission from this sector has increased at a very rapid rate over the years (almost doubled from **11.98 MtCO₂e in 2005 to 23.54 MTCO₂e in 2018**).

Within energy sector, **transport has the highest share in emission (54.23%), followed by industries (20.51%) and residential sector (16.46%) in 2018.**

Emissions from the Industrial Processes and Product Use (IPPU) sector are mainly driven by Chemical (85 per cent), Metal, Mineral Industries and Non-Energy Products from Fuels and Solvent Use.

Ammonia Production has the largest share in the IPPU emissions (67 per cent) in 2018.

Agriculture, Forestry and Other Land Use (AFOLU) sector often acts as a net sink of emissions due to significant increase in forest area.

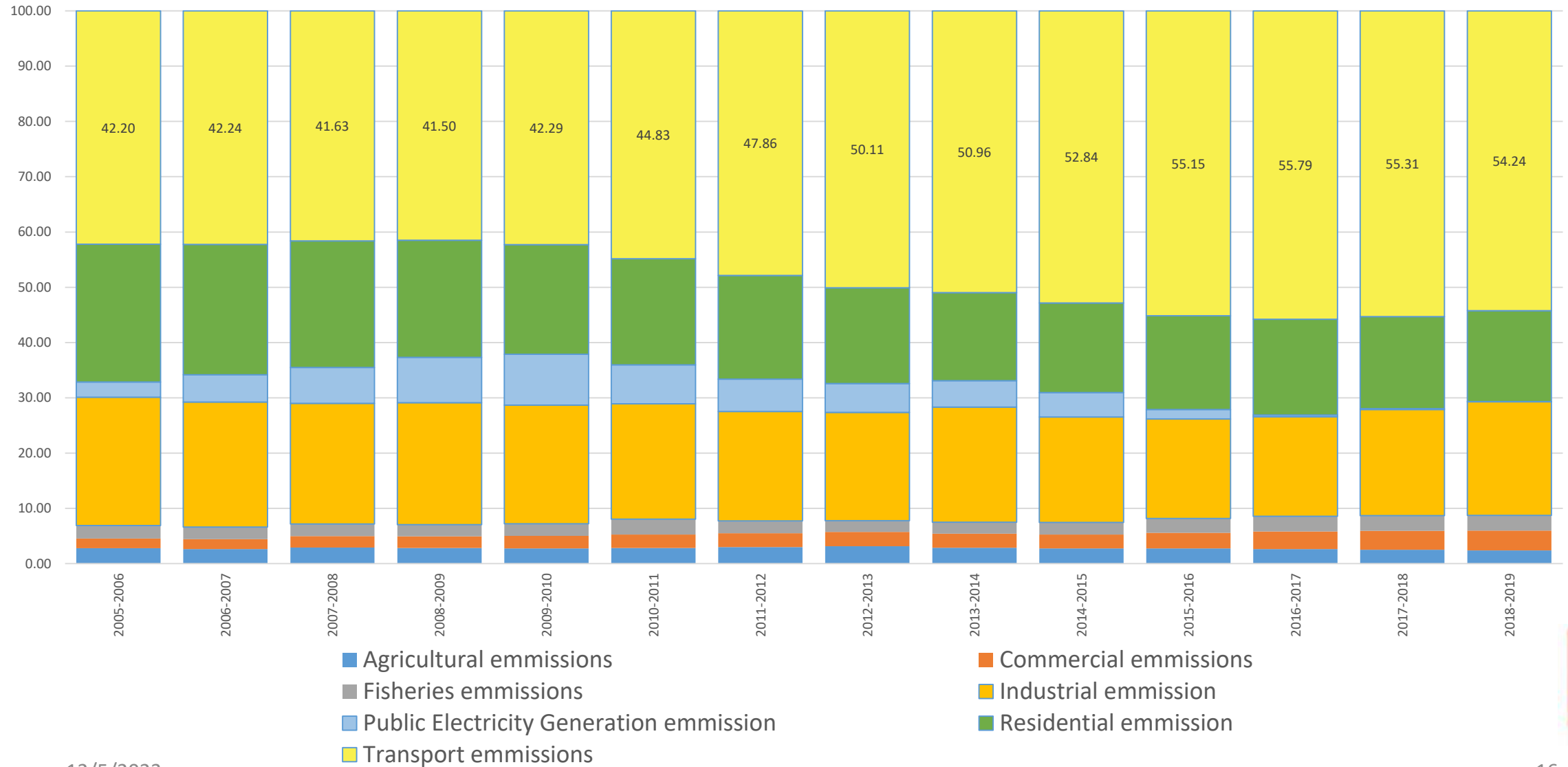
The average annual emissions from 'Livestock' and 'Aggregate sources' were 2.56 Mt CO₂e that were neutralized by CO₂ removals from the 'Land' sub-sector.

Emission from the Waste sector is mainly driven by Domestic Wastewater (59 per cent), Solid Waste Disposal (22 per cent), and Industrial Wastewater (19 per cent) in 2018.

Within industrial wastewater, pulp and paper industry has the maximum share in emission (55 per cent) in 2018 in Kerala.

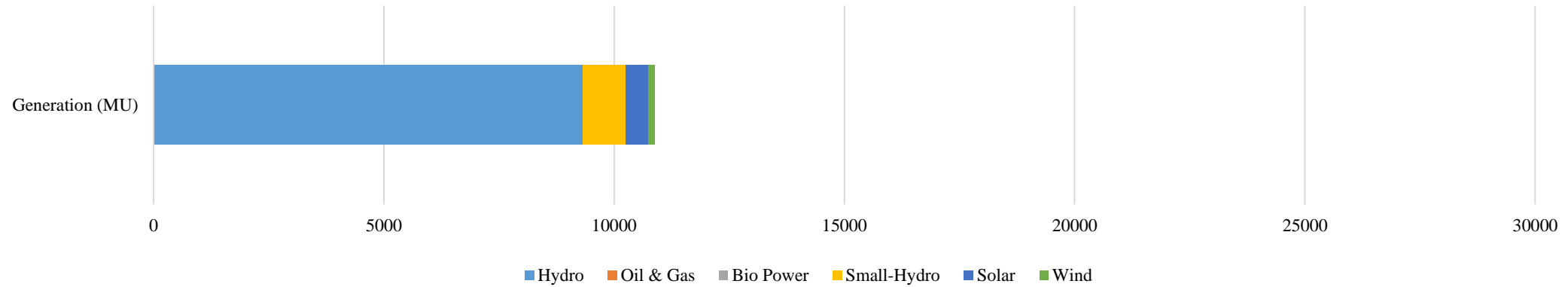


Sector-wise Emission Shares in Kerala:

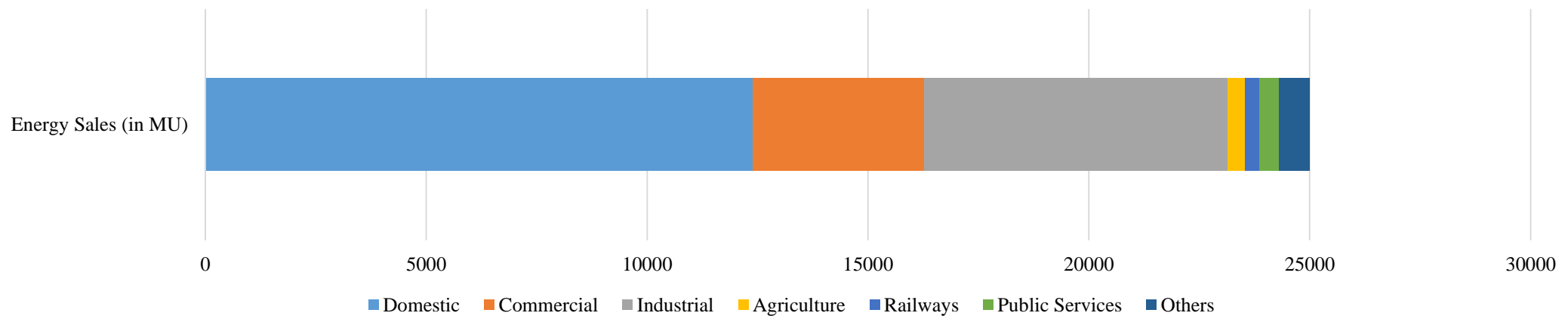


Power generation from various sources and sales to different sectors in Kerala in 2021-22

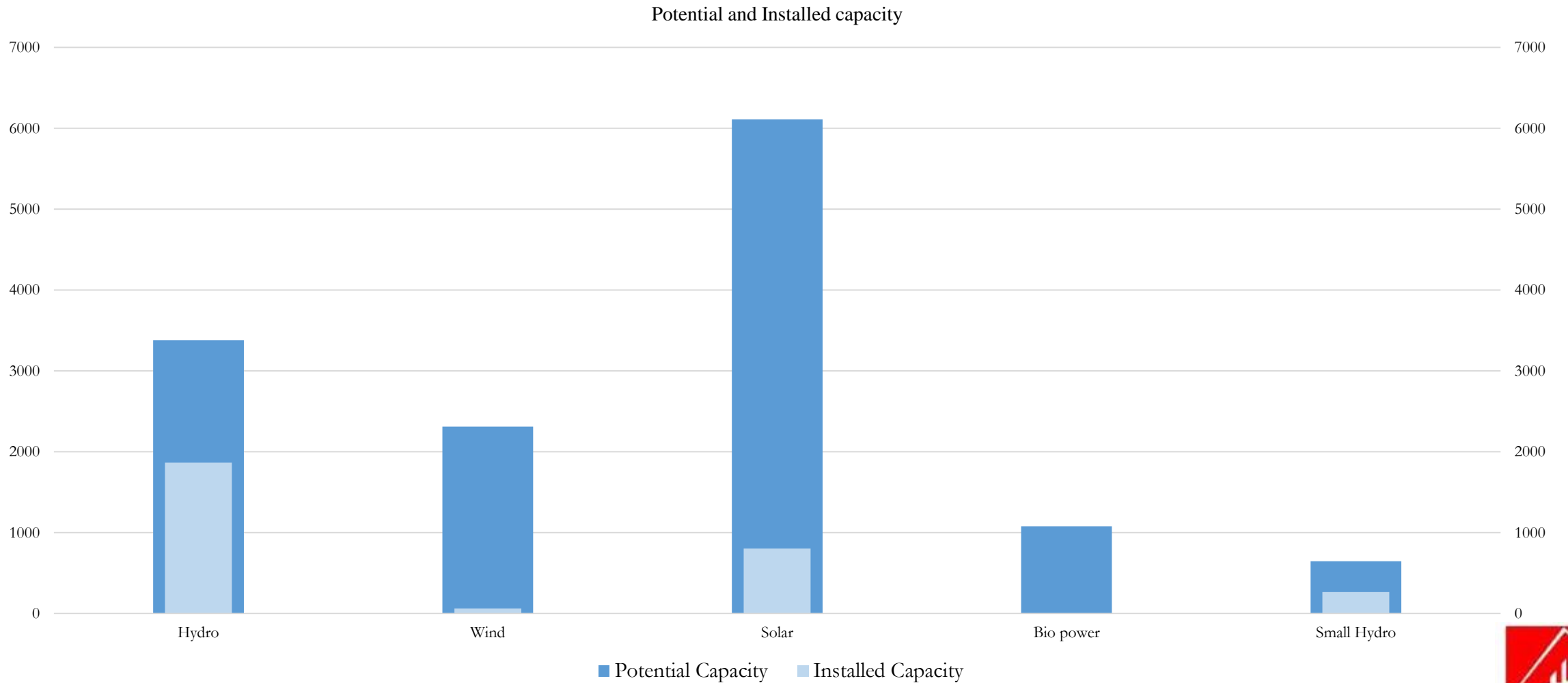
Power generation in Kerala (MU)



Energy sales in Kerala (MU)

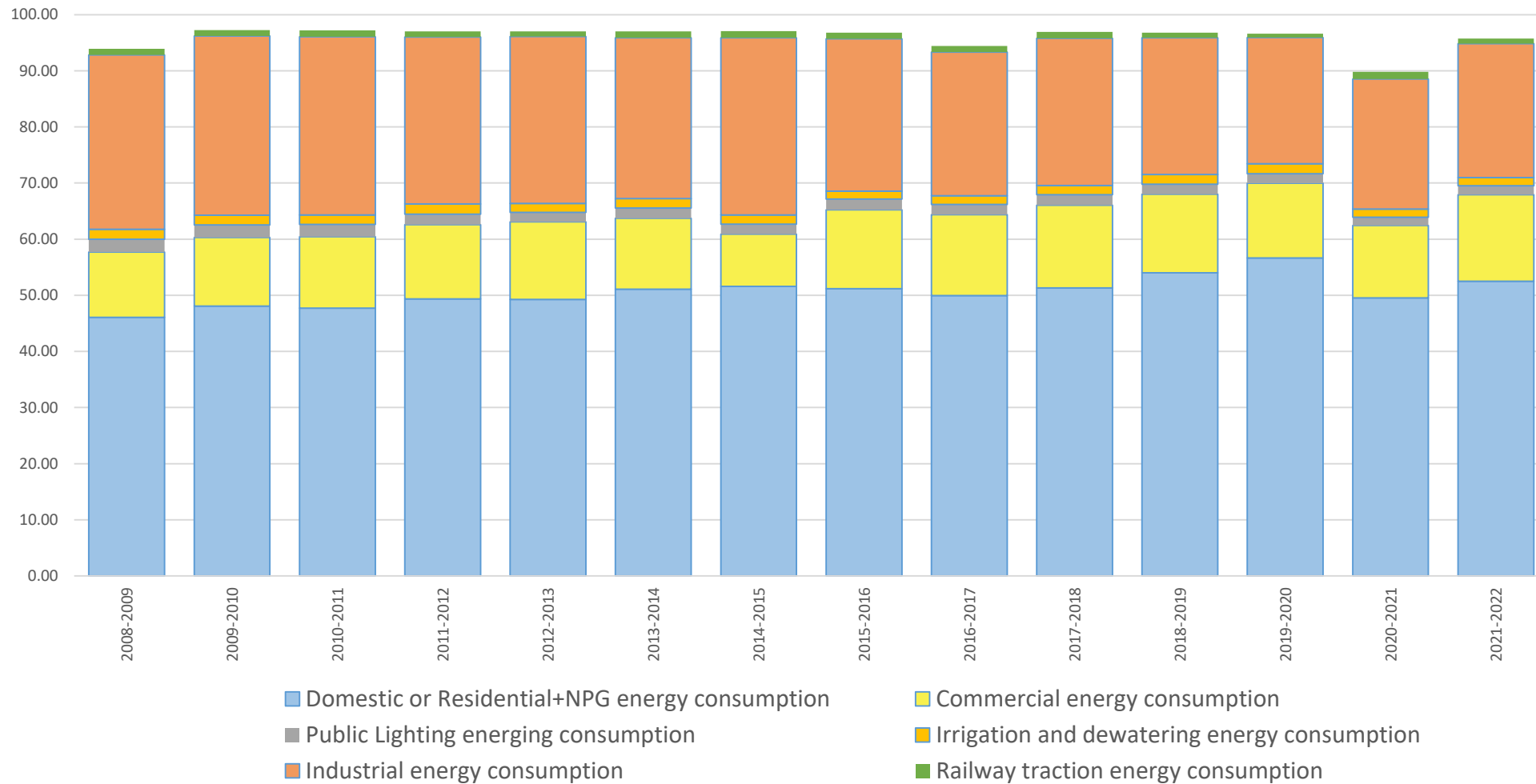


Potential and Installed Capacity



Source: India Climate and Energy Dashboard.

Pattern of Electricity Consumption in Kerala(%)



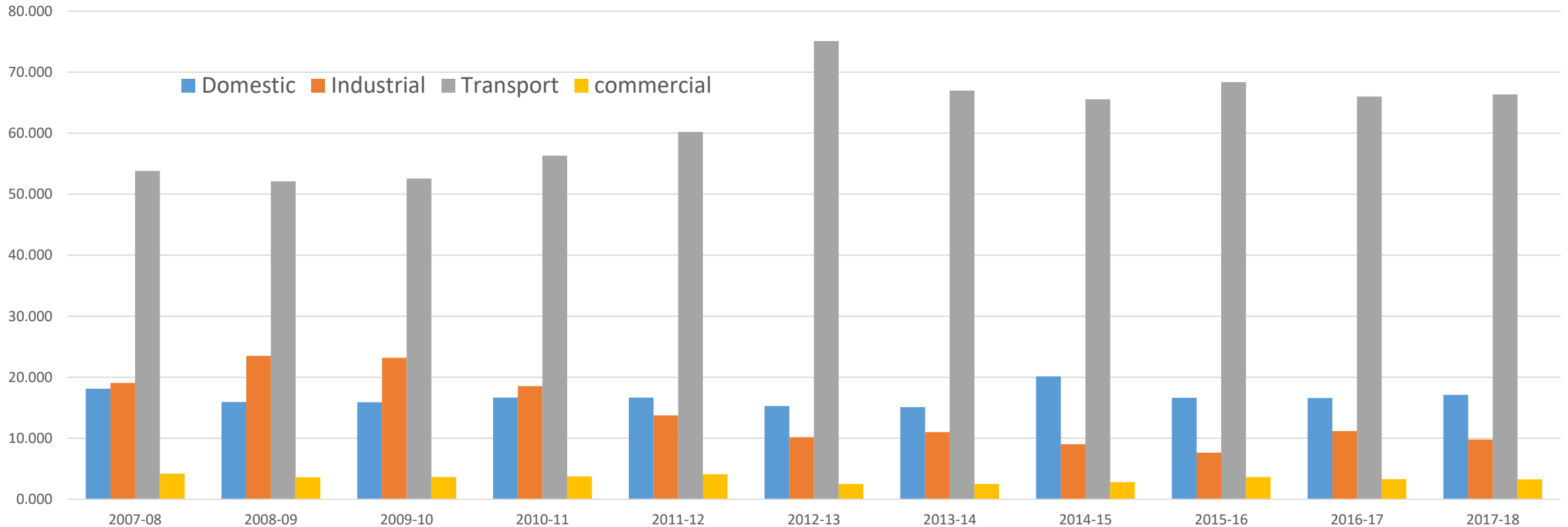
CDS

Pattern of Energy Consumption from Various Sources (Electricity and Petroleum) :

- Domestic sector consumes highest share of electricity energy followed by industrial and commercial sectors. Kerala meets its substantial portion of energy demand by purchasing power from other states.
- Power generation in Kerala is 10888.01 MU in 2021-22, while energy sale is reported as 24991.46 MU in the same period.
- Around 66% of total generation and power purchased by KSEB is purchased at the delivery point, i.e. not generated within the state. This is one of the leading reasons which might be contributing to lower CO₂ emission in the state.
- Further, the major sources of power generation in Kerala are hydro (85%), followed by small hydro (8%), solar (4%), wind (2%) and oil and gas (1%). Less or no reliance on thermal power is also contributing to less emission from power sector.



Pattern of Petroleum Product Consumption in Kerala



CDS

Energy and Climate Policies

- Kerala is vulnerable to climate change – climate change is an agenda for development planning in the state for quite some time
 - Kerala Municipality Act and Kerala Panchayat Act 1994- preserving traditional drinking water resources, waste management, afforestation
 - People's plan 1996- Reduce, Reuse, Recycle and Recovery for sustainable plan
 - Malinya Mukta Keralam 2008, Clean Kerala Mission, Haritha Keralam Mission
 - Kerala state environment policy, 2009
 - Kerala perspective plan 2030 as part of Kerala Economic Review 2015
 - State Action Plan on Climate Change (SAPCC) in 2014
 - SAPCC 2.0 more recently in 2022- most recent
- Mitigation and adaptation strategies in some sectors



Mitigation strategies

- Strategies for power, transport, industries, agriculture and buildings ~ 80% of emissions in Kerala
- Power-

RE-based electricity generation	Adoption of RE	Transmission and distribution	Plant efficiency of thermal power plants
Kerala Solar Energy Policy 2013	KERC (Renewable Energy and Net Metering) Regulations, 2020	Ujjwal DISCOM Assurance Yojana (UDAY)	PAT Scheme
Development of Wind Farms in Private Land	Renewable Purchase Obligations (RPO)	Restructured Accelerated Power Development and Reforms Programme (R-APDRP)	Renovation and modernization activities
Hydrogen energy investment	Feed-in tariffs	Integrated Power Development Scheme (IPDS)	Kerala Industrial and Commercial Policy 2018
Subsidy schemes for RTPV and government producers,		Perform Achieve Trade (PAT) Scheme	National Mission for Enhanced Energy Efficiency
Urja Kerala Mission,		Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY)	Carbon tax
Kerala Power Policy 2019,		TransGrid 2.0,	
National Solar Mission		Urja Kerala Mission	



Mitigation strategies

- Transport-

Public transport improvement	Electric/Clean Mobility Kerala	Infrastructure Development
City mobility plan Kochi- development of road network	Electric Vehicle Policy -e-bus	Urban Infrastructure Development
Integrated transport system - Kochi Metro Rail	Non-Motorized Transport (NMT) FAME	Scheme for Small and Medium Towns
		Kerala Sustainable Urban Development Project
		Atal Mission for Urban Transformation

- Buildings-

- Kerala government has issued the Kerala Energy Conservation (Building Code) Rules 2017 for building construction;
- Improve energy efficiency include Pradhan Mantri Ujjwala Yojana (provision of clean cooking fuel to deprived women in rural areas and those below the poverty line)
- Unnat Jyoti by Affordable LEDs for All (UJALA Scheme) and Energy Conservation Building Code (ECBC)



Mitigation strategies

- Agriculture
 - **Short-term goal-** Assessing the financial and technical viability of solar-based dedicated feeder
 - **Long-term goal-** Identifying land parcels suitable for solar plants close to the distribution substation, estimating the potential and installing solar power plants
 - Efficient agricultural practices among farmers. Renewable based irrigation through Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Yojana (PM-KUSUM)
 - **Demand-side management-** Use of energy-efficient pumps, solarisation of off-grid and grid-connected agricultural pumps, agriculture feeder separation, and awareness
- Industry-
 - Major energy-intensive industries (Petroleum refinery, cement, chemicals, ammonia, and fertilizer) part of PAT cycle- others are also encouraged to enter it
 - MSME encouraged for energy audits, energy efficiency capacity buildings
 - Recent 2022 announcement- introduction of carbon tax in industry



Adaptation strategies

- Strategies for adapting to actual and expected climate change-agriculture, livestock, dairy development, coastal fisheries, forest and biodiversity, health and water resources
- Agriculture

Type of Scheme	Details of various schemes under the category
Crop development & bio diversity	<ul style="list-style-type: none">• Development and promotion of location specific crops (rice, pulses, coconut, bamboo)• Biodiversity and local germplasm conservation and promotion
Productivity enhancement	<ul style="list-style-type: none">• Crop Health Management through pest surveillance system, climate resistant farming• Promotion of vertical farming
Supply chain management	<ul style="list-style-type: none">• Schemes related to agro service centre and delivery system• Strengthening agriculture marketing



Adaptation strategies

- Livestock, dairy development, coastal fisheries-
 - Several policy initiatives- major ones focus on monitoring and assessing the situation
 - Spreading awareness to adapt to all climate change risks and conserving environment
 - Use of insurance, compensation
 - Practice sustainable methods
- Forest and biodiversity-
 - Promote ecosystem and community resilience through targeted activities for encouraging adaptation through regeneration, restoration
 - Tree cover enhancement that helps to maintain forest cover and promotes livelihood diversification activities, to protect the forest-dependent communities
- Health- SAPCCH (SAPCC and Human health), Aardram Mission and E-health Kerala (use of
- Drinking water- Policies related to increasing drinking water supply (portable drinking water etc.), conservation of water, extreme water management and irrigation development system



EV policies and pollution control schemes

- EV Policy- Kerala introduced an EV policy in 2019
 - Clean transportation and environmental sustainability through pollution reduction, energy efficiency and conservation
 - Public and Bulk Charging Stations will be installed throughout the State in a phased manner
 - Meet their power requirement from renewable or conventional energy sources or from Distribution Companies
 - Several financial incentives
- Pollution control initiatives
 - Air quality monitoring stations established in several points in the state
 - setting up of online consent management system for ease of doing business, installation of night vision cameras for surveillance of Periyar
 - development of web-based decision support and monitoring system for pollution abatement
 - Haritha Keralam Mission is implemented with three sub-missions
 - (i) Sanitation and waste management
 - (ii) Water conservation
 - (iii) Agricultural development



CDS

Thank you



CDS