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Original Research Paper

A Critical Review of Operational Practices and Regulatory Enforcement in PUC Certification of Vehicular Emissions

Om Parkash Kapoor, Dr. Anil Chandhok, Dr. Navdeep Sharma Dugala, Dr Akant K Singh

[1]Research Scholar, USB, Chandigarh University, Gharuan, Distt. Mohali, Punjab, India
E-mail: opkapoorz@rediffmail.com

[2]Professor, USB, Chandigarh University, Gharuan, Distt. Mohali, Punjab, India
E-mail: anil.e4863@cumail.in

[3] Professor, Department of Automobile Engineering, Chandigarh University, Gharuan, Distt. Mohali, Punjab, India
E-mail: hodautomobile@cumail.in

[4]Associate Professor, Department of Automobile Engineering, Chandigarh University, Gharuan, Distt. Mohali, Punjab, India
E-mail: akant.e13980@cumail.in

Corresponding Author : Om Parkash Kapoor
E-mail : opkapoorz@rediffmail.com

Abstract

The emissions from vehicles are the major driver for deteriorating air quality which harms the society and the environments despite the legal mandate of PUC certification of on-road vehicles. The effectiveness of regulatory enforcements and PUC operational activities are subjected to critical examination through this review. The internal issues such as inconsistent testing standards, inadequate technical & topical trainings, missing equipment maintenance and calibration, inconsistent testing methods and standards are brought out for the attention of the leaders in PUC. External issues pertaining to exponential rise in vehicles population, ageing motor vehicle fleets, PUC governance fragmented structure and its subsequent weak compliance coupled with low monitoring and missing feedback loop put constraints on policy implementation. The comparative analysis carried out for best global practices in European Union, Singapore, China and California (USA) depict that there it is robust on-road surveillance, strict enforcements mechanisms enhance vehicular pollution control effectiveness. Therefore, what we get in our findings that the PUC system remain under performing for reasons of limited modernization, managerial oversight gaps, low accountability and insufficient data-based governance.

However, in spite of all this, this paper explores the PUC regulatory structure established under Central Motor Vehicles Rules (CMVRs) 1989, and supported by state Transport Departments, MoRTH, and CPCB. The paper thus goes further emphasizing to adopt remote sensing (PEMS) devices, PUC operator accredited with standardized certification, vehicle lifecycle interventions (e.g., fitness, insurance, scrappage). The lasting improvement will only happen when vehicle owners get involved besides strengthening compliance mechanisms and instituting policy reforms. The elements of framework in Figure-1, explain all these. Strengthening the PUC with such like frameworks proves essential for achieving national clean-air goals, protecting health of society, and supporting sustainable mobility transition and SDGs.

Keywords

Vehicular emissions; Pollution Under Control (PUC); Compliance enforcement; Regulatory governance; Environmental policy; Public health.

Section 1. Introduction

Rising motorization in the country at an unprecedented pace causing vehicular emissions to become dominant contributor to urban air pollution in the country (CPCB-2023). Vide central Motor Vehicle Rules (CMVRs) 1989 Pollution Under Control (PUC) certification system was established to control pollution from on-road vehicles emissions. In order to prevent excessive vehicular pollutants discharge, PUC certification functions as a tool designed to ensure that the vehicles comply with permissible emissions norms. PUC certification continues to face internal and external challenges despite decades of its implementation. Its internal issues are operator`s inadequate technical and topical knowledge, weak organization's quality culture, inconsistent performance, manipulated test results and poor adherence to quality standards applicable to PUC. The effectiveness of PUC gets constrained by lack of appropriate testing technologies and feedback loop between PUC & Transport department, weak regulatory enforcements and no economic incentives if

***Corresponding Author:**

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operators ROI cannot get generated for any reasons, may be non-compliance, thereof.

External factors responsible are low public awareness and the modern vehicle emission system, such as OBD based monitoring system, which creates technological gap in accuracy and credibility (Shiv kumar & Purushotaman 2022). The present PUC mechanism supposed to be functioning as intended and the current operational and enforcement practices adequacy to support air quality improvements commitments under the National Clean Air Program (NCAP) and Paris Agreements Goals as stated in (MoFECC 2022) will stand to face the challenges. The critical assessment of PUC system to determine structural gaps and opportunities for enhancements is called for by the researchers in today`s environments.

The impact of internal & external shortcomings and flaws existing in the functioning of PUC system, have raised questions about its role in regard to fulfilling the air quality objectives which have been foreseen and established under the National Clean Air Program (NCAP) and other commitments in the international scenario.

The deficiencies as stated above, have made scholars, researchers and policy makers to go for a thorough and critical examination of the PUC framework to identify gaps and areas where improvements through their research could be affected.

1.1 Problem statement:

In order for the economic drive required to move goods and people across distances to meet population demands, vehicular fleet is increasingly causing air pollution to rise, which in turn is adversely impacting the society and the environments. This is the real-world situation and a acute problem in the country. Increasing vehicles fleets are severely affecting ambient air quality. Over the increase in air pollution, there are occurring persistent breaches in the working of PUC, which have altogether affected its role to reduce air pollution by exercising control over it. The increase in vehicles emissions provide evidence of gaps in the reliability of test and measurements affecting PUC compliance behavior making the vehicular pollution problem, a critical one. This problem affecting public health because of polluted environments requires a policy change in governance and compliance for PUC.

1.2 Objectives of the Review:

1. To closely look at the PUC process, focusing on how it works in terms of operating procedures, equipment maintenance and calibration, and the certification services provided to the vehicle owners. All these aspects are shaped by the rules and regulations that govern and ensure compliance.
2. To propose ways to improve the process based on the lessons learned from the operational practices, structure, and how regulations are carried out in other countries, especially in areas like emission testing, vehicle inspection, and enforcement methods.

Based on research studies, government reports, regulatory evaluations, and inputs from professionals, this review seeks to identify the main issues in the current PUC framework and suggest useful ways to improve it. Enhancing the system that controls emissions from the vehicles in use is essential for achieving national air quality goals and for reducing the major health effects caused by pollution from traffic. This review paper is organized into eight Sections.

Section -1 Introduction

Section--2 Vehicular Emissions Review and Air Quality in the country

Section--3 PUC Certification Framework in the country

Section--4 Performance of PUC centers

Section--5 Regulatory Performance & Governance

Section--6 Global Benchmarks

Section-7 Challenges and Systems gaps

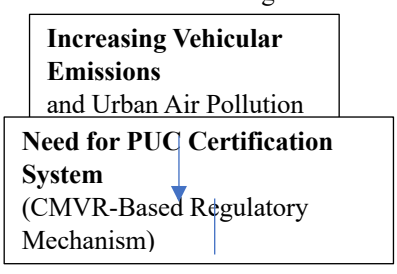
Section- 8 Conclusion and Policy Road map

1.3 Analytical Framework of the Review

An integrated analytical framework is devised to critically examine the operational practices and regulatory enforcement mechanisms associated with the Pollution Under Control (PUC) certification system for vehicular emissions.

The framework is based on the understanding that the effectiveness of vehicular emission control depends not only on the existence of regulatory provisions but also on the operational integrity, institutional capacity, technological adequacy, and enforcement consistency within the PUC ecosystem. The framework links operational and governance performance with broader environmental and public health outcomes, including reduction of vehicular emissions, improvement in ambient air quality, and support for national and international environmental commitments such as the National Clean Air Programme (NCAP) and Paris Agreement goals. The framework also incorporates policy reform pathways, including third-party audits, enhanced digital monitoring, integrated feedback systems, remote sensing deployment, and institutional strengthening measures aimed at improving governance and compliance effectiveness.

The Framework for Evaluating PUC Operational and Regulatory Performance is shown in Figure-1



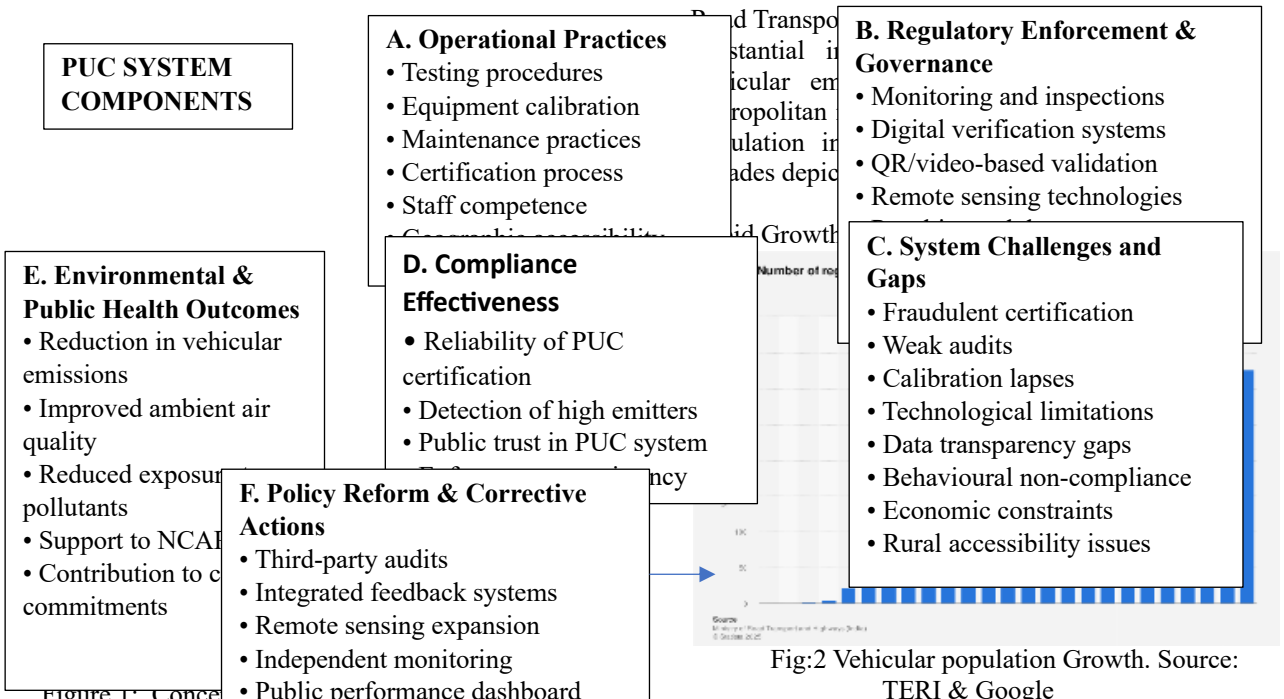
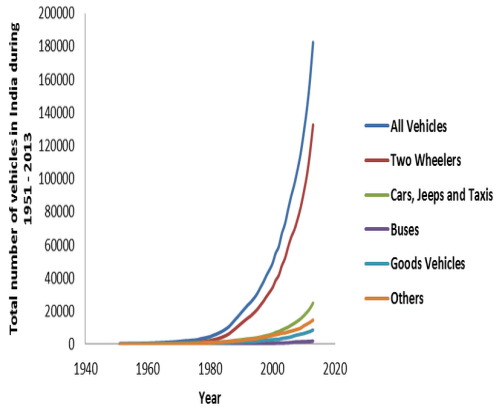


Figure 1: Conce

Section 2. Vehi
Quality in the co

This review study uses a qualitative critical analysis approach to look at how the Pollution Under Control (PUC) certification system for vehicle emissions



works in the country. It looks at the ways the system operates, how regulations are enforced, and the challenges in governing it. The study is both analytical and policy focused. The study uses information from peer-reviewed research papers, government reports, official notices, technical guides, committee findings, and reports from institutions that deal with vehicle emissions and managing air quality

2.1 Vehicular Emissions and their Trends

We have witnessed rapid motorization over the last three decades, driven by urbanization, economic growth and increased affordability of private and public vehicles. The country's vehicle population has grown from 55 million in 2001 to over 340 million in 2023, making India one of the world's fastest-growing automobile markets (Ministry of

Fig:2 Vehicular population Growth. Source: TERI & Google

Vehicular emissions remain a key contributor to deteriorating air quality. Studies estimate that the transport sector contributes 28–40% of PM2.5 levels in major Indian cities such as Delhi, Mumbai, Bengaluru and Kolkata (Central Pollution Control Board [CPCB], 2021; Guttikunda & Mohan, 2023). Additionally, road transport accounts for nearly 90% of total CO emissions, 30–35% of NOx emissions, and is a rising source of greenhouse gases. International Energy Agency [IEA], 2023).

Despite the tightening of fuel and technology standards such as the implementation of Bharat Stage-VI (BS-VI) norms in 2020, a large proportion of India's vehicle fleet still consists of older, poorly maintained vehicles that are disproportionately responsible for harmful exhaust emissions (CSE, 2022). Diesel commercial vehicles and two-wheelers particularly contribute to high NOx and particulate output due to aging, poor combustion efficiency, and inadequate emission checks (CPCB, 2021).

In order to keep in -use vehicles meeting emission standards, the PUC centers were established to carry out verification of emission limits after their registration. But the deteriorating air quality makes it evident that PUC system is not functioning for compliance as well as to provide its performance.

2.2 Urban Air Quality and Public Health Burden

Our country is home to 14 of the world's 20 most polluted cities, with PM2.5 concentrations frequently exceeding national and WHO limits (IQAir, 2023). The national ambient air quality standard for PM2.5 is 40 µg/m³, whereas monitoring data in several cities regularly exceed 90–120 µg/m³ during peak periods (CPCB, 2022).

Vehicular emissions release a complex mix of harmful pollutants — PM, NOx, CO, VOCs,

benzene and ozone precursors — all negatively affecting human respiratory and cardiovascular health. The Global Burden of Disease (GBD) study links ambient air pollution in India to more than 1.67 million premature deaths annually (Balakrishnan et al., 2022). One of PM2.5 Emissions are shown in Fig 3.

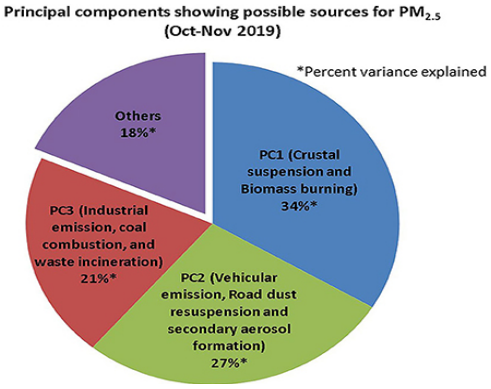


Fig.3: Transport Sector's Contribution to Air Pollution in terms of PM 2.5. Source: Google.

Certain urban demographics are particularly vulnerable:

Vulnerable Group	Health Impact Risk
Children	Asthma, stunted lung development
Elderly	Greater cardiovascular and respiratory impacts
Traffic police & drivers	High roadside pollutant exposure
Low-income populations	Higher exposure, less access to healthcare

Health studies continue to show that people living or working near busy roadways experience a disproportionately high burden of respiratory and related illnesses, reflecting the strong association between traffic concentration and adverse health outcomes (Sharma et al., 2023). The vehicular air pollution affected social and economic losses annually at more than USD 36 billion (World Bank, 2022). It is not that it is essential to achieve better air quality but also to reduce growing country`s public health burden which naturally exert huge pressures on the national budget.

2.3 Intended Role of the PUC System in Emission Control

The Pollution Under Control (PUC) system is established as an oversight mechanism with the aim that the on-road vehicles emissions do not go beyond their specified limits as per central Motor Vehicles Rules1989 (CPCB, 2021). The PUC Tests are meant for monitoring compliance during the service life of a vehicle whereas the test conducted during manufacturing are type approval and conformity of Production. The objectives of PUC framework consist of the following:

- Periodic emission tests for all categories of in-use vehicles.
- To Identify gross polluters having excessive emissions.
- In a way Promoting vehicle preventive maintenance by enforcing compliance to PUC systematic checks.
- Feeding the emissions compliance data into the state databases (recently integrated into Parivahan portal)

These objectives are meant to support environmental policy so much as to achieve ambient air quality in urban areas by reducing the emissions from vehicles.

Distribution of Responsibility in the PUC System

The coordinated functioning of all the stakeholders' groups determines the PUC effectiveness as given in Table-1:

Table-1

Stakeholder	Core Role
State Transport Department / RTO	Licensing, compliance enforcement, monitoring
PUC Centre Operators	Emission measurement, certification accuracy
Vehicle Owners	Maintenance, timely check compliance
Traffic Police	On-road verification of certificates
CPCB / SPCBs	Standard-setting & oversight audits

Table 1 shows the regulatory and operational linkages.

Expected Impact on Vehicular Emissions:

In case the PUC system operations are effective then the PUC checks can identify gross vehicle polluters, which may estimate around 10-20 % fall in emissions. Then it can be expected that PUC system may bring down average particulate matter and carbon but the evidence obtained suggests that PUC performances are below than what is expected benchmarks.

Current Indicators of PUC System Performance:

Field evaluations report:

- 4–12% failure rates observed against expected 20–25%, indicating potential testing inaccuracies (CSE, 2022)
- Compliance gaps: Many vehicle owners avoid periodic testing until penalized
- Issues of under-reporting pollution due to manipulation and calibration failures

Table 2: Intended vs Observed PUC System Impact

Parameter	Intended Outcome	Observed Trend (Recent Studies)
Emission reduction in in-use fleet	Significant drop expected (PM/CO/NOx)	Limited / inconsistent improvement
Detection of high emitters	20–25% expected fails	4–12% reported fails

Operational integrity	Strong calibration + audit control	Frequent manual overrides, poor oversight
Data usefulness	Real-time monitoring conforming to policy	Fragmented, limited analytics
Vehicle owner acceptance	Routine compliance	Observed as reactive in place of preventive

(CSE 2022; CPCB 2021)

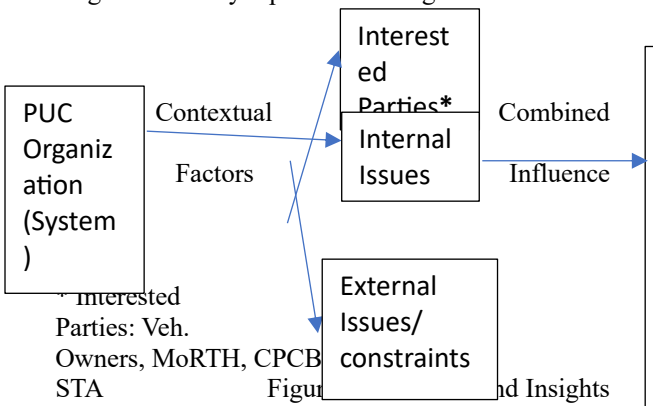
Key Interpretation

PUC program to deliver effective control on vehicular emissions plays a key role in India's approach to controlling vehicular emissions. Instead, its weaknesses have limited environmental benefits, it supposed to deliver. Here in the review the shortcomings are examined in detail.

2.4 Challenges Affecting the Performance of the PUC System

The present PUC mechanism finds substantial obstacles in its way to implement regulatory approach so as to control vehicular emissions. This happens because of the weaknesses in its functioning including the broader policy and environmental factors for it is designed to achieve.

The PUC certification system functioning, have its internal processes which interact with external influences to produce effective output of controlling the vehicular emissions. Its internal processes are test & measuring practices of vehicular pollutants, equipment calibration & maintenance and their use, feedback mechanisms and the workforce capabilities together interact with regulatory monitoring & measuring, audit outcome, performance reviews implementations coupled with influence of organizational environmental policy for governance and compliance. All the above factors, in practice, dilute the expected impacts of PUC certification process. These contextual factors are diagrammatically represented in fig-4 below:



* Interested Parties: Veh. Owners, MoRTH, CPCB STA

Figure 4: Contextual Factors and Insights from PUC contextual Factors (Prepared by Author)

2.4.1 Internal System Issues

Internal issues refer to problems within the operation and governance of the PUC system. The Key concerns are:

(i) Limited and Uneven Training norms and Standards: The technical training is very significant in the wake of vehicular air pollution. The training imparted is not uniform. Along with training on equipment use, the training on environments and the concerned policy requirements need to be imparted on urgent basis. (MoRTH, 2022).

ii) Scope for Human Error and Manipulation: PUC workforce has the opportunity to override test results because of some manual inputs. This all creates scope for unfair practices resulting in defective PUC certificate. A significant number of centers continue to use emission analyzers that are outdated or insufficiently calibrated & maintained, inadequate knowledge which all increase the likelihood of vehicles being incorrectly certified as compliant (Bhowmik & Ghosh, 2021).

(iii) Inaccurate Calibration, maintenance & upkeep of equipment and their Technical Reliability: PUC centers use emission analyzers & smoke meters that are not maintained, not periodically calibrated their upkeep is error some which all result in vehicles incorrectly certificated (CSE- 2022).

(iv) Gaps in Data Quality and System Integration: Absence of Feedback loop between PUC and state Transport department and delays in data uploads, incomplete entries and other inconsistencies, affect the reliability of emission records and related analytics (CPCB, 2021).

(v) Insufficient Monitoring, measuring and Audit Practices: In many regions, state transport authorities lack mechanisms for continuous or real-time monitoring and measuring the PUC activities, leading to irregular inspections and undetected non-compliance in the PUC.

These internal concerns are best presented for ``Impact on Emission Control`` in a tabular form, as shown in Table 3.

Table 3: Internal Issues Affecting PUC Centre Performance

	Descriptio	
	Staff at PU often do n uniform or training equipment calibration pollution social h environme updates to emission norms.	
Operational Culture and Ethical Conduct	Routine practices may be shaped by informal things like quick processing due to customer pressure which may affect	Such practices increase the likelihood of unfair testing and distort

	strict adherence to prescribed procedures.	overall compliance.
Lack of Maintenance of Equipment	Gas analyzers and Smoke meters are sometimes used without procedural recalibration and periodical maintenance.	Values of emission measurement readings gets affected resulting in incorrect PUC certification.
Data Management and Record Keeping	Errors in Digital record-keeping systems such as delays, wrong or incomplete entries in them leads to delays in uploading information resulting in uneven-quality documentation.	This all-affects traceability, reduces data quality, and enforcement actions unimpactful.
Performance Monitoring	Periodical internal & external audits, CAPA implementations, performance reviews and feedback, all these in PUC system are not implemented	All such aspects lead to low quality control, accountability and poor practices.

Thus, the technical challenges and internal governance are important factors which undermine the reliability of emissions testing in PUC. These weaknesses reduce vehicle owners' confidence in the system and limit its ability to achieve meaningful reductions in controlling vehicular emissions affecting air pollution.

2.4.2 External Issues Affecting System Performance

External challenges from the technological, economic, and regulatory conditions and the organization structure affect the PUC system function in practice. These are described here in under:

i) Rapid Vehicle Growth and Increasing Congestion

ii) The rising vehicle population in the country continuously undermine improvements brought out by emission control strategy for the reason that major portion of older, high-emitting vehicles are still in use (IEA, 2023).

ii) Vehicle Owners Perception and PUC Compliance Behavior

Many vehicle owners perceive the PUC test as an administrative burden rather than a preventive measure taken for cleaner air. As a result, compliance to get PUC certificate is often delayed till enforcement action becomes unavoidable (CSE, 2022).

iii) Financial Considerations

Repair and maintenance costs discourage many vehicle owners operating commercial vehicles feel that repair and maintenance costs are more than from undertaking corrective actions such as repairs after failing an emission test.

iv) Technological Limitations

Limited deployment of technologies such as On-Board Diagnostics (OBD) testing and remote-sensing systems such as PEMS restricts the ability to accurately identify vehicles that pollute heavily under real driving conditions.

v) Uneven On-Road Enforcement

Traffic enforcement related to emissions checks is inconsistent across states and cities, reducing the deterrence value of non-compliance penalties.

vi) Road conditions

Many of the roads in and around the suburban and industrial areas are broken and full of troughs & holes which make the vehicle to emit more resulting in worsening the air quality.

Taken together, these external pressures constrain the effectiveness of the PUC system even if internal operations were functioning optimally, as indicated earlier in Table 3.

External Issues Affecting Regulatory Enforcement

These issues stem from broader legal, social, and economic environments. They are smmarized in **Table 4** below.

Table 4
External Issues Influencing the Enforcement of the PUC System

External Issue Category	Revised Description	Revised Consequence
Regulatory Oversight Limitations	State Transport departments and pollution control boards often lack systems for continuous monitoring and do not altogether apply strong penalties.	Weak enforcement measures often allow non-compliance to continue.
Technological Gaps	Adoption of improved testing tools such as OBD-based emission checks and remote-sensing equipment has been slow.	Routine PUC tests often fail to capture true on-road emission levels.
Social and Behavioral Factors	Many vehicle users prioritize convenience and cost, showing limited willingness to undergo repeated or stringent emission checks.	Leads to poor compliance and neglect of emission-related maintenance.

Economic Incentives	Smaller workshops running PUC centers may focus on revenue rather than strict testing requirements.	Profit motives can result in certificates being issued without proper testing.
Competitive Pressures	Centers face competition for customers and may fear losing business if they enforce stricter testing protocols.	Encourages low level & relaxed testing or misconduct to retain clients.

Summarizing we say:

The external regulatory and social environment often pushes PUC centers to prioritize throughput over rigorous testing. PUC System priority of throughput over rigorous testing enables high emitting vehicles to escape. This altogether results in reduction of intended impact of emission control policies.

2.4.3 Combined Influence of Internal and External Pressures

PUC adopts procedural shortcuts in testing and measuring vehicular emissions because of its internal weaknesses and external constraints described above, which ultimately make the emission results questionable. These aspects contribute to give rise to air pollution load and affects vehicle owners` confidence in PUC testing. Collectively these interlinked internal weaknesses and external constraints undermine the stability and credibility of PUC framework resulting in limiting its ability to support country`s broader air quality objectives.

The key insights emerged from this section are as follows:

- PUC center's operational deficiencies when combined with its contextual factors (its internal & external issues and interested parties' stakes) has increased its impact on social health and environmental issues.
- Instead of taking corrective action measures for the deficiencies of PUC certifications, it would be better if comprehensive system level approach is taken to strengthen the PUC mechanism.

The review of operational functioning and enforcement practices is the result of discussions to bring out and identify meaningful improvements where those can be implemented in PUC.

Section 3. PUC Certification Framework in India

The PUC certification system in the country works through a multi-level legal and institutional setups as explained under the Motor Vehicles Act, 1988 and the Central Motor Vehicles Rules (CMVR), 1989 and depicted in Figure-5 at para 5.1.

3.1 Regulatory Basis of the PUC System

Legal Framework (Motor Vehicles Act & CMVR Rules): Vide Central Motor Vehicle Act 1988, CPCB fixed vehicular emission standards under rule 115 of Central Motor Vehicle Rules (CMVRs)1989, so as to authorize the central government to regulate and enforce them. These provisions specify the permissible limits for in-use vehicles, define testing requirements, outline penalties for non-compliance, and set procedural norms for PUC center operations to be implemented by State Transport Authority (STA) in each state, reiterated by the Central Government in parliament session dated 21 November 2025.

Institutional Roles: CPCB, MoRTH, and State Transport Authorities

The national emission standards are developed by the Central Pollution Control Board (CPCB). These are issued as technical protocols for testing. The Ministry of Road Transport and Highways (MoRTH) is responsible to issue policy direction, integration of digital systems such as VAHAN, and overall regulatory governance & oversight. PUC center authorizations, monitoring inspections, and day-to-day enforcement across cities and districts are handled by State Transport Departments. MoRTH's 2021 notification (G.S.R. 410(E))

Relationship with Bharat Stage (BS) Emission Norms

Bharat Stage standards BS-IV & BS-VI establish emission limits for newly manufactured vehicles. PUC norms are derived from these standards to ensure that vehicles already in use continue to operate within acceptable pollution levels. With the rollout of BS-VI norms, in-use vehicle emission thresholds have become more stringent to match the national shift towards cleaner technologies.

The emission levels verified through PUC checks need to align with the Bharat Stage standards applicable to the vehicle fleet (CAG of India, Chapter 4, November 2025).

3.2 Certification Requirements and Validity

Vehicle Categories: Petrol/CNG and Diesel

Petrol and CNG vehicles are checked for pollutants of carbon monoxide (CO) and hydrocarbons (HC) only, while diesel vehicles undergo smoke-opacity measurement in Hartridge smoke units. Older and high-usage commercial vehicles often face tighter oversight by the officials of transport department due to their greater emission potential. CPCB's official guidance makes clear that PUC testing covers all categories of motor vehicles although measurement methods differ by fuel type.

Validity Rules

Rule 115(7) of CMVR 1989 sets the validity timeline. These provisions were reaffirmed in a 2023 High Court ruling.

- New vehicles: Validity of PUC certificate is for one year from the date of registration.
- Existing vehicles: Certificate validity is typically six months, allowing for more frequent monitoring.

Repairs and retesting are needed for those

vehicles that fail to meet the emission limits so as to return to regular operation.

Renewal and Documentation

Under Rules, the vehicle requires a valid PUC certificate that must be available with the vehicle owner or reflected digitally on the VAHAN platform. In many states, before the expiry of PUC certificate, automated SMS or digital reminders are issued before the expiry of the certificate.

According to MoRTH's clarification to Parliament (21 November 2025), PUC data must be electronically transmitted to the VAHAN system, and owners are required to either carry the certificate or ensure it is digitally retrievable under Rule 116.

3.3 Testing Parameters and Procedures

Core Emission Parameters: The PUC test primarily measures:

- Carbon Monoxide (CO)
- Hydrocarbons (HC)
- Smoke density or opacity in Hartridge smoke units (for diesel vehicles). These indicators of air pollutants in a way reflect fuel efficiency, combustion quality, and overall engine health.

Audit reviews from the Comptroller and Auditor General (CAG) also cite CO, HC, and smoke density/opacity as the core parameters used for compliance checks (CAG, Nov 2025).

Testing Equipment: Gas Analysers and Smoke Meters

State transport Authority (STA) approved make digital analyzers are used for petrol/CNG vehicles, and smoke meters are used to evaluate the opacity of diesel exhaust. Modern measuring systems such as those given above, record readings automatically to reduce chances of tampering or manual manipulation.

The draft amendment GSR 740 (2020) explains that PUC-L1centres must use equipment approved under AIS-137 standards, including digitally integrated analyzers and smoke meters.

Calibration and Standard Testing Protocols

Equipment calibration must be conducted at prescribed intervals (in relation to last calibration) using certified reference gases. The testing method typically includes:

- Ensuring the engine is warmed up
- Maintaining appropriate idling conditions
- Taking multiple readings for accuracy.

Uniform procedures across states help maintain data consistency and improve system reliability.

The calibration standards must have the traceability to National Standards. State-level transport advisories emphasize regular calibration of equipment and routine verification checks as these are key factors in credible emission testing.

3.4 Certification, Records, and Digital Integration

Certificate Structure and Required Information: As per the standard format, the PUC certificate includes identification details, emission readings, permissible limits, validity duration. PUC Centre testing personnel credentials such as training certificates and registration documentation etc of PUC centre need to be maintained. These elements in PUC certificate support accountability and regulatory traceability. MoRTH's notification G.S.R. 410(E) (14 June 2021) Introduced a uniform PUC certificate format mandated for nationwide use vide MoRTH's notification G.S.R. 410(E) (14 June 2021).

Digital Integration through VAHAN

Test outcomes are uploaded instantly to the VAHAN database, which enables:

- Centralized monitoring & measuring activities of compliance
- Reduction of fraudulent or manually fabricated certificates details before and after `VAHAN` was introduced.
- Automatic generation of challans for vehicles lacking valid PUC certification

Linking each PUC result directly to the VAHAN platform vide Notification G.S.R. 527(E) (2018), enabling centralized verification and systematic oversight.

QR-Based Verification

Use of QR codes on PUC enabled quick verification by enforcement teams, in many states such as authentication of PUC certificates on the spot and to curb unauthorized edits or duplication by the officers has become possible due to this feature.

Recent government directives require photo/video validation during testing, and certificates now include QR codes to curb misuse. This has been widely reported in national news outlets.

3.5 Enforcement and Compliance Mechanisms

Penalties for Non-Compliance: Operating a vehicle without a valid PUC certificate can attract a penalty of ₹10,000, along with the possibility of temporary suspension of the Registration Certificate is enabled by the Motor Vehicles (Amendment) Act, 2019. These strong financial and administrative measures are meant to deter negligence and promote regular compliance among vehicle owners.

Section 190 of the Motor Vehicles Act, 1988 authorizes penalties—including fines and potential license implications—for operating a vehicle without a valid PUC certificate. Enforcement summaries referenced by the National Green Tribunal reiterate these provisions.

Roadside Checks and Monitoring Practices

On-the-spot inspections and verify certificates through the use of handheld digital tools are now carried out by Traffic Police Enforcement teams and state Transport Departments. Use of remote-sensing technologies (PEMS) in several major cities have also begun to supplement physical checks by identifying high-emitting vehicles automatically, even without stopping traffic.

Departmental and environmental audit reports (2021) note that enforcement teams use spot checks,

visible smoke monitoring etc to identify high emitting vehicles.

Awareness Measures and Compliance Incentives: Various awareness campaigns and service-based incentives—such as reminders linked to insurance renewal or discounts offered during servicing—To encourage vehicle owners to maintain valid PUC certification so as to adopt an environmentally responsible approach to emission control, various awareness campaigns and service-based incentives are given. These are reminders linked to renewal of vehicle insurance or discounts given during servicing.

MoRTH circulars advise State Transport Departments to expand PUC availability, particularly through centers at fuel stations, and to ensure routine auditing of these facilities.

3.6 Governance and Operational Requirements for PUC Centers

Centre Licensing and Accreditation: PUC centres must obtain approvals from their State Transport Departments so as to comply with prescribed norms relating to infrastructure, equipment, and staffing, in order to operate legally. To ensure continued adherence to these standards, PUC centers are also subjected to periodic inspections by the state Transport departments.

Affidavits submitted before the National Green Tribunal (e.g., by the Maharashtra Transport Department) confirm that only centers authorized under Rule 115 may operate, and they must follow prescribed norms for test conduct and certificate issuance.

Operator Training and Skill Requirements: In order to ensure accurate data entry, PUC operators conducting the tests must be trained in operating the approved equipment, follow standardized test routines, maintain the machines and their calibrations. Emphasis on ethical testing practices during the training helps reduce the risk of manipulated or incorrect measurement readings.

CPCB and MoRTH guidelines place emphasis on competency certification, structured training, and familiarity with updated emission-testing procedures for center operators.

Audit Mechanisms and Safeguards Against Fraud: Surprise & unannounced checks by the transport department were taken up. They also relied on digital safeguard measures such as automated photograph capture during emissions testing (a requirement introduced in recent years) and integrated data-tracking systems to detect irregularities of the kind of fabricated readings, manipulation of analyzer data and issue PUC certificate without conducting the tests on the vehicle.

In order to achieve consistent emission control outcomes, oversight and regular monitoring of PUC system needs to be strengthened.

To meet the needs of recent regulatory reforms, videography of PUC testing and conduct of random audits are certainly essential steps. Audit reports will highlight these consistently and will result as protection measures from fraudulent certification.

In Summary we can say that: The parts of the PUC system work together to make sure that vehicles on the road stay within allowed emission levels during their entire useful life. This will help strengthen the trust in the country`s system for ensuring that control on emissions is met.

Section 4. Performance of PUC Centers in India

4.1 Centre Coverage and Accessibility

The authorized PUC center's locations across states differs significantly particularly between rural and urban regions. The concentrations of PUC centers and their access to vehicle owners in regard to their testing facilities in Metropolitan cities is higher relative to rural and semi urban areas (MoRTH, 2021). Vehicle owners either avoid or postpone testing of their vehicles where accessibility to these centers is low. This factor weakens the preventive intent of PUC system. Transport department initiatives to establish PUC centers at fuel stations or near to them, have improved but in some areas the geographical disparity still continues to persist (Parivahan).

Implication: Unequal location of PUC centers affects uniform enforcement and creates compliance gaps.

4.2 Quality of Testing and Calibration Compliance

Field studies and independent audits and their observations have pointed out the issues in regard to maintenance, calibration and use of test procedure. It came out from several studies that gas analyzers were overdue for calibration, PUC center that issued PUC certificate without appropriate testing and smoke meters that provided inconsistent measurement readings were being followed. Such common issues of the nature of overdue calibration of analyzers, inconsistent performance of smoke meters, and departures from prescribed testing procedures are prevalent in PUC Centers. (CPCB audit summaries; EPIC field assessments).

Implication: Inadequate calibration, maintenance and procedural lapses undermine the reliability of PUC data for regulatory or policy decisions.

4.3 Operational Integrity and Fraud Concerns

The performance of PUC Centers is brought out by investigative reports and field experiments. These are documented as fraudulent practices including issue of PUC certificate without conducting tests, manually changing the measured results or not reporting the failed tests etc. Decoy vehicle experimenting could show many inconsistencies and evidence of manipulations in many cases (EPIC-India). As a case in Delhi urban PUC Centers were found in doing fraud for PUC certification that prompted a policy response for a mandatory video verification while doing PUC certification (EPIC-

India: Improving Vehicular emissions fitness performance- for Delhi).
Implication: The regulatory credibility is weakened, vehicle owners` confidence reduced and high emitting vehicles continue on-road undetected when fraudulent practices in PUC certification exist.

4.4 User Awareness, Cost Perception, and Customer Behavior

It is found in Surveys that many vehicle owners consider PUC certification a routine legal formality but not an important step towards vehicle maintenance. Awareness regarding the environmental and health rationale among vehicle owners, is often limited. Cost considerations also influence behavior—many owners prefer minimal expenses and quick certification rather than undertaking necessary repairs. As a result, the PUC certificate becomes the primary objective, with less attention paid to actual vehicle condition (CSE studies; EPIC-India surveys).
Implication: Limited awareness and cost-driven choices inculcate the behaviors towards non-compliance for certifications of vehicular emissions and weaken the deterrent value of the PUC system.

4.5 Public Health and Environmental Performance Outcomes

Evidently periodic emission testing is designed to help reduce overall vehicle pollution, available evidence suggests that high-emitting vehicles continue undetected and operate on urban roads. Remote sensing tests in big cities usually find that vehicle emissions are higher than the limits set by lab tests or PUC checks, especially for older cars. In reality, the pollution from vehicles on the road is often more than what is measured at PUC centers.
Implications: Insufficient effectiveness of the PUC system contributes to sustained air quality and public health risks associated with on road vehicular traffic emissions.

4.6 Audit Observations, Court Directions, and Areas Requiring Reform

Studies from state and national audits, court rulings, and policy checks often suggests that improving calibration standards, conducting more frequent audits, using Video or QR codes as proof of testing, connecting more with the VAHAN system and speeding up the use of remote sensing for road checks are important steps. At the same time, rules and compliance actions like using a standard format for PUC certificate, sending data digitally and requiring video records show how regulations are trying to resolve these issues. Pilot projects using remote sensing and other digita l tools are currently being carried out in multiple cities (Press Information Bureau, 2021). For these initiatives to be successful, there needs tobe consistent implementation, strict e nforcement, regular monitoring, and independent evaluation.
Implication: While many corrective actions have been announced, it`s important to keep them going consistently to improve governance and compliance, so that long standing issues can be properly addressed and resolved.

4.7 Evidence from Peer-Reviewed Studies and Remote-Sensing Evaluations

Recent studies using remote sensing devices and portable emissions measurement systems have found that many vehicles with valid PUC certificates still release harmful pollutants at levels much higher than allowed when driven in real world conditions. Research from the ICCT RS-TRUE project in Delhi showed that several vehicle types, including some BS-VI models, had higher levels of Nox and CO than what was measured during PUC tests and type approval standards (Narla et al., 2024; ICCT reports).
EPIC India`s tests with fake vehicles revealed more problems in how the tests were carried out. There were also cases where certificates were given even though the testing was not done properly or was not complete. These results show that just because a vehicle has a PUC certificate does not always mean its emission system is actually working as it should.
Implication: Although reforms have started, how well they work depends on careful implementation, stronger institutional actions, and independent audits.

Section 5. Regulatory Enforcement & Governance

5.1 Legal and Institutional Framework

In the country, the PUC certification system works through a structured legal and organization setup created under the Motor Vehicles Act, 1988 and the Central Motor Vehicles Rules (CMVR), 1989. The Ministry of Road Transport and Highways set the national rules and policies, while the Central Pollution Control Board sets the technical standards and how tests are done. State Transport Departments and Regional Transport Offices handle the actual licensing, checking, and making sure things are followed at the local level, using approved PUC testing centres. The entire legal and Institutional framework is shown in Figure 5.

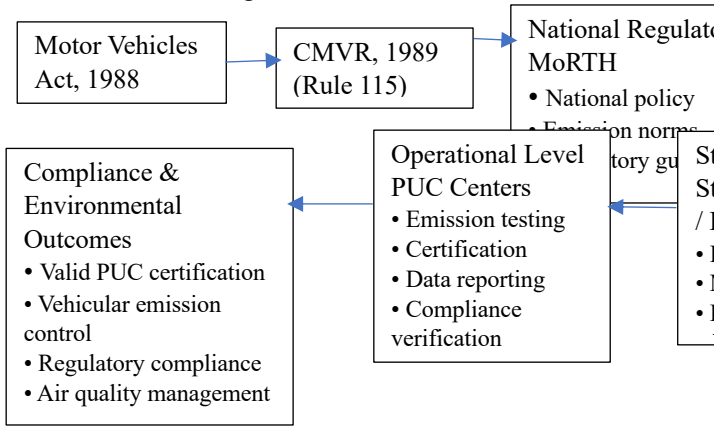


Figure 5. Legal and Institutional Framework of the PUC Certification System

Together, this system helps make sure vehicles meet pollution standards, follow the rules, and reduce vehicle-related pollution.

5.2 Digital Governance, Transparency, and Monitoring Systems

To improve supervision and regular monitoring, many states now ask PUC centers to upload all test results directly to national systems like VAHAN. This digital system makes it easier to track information, allows enforcement agencies to check data in real time, and helps prevent any unauthorized changes or manual interferences with the data.

Because of repeated issues, regulators have added more safety steps like taking videos or pictures of every test and giving certificate with QR codes. Traffic police can quickly check these codes during stops to confirm the certificates are real. This makes sure that certificates are only given after real test is done.

Authorities are slowly trying out new surveillance technologies like remote sensing devices, ANPR systems for license plate recognition, and automatic penalty systems. These tools help spot vehicles that emit a lot of pollution or do not follow the rules, even when they are not at the PUC center. This makes it easier to keep track of vehicle emissions during regular PUC checks.

5.3 Penalties, Compliance Mechanisms, and Incentive Structures

The rules regarding penalties are outlined in the Motor Vehicle Act 1988 and the CMVR 1989. If a vehicle is found running without a valid PUC certificate, financial penalties and the possibility of losing its registration can be enforced under these regulations. These rules act as legal warning to encourage people to follow the rules properly.

Roadside inspections, border check-point verification, and random vehicle audits can be done by the enforcement teams. In some states, fuel stations have been instructed to not supply fuel for vehicles that fail to produce a valid PUC certificate, which works as a strong economic disincentive.

Policy makers should think about connecting the validity of a PUC with other important services like insurance renewal or fitness certification. This way, if some-one does not comply with the PUC rules, it will automatically stop them from completing other official procedures.

Creating a system where feedback is used to enforce rules, by gathering information from test outcomes, roadside checks, complaints, and audits, state departments and the CPCB then take action to improve things. This method helps find issues faster and allows for prompt rechecks or temporary suspension of licenses.

5.4 Institutional Challenges and Governance Gaps

Quality enforcement varies a lot from one state to another. Some states have made good progress with digital systems connected to VAHAN and have started using video verification methods. However other states still struggle with keeping track of things, ensuring proper calibration and doing regular checks. These differences lead to uneven levels of enforcement and are as where people are not following the rules as closely.

Limited audit capacity. Independent reviews such as the CAG audit have pointed out that transport departments do not have adequate mechanisms in several states for third-party calibration of PUC equipment. Irregular inspections and insufficient maintenance arrangements weaken technical reliability. The audit further stated that software checks alone cannot ensure accuracy without consistent and regular physical audits.

Fraud and collusion. There are instances shown by field investigations and controlled testing exercises that vehicles receive certificates without proper testing or with manipulated readings. Such practices reveal structural vulnerabilities that facilitate misconduct of unfair practices that reduce the credibility of PUC certificates.

Restricted public transparency. Although centralized data uploads have improved internal visibility for regulators, but it requires comprehensive public-facing dashboard that could regularly report PUC activity, pass rates, or enforcement actions. This limits external scrutiny and reduces opportunities for independent evaluation.

Weak grievance and feedback systems. Most of the states do not have a systematic process for integrating public complaints, enforcement findings, and audit outcomes, in the light that few of the states may be providing SMS notifications or simple complaint portals. As a result, corrective actions against persistently non-compliant centers are often delayed to get implemented.

5.5 Recent Reforms and Their Initial Impact

Standardized PUC certificate and digital linkage. The introduction of a uniform national certificate format and the requirement that all PUC data be linked to VAHAN were major steps taken in 2021. Early adopters have reported improved data consistency and greater ease of enforcement due to uniformity in digital records.

Video/photograph verification and QR codes. The authorities now require image or short-video evidence of each test and provide QR-enabled certificates that can be scanned instantly in order to address fraudulent testing practices. Pilot areas report better traceability and a reduction in certificates issued without genuine testing.

Remote sensing pilots. High levels of NOx and CO emissions from certain vehicle segments captured by remote sensing campaigns, taken up in Delhi–Gurugram, underscored the importance of supplementing PUC tests with on-road measurements.

Enhanced digital enforcement. Districts using ANPR-linked e-challan systems have seen a rise in detection of vehicles lacking valid certificates. Technology-led enforcement mechanisms are proving effective wherever implemented rigorously. The recent reforms have made some progress, but there are still problems to solve. Even if videos showing measurements are shared, it might not stop people from changing the data unless there are strict and ongoing checking and supervision. Using remote sensing tools need the ability to track down those who break the rules. Also, regular checks along with fixes and support from management are necessary for real enforcement to work.

5.6 Critical Evaluation: Effectiveness, Risks, and Key Recommendations

What is working well:

(i) Using the same certificate format and mor e digital tools has made data more consistent and easier to check.

(ii) Using videos and QR codes for verificatio n has increased transparency in many city are a

(iii) Remote sensing technology helps gather real- world data on emissions, making it easier to identify major polluters accurately.

Key gaps and risk thereupon:

- Many states lack adequate technical infrastructure and staff to review the increasing volume of digital evidence.
- Fraud and malpractice may continue in newer forms unless supported by independent third-party audits, performance reviews, regular monitoring and strict penalties.
- Differences in state-level implementation create uneven compliance and leave certain regions more vulnerable to weak enforcement. This needs to be promptly addressed.

Section 6. Global Benchmarks — Comparative Summary

Singapore

Singapore closely monitors diesel and heavy vehicles through a strict system of regular emission tests. This process is backed by thorough audits and strict penalties for those who do not follow the rules. The authorities reinforce center-based inspections through additional on-road monitoring, in several urban zones. **Strengths:** The combination of strict enforcement and significant penalties results in very high compliance rates. The likelihood that high-emitting vehicles remain undetected is reduced by frequency and rigor of inspections.

European Union (Periodic Technical Inspection – PTI across Member States)

In EU countries, they operate a harmonized PTI framework that mandates vehicle inspections at fixed intervals. The scheduled PTI tests are verified with roadside emission checks or environmental audits to see actual performance of pollution certification on the road, in many member states. **Strengths:** Common regulatory standards across the EU ensure uniformity. To identify real-world high emitters and minimizes the ability of vehicles to pass idle/static tests while still polluting excessively during operation, periodic testing with random or on-road measurements are consistently used.

California / United States

Emissions testing for older vehicles is adopted in California. Newer models of vehicles undergo screening through On-Board Diagnostics (OBD) systems that continuously monitor malfunction indicators. In major urban areas, remote-sensing checks and periodic compliance audits supplement these requirements.

Strengths: **The integration of OBD monitoring with roadside remote sensing ensures year-round oversight rather than occasional inspections. This method is used regularly to find problems with emission systems early, which helps greatly in making sure emissions meet real-world standards.**

China (Major Urban Regions)

In big Chinese cities, steps like checking vehicles more frequently, strictly following rules and taking strong actions against those who break the rules are used. This includes penalties, removing a vehicle`s registration, or putting limits on cars that pollute a lot. Officials also keep detailed digital records to monitor each vehicle`s history of following the rules.

Strengths: To quickly spot major polluters, regulators enforce strict rules with frequent inspections. Using digital tracking makes it easier to hold companies accountable and helps take quick actions to fix problems.

Section 7. Challenges and System Gaps (Critical Synthesis)

7.1 Challenges: The main weaknesses found in the literature and policy review are highlighted, explain why the PUC mechanism -although required by law- usually does not lead to real reductions in emissions on the road. These challenges can be grouped into six main areas:

(a) problems with the overall system and how it is managed

(b) gaps in technical knowledge and methods used,

(c) worries about how the system is run and its reliability,

(d) Issues with data quality and lack of transparency,

(e) Limitations caused by people`s behaviors and economic factors.

(f) Problems related to access and fairness

7.2 Systemic & Governance Gaps

7.2.1: Uneven implementation, institutional capacity and deterrence gaps

- Uneven implementation across states.

National rules are the same everywhere, but in different states, the way they carry out these rules

varies a lot. This means some areas have poor oversight, and violations can go undetected, which lowers how well people follow the rules.

- Limited institutional capacity

Many transport departments and RTO`s struggle to carry out regular checks and surprise inspections because they have not enough staff, technical experts, or labs, and their budgets are too small. Without enough people on the ground to enforce rules, digital tools alone cannot make sure people follow them.

- Weak deterrence in practice: Even when there are penalties for breaking the rules, they are not always used consistently or quickly. This makes the penalties less effective at stopping people from breaking the rules.

7.2.2 Technical & Methodological Gaps

- The testing method used in PUC inspections do not show how much pollution vehicles really produce when driven in real life. The standard test check for emissions when the engine is idling and when smoke levels are measured, but they do not include the situations like when a car is speeding up, starting when it is cold, or running under heavy load. These are all situations that happen a lot in city driving and make a big difference in how much pollution people are exposed to.
- Slow use of new diagnostic tools: The PUC system is not effectively identifying high emitters quickly and correctly, partly because technologies like OBD, Portable Emissions Measurement Systems (PEMS), and remote sensing are not being used enough.
- Calibration lapses: Repeated checks and research consistently show that equipment which is not properly cared for or set up wrong can cause the test results used for certification to be wrong.

7.2.3 Operational Integrity & Fraud Risks

- Certificates were given out without proper testing: In field investigations and studies involving decoy vehicles, there have been cases where centers were found issuing PUC certificates without performing the necessary tests or altering the readings to make vehicles pass.
- Evolution of fraudulent practices: In the absence of regular oversight and periodical monitoring, procedural safeguards like QR codes or video verification can be bypassed through collusion or manipulated uploads.

7.2.4 Data, Transparency & Evaluation Gaps

- Absence of a unified public performance dashboard: Lack of nationally accessible platform showing key indicators such as pass–fail rates, audit frequency, or center suspensions, makes third-party scrutiny difficult. This needs to be built up.
- Weak data utilization: Many centres lack the analytical tools or protocols needed to convert the inputs into actionable enforcement decisions to relay back for implementation, even if states upload data to digital systems.

7.2.5 Behavioral & Economic Barriers

- Cost- and convenience-driven decisions by owners: PUC testing is taken as a box-ticking exercise by many vehicles owners as they prefer minimal expenditure, opting for quick certification over needed repairs. This shows vehicle owners understanding of vehicular pollution. Also, the ethical standing of PUC workforce needed to be built up.
- Low awareness of health impacts: Public understanding of the health risks associated with vehicle emissions is uneven. This reduced societal pressure needs to be built up for better compliance and maintenance.

7.2.6 Equity & Accessibility Issues

- Geographical disparities in PUC centre availability: The likelihood of skipped tests or reliance on informal operators gets increased in rural and peri-urban regions where we have fewer authorized centers.
- Enforcing rules more strictly without offering specific help can add more money worries for people who own older cars, especially since they already spend a lot on repairs. This unclear situation needs regulators to pay closer attention.

7.3 How These Gaps Interact

These challenges affect each other in a cycle. The ability to detect a fraud and use advanced tools checking vehicles is limited because the administrative system is not strong enough. Lack of transparency reduces the accountability of public and institutional bodies. Economic and personal biases also lead vehicle owners to follow rules only when necessary. Overall, these problems make the PUC System more like a formality than an effective way to protect public health and the environment from vehicular pollution

7.4 Priority Short-Term Corrective Actions

1. Make sure all PUC Centers undergo mandatory third-party calibration, regular independent audits, take necessary corrective actions, and have their performance reviewed to improve technical accuracy and prevent any form of manipulation.
2. Establish feedback loop between PUC Centre and Transport department.

Without feedback loop quality control of PUC activity cannot be achieved.

3. Use of remote sensing on busy corridors employing PEMS, with clear follow-up protocols to ensure that detected violators face timely inspections or certificate suspensions.

4. Organizers to offer targeted support such as subsidies or mobile PUC units for rural regions and low-income users, reducing inequities and encouraging compliance among owners of older vehicles.

5. A monthly feedback systems need to be established in each state's transport authority to systematically review PUC records, roadside checks, remote-sensing alerts, and public complaints for targeted enforcement where necessary.

6 Publish a nationwide PUC performance dashboard to support academic research, and public oversight.

8. Conclusion & Policy Roadmap

8.1 Conclusion

The review carried out as above makes it clear that India's Pollution Under Control (PUC) framework, though firmly supported by legislation and national digital systems, is not delivering the level of emission control that it is designed to achieve.

Different ways of carrying out the process, lack of proper technical skills, old testing methods, uneven monitoring efforts and not enough involvement from vehicle owners have all made the system less effective. Because of this, PUC Certification usually just serves as a required step rather than a true sign of how much pollution a vehicle actually produces.

Many studies including those that use remote sensing tools, show that cars with proper PUC certificates can still pollute more than allowed when they are on the road. This keeps happening, which shows a big problem between how well the system works and how the rules are set up. Unless the testing is better, enforcement is stricter, and the people are encouraged to really follow the rules, the PUC system won`t help the country reach its goals for cleaner air and healthier cities

Looking ahead, it`s important to move away from just following rules on paper to focusing on real results. Since digital plate forms are already in place, the country is in a good position to improve the pollution control system into something more open, tech-driven, and based on real data, which will better show actual vehicle emissions.

8.2 Policy Roadmap for Strengthening the PUC System

The PUC framework can be updated to work as reliable system for controlling emissions with the following set of policy guidelines outlined:

Priority Action	Purpose / Expected Benefit
1. Strengthen audits and penalty mechanisms	Makes sure each test matches real inspections, creates a strong warning, and helps stops unfair actions.
2. Requires calibration by an external party and regular monitoring, including unexpected inspections.	This helps stop any tempering with testing tools or data and improves the overall quality control
3. Expand remote sensing for on-road monitoring	Gives better scientific support for enforcing rules and finds vehicles that emit a lot of pollution but were caught by regular idle tests.
4. Use OBD-based diagnostics for newer types of vehicles.	This ensures that PUC processes are up-to date with today`s car technologies and allows for ongoing monitoring.
5. Set up real time feed back systems between the PUC center for results and enforcement units (Transport departments).	This ensures that any unusual readings or faulty certificates are immediately detected and action is taken.
6. Create a publicly accessible compliance dashboard	Allows for states comparisons, helps with independent research, and boosts transparency.
7. Promote citizen awareness and behavior-change initiatives	Promotes regular vehicle upkeep and encourages owners to follow rules on their own, instead of relying on penalties and surprise inspections.
8. Makes it easier for people in rural areas and those with low incomes to access services.	Avides placing extra burden on already vulnerable groups and make sure everyone follows rules fairly.

8.3 Strategic Shift Required

Make it easier for people in rural areas and those with low incomes to access services. Avoid placing extra burdens on already vulnerable groups and make sure everyone follows rules fairly.

Current Approach	Needed Shift
Manual procedures with limited diagnostic scope	Real-time assessment focused on actual emissions and Technology-driven.
Data dispersed across agencies and rarely shared	Integrated platforms with open, transparent reporting
Weak enforcement and limited follow-through	Data insights to trigger risk-based actions automatically.

State-level variations in oversight	Harmonized national standards across all states of the country with measurable performance indicators

The country can move closer to global standards by implementing these changes. This will improve the trust in its system for controlling emissions and lead to significant cuts in pollution from vehicles.

8.4 Final Remark

A stronger PUC framework can be a key part of the clean air plan, which is very important for the country. The changes needed -like having independent audits, periodical internal audits, performance reviews, using NABL- approved labs for machine calibration, keeping equipment and machine maintenance records in good shape, finding problems and fixing them, giving certified trainings on regulations & seriousness of environment degradation etc to PUC staff, using modern diagnostic tools, checking vehicles on the roads regularly, making reports clear and open, sharing feedback between PUC and transport departments, getting vehicle owners involved, and ensuring strict rules and compliance -all realistic and can be done right away. Making the PUC system better is not only affordable but also highly effective in improving air quality and thus helping millions of people live healthier lives.

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