Sustainable Transport in Gujarat

Lessons from Two Case Studies

Minal Pathak and Shwetal Shah

Introduction

India’s transportation sector produces over 13 percent of the country’s CO₂ emissions. As one of the most rapidly growing sectors in the country, transportation contributes to poor air quality and congestion in cities. Transportation is a leading cause of air pollution in Indian cities, and most fail to meet the national ambient air quality standards. Health impacts from exposure to high levels of ambient particulate matter are a significant public health challenge in India.¹ The sector is heavily dependent on oil imports, which poses a major challenge to India’s energy security. Clean transport is therefore a priority policy goal at the national and subnational level. India’s business-as-usual projections show travel demand will increase from 6,962 billion passenger kilometres (bpkm) in 2010 to 30,517 bpkm in 2050.² Driven by increasing population, incomes, and urbanisation, India’s transportation emissions are projected to increase six fold by 2050 from current levels.

The focus on clean transportation is evident in India’s Nationally Determined Contribution—commitments to greenhouse gas emission reductions under the United Nations Framework Convention on Climate Change—which envisages reducing the emissions intensity of India’s GDP by 33 to 35 percent by 2030, relative to 2005. Recent support for cleaner transport, alternative fuels, and energy efficiency highlight these efforts. Electronic vehicles (EVs) are a key technology for deep decarbonisation of the transport sector and deliver air quality benefits from zero tailpipe emissions.

TRANSPORTATION GOVERNANCE AND POLICYMAKING IN INDIA

The regulatory environment for urban public transport in India is laid down in various laws, regulations, policies, and executive orders. Many of these standards are mandated by the national government, but some transportation policies and implementation fall with subnational governments. For instance, several states such as Delhi and Maharashtra regulate public transport. States also enforce the town and country planning acts that regulate urban planning, including transportation. Almost all states have municipal laws that lay down the structure and powers of urban local governments. These governments are authorized to regulate traffic, deal with traffic violations, impose pollution control laws, and implement land-use transport plans and are responsible for transport infrastructure, including roads and public transport.

To address growing dependence on oil imports and environmental issues of congestion and air pollution, the central and state governments have initiated policies and measures to enable a shift toward sustainable transportation. These include national policies and programs for fuel efficiency, low-carbon technologies, investments in public transport infrastructure, and climate change mitigation (Table 1).

India's 2006 Urban Transport Policy is the key guiding policy for urban transport in India. The policy focuses on land-use and transportation planning, parking strategies, investments in public transport and non-motorized transport, coordinated planning, cleaner transport, and capacity building and financing. City governments operate public transport in cities. In some Tier II and Tier III cities, where urban governments lack capacity to support public transport systems, bus services are provided by private bus operators loosely regulated by the government.

In recent years, clean energy and climate change mitigation have gained traction, resulting in an enhanced focus on cleaner vehicles and fuels. One such example is the recent focus on EVs.

EVs offer multiple benefits for India, including improved air quality, reduced oil import dependence, and decarbonization in the long run from decarbonized electricity. India's National Electric Mobility Mission Plan (NEMMP) was announced in 2013 with a target of achieving sales of 6 to 7 million electric and hybrid vehicles in the country by 2020. Aiming to help achieve energy security and boost the domestic manufacturing of EVs, the government announced supply-side and demand-side incentives, support for R&D in technology, and investments in charging infrastructure.

In 2015, under the aegis of the NEMMP, the government launched the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) scheme. FAME would provide incentives to promote manufacturing of electric and hybrid vehicle technology and enhance their share of the market. Buyers of EVs were given a demand incentive in the form of an upfront reduced purchase price to enable wider adoption. The first phase of the scheme supported nearly 300,000 EVs. Between 2015 and 2019, the allocated funds doubled from INR 750 million to INR 1.4 billion. Grants were sanctioned for specific projects under the categories Pilot Projects, R&D/Technology Development, and Public Charging Infrastructure.

3. Dhar, Pathak, and Shukla, “Transformation of India’s Transport Sector under Global Warming of 2 °C and 1.5 °C Scenario.”
Table 1: Overview of Selected Policies Focusing on Clean Transportation in India

<table>
<thead>
<tr>
<th>Policy</th>
<th>Targets and Objectives</th>
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<tr>
<td><strong>Urban Transport</strong></td>
<td>• Enhances mobility in urban areas with a range of strategies, including land-use and transportation planning, better allocation of road space, improved public transport integration, financing, enhancement of non-motorized transport, and the promotion of cleaner technologies.</td>
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<tr>
<td>National Urban Transport Policy</td>
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<tr>
<td><strong>Alternate Fuels</strong></td>
<td>• Provides blending targets for ethanol and biodiesel</td>
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<td>National Policy on Biofuels</td>
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<tr>
<td><strong>Efficiency</strong></td>
<td>• Designates corporate average fuel economy norms for passenger cars, fuel economy norms for commercial vehicles, and separate standards for agricultural vehicles.</td>
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<tr>
<td>Corporate Average Fuel Efficiency (CAFE) regulations</td>
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<tr>
<td><strong>Electric Vehicles</strong></td>
<td>• Invests in R&amp;D for power and electric vehicle infrastructure.</td>
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<tr>
<td>Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India (FAME)</td>
<td>• Implements phased R&amp;D strategy, demand and supply incentives, and manufacturing and infrastructure upgrades.</td>
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<tr>
<td>National Electric Mobility Mission Plan</td>
<td></td>
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<tr>
<td>FAME II</td>
<td>• Allocates an additional INR 100 billion (USD 1.3 billion) in funding.</td>
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<td></td>
<td>• Lowers tax on EVs from 12 percent to 5 percent.</td>
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<td></td>
<td>• Implements an additional tax deduction of INR 1.5 lakh (~USD 2300) on the interest paid on loans for the purchase of personal EVs.</td>
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<tr>
<td></td>
<td>• Lowers customs duties on certain parts for EVs to zero.</td>
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In 2019, the government announced FAME II, lasting for another three years, and increased the budgetary allocation to INR 100 billion. The new plan was more ambitious and included an enhanced focus on public transport, including shared transport, solar charging of batteries, and investments in charging infrastructure. For electric buses, demand incentives on operational expenditure, i.e., financial aid against actual operations would be delivered through state or city transport corporations (STUs). While FAME I also permitted vehicles with lead acid batteries, only lithium-ion batteries would be allowed under the new plan. FAME II provided demand-side incentives of INR 20 billion for electric two-wheelers, INR 25 billion for electric three-wheelers, INR 5.25 billion for electric four-wheelers, and INR 35.45 billion for electric buses. Nearly 6,000 electric buses for 64 cities and 400 interstate transport buses were approved under FAME II. The buses were estimated to operate for a total of 4 billion kilometers, with anticipated fuel savings of 1.2 billion liters and avoided CO₂ emissions of 2.6 million tons.

6. Ibid.
The government simultaneously announced other initiatives such as keeping the rates of goods and service tax (GST) in the lower bracket (12 percent) compared to 28 percent for conventional vehicles. The Ministry of Power has allowed the sale of electricity for the charging of EVs to be classified as a “service” as an incentive to attract investments in charging infrastructure. The Ministry of Road Transport Highways also waived off permit requirements for battery operated EVs carrying passengers or goods.8

**Gujarat’s Focus on Climate Change**

The state of Gujarat is located in western India and has a population of over 60 million.9 The state accounts for 6 percent of the country’s area and contributes about 8 percent to the national GDP. It is an industrially developed state, contributing 16.8 percent of the country’s industrial output, the most of any state in the country. The story of Gujarat’s industrial development stretches over five decades and was mainly facilitated by a long coastline and investments in robust road, rail, air, and port infrastructure. Some success has been attributed to the entrepreneurial spirit of the people of Gujarat and proactive and business-friendly government, including policies conducive to large and micro, small, and medium enterprise (MSME) industries and effective support for investors. Gujarat excels in skilled manpower, with the least man days lost of the country’s total. The state also has a power surplus, meaning it has an uninterrupted power supply.

Gujarat’s focus on climate change can be assessed by its proactive initiatives on clean energy and climate change. The state has a strong institutional culture of implementing clean energy policies. Since its inception in 1980, the Gujarat Energy Development Agency (GEDA) has implemented a large number of renewable energy and energy conservation programs in the state. Gujarat’s Climate Change Department, established in 2009, is the country’s first-ever state-level department focusing on climate change adaptation and mitigation actions. The department coordinates the formulation and implementation of the State Action Plan on climate change, coordinates with the federal government for policy support, and works closely with the various state government departments by providing strategic information and channelling financial resources. Setting a good example of institutional integration, the Climate Change Department has brought together all 18 functional departments under the state government, requesting them to incorporate climate change in their annual budget. Gujarat was the first state to develop a solar policy and had nearly half of the country’s solar capacity in 2014. In January 2020, the state contributed 12 percent of the country’s total grid-interactive renewable power installed capacity.

In the eighteenth edition of the India Today Group’s annual State of the States survey, which ranks the India’s states on a range of parameters adjudicating for the “best performing” and “most improved” states across the country, Gujarat topped in the economy category.10 The state has been declared the least corrupt Indian state in the *India Corruption Survey 2019* conducted by Transparency International India.11 For some of the above reasons, Gujarat has been a preferred destination for investors. The state has successfully implemented policies to promote public transport in cities, improve energy efficiency, and promote cleaner technologies and fuels. The Chief Minister Urban Bus Service (CMUBS) scheme, announced in 2018, provides viability gap funding to local governments willing to upgrade urban bus transport through public-private partnerships. However, in the major cities of Gujarat (e.g., Ahmedabad, Vadodara, Surat, and

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CMUBS would double incentives for the use of electric buses. The subsequent sections discuss two case studies of Gujarat’s pursuit of sustainable mobility: the impact of Gujarat’s EV policy and the impact of the Bus Rapid Transit System in Ahmedabad.

**EVs in Gujarat**

In recent years, clean mobility has been prioritized in government decisions and policies. According to some government sources, this increased awareness is a notable achievement. During the period of FAME I, Gujarat adopted a multi-pronged strategy to incentivize different segments and target groups. For instance, the government announced a special subsidy scheme for school and university students willing to purchase an electric two-wheeler. GEDA has invited manufacturers to run battery-operated vans for school students in Gujarat. An incentive of INR 40,000 (~USD 500) was announced for the purchase of electric three-wheelers. Tying in with a new proposed smart city, Dholera, the state government announced support for the manufacturing of EVs and batteries.

The state government initiated a consultation on the draft EV policy with stakeholders in 2019. The policy will aim to establish the state’s leadership in electric mobility by encouraging development of the local EV market and promoting investments, job creation, and research by incentivizing manufacturers and investors. In alignment with the timeline of FAME II, the upcoming policy will have an operational period of three years, until March 2022. Demand incentives will be promoted through the state transport department, while the GEDA will be responsible for charging stations. The State Electricity Regulatory Commission will be responsible for setting tariffs.

The Ahmedabad Municipal Corporation (AMC)—the agency in charge of public transportation in Ahmedabad—decided to introduce electric buses in the city’s Bus Rapid Transit System (BRTS) by availing FAME II benefits. Under the first sanction of FAME II, Gujarat received sanction for 550 buses, which included 300 buses for Ahmedabad, with the remaining 250 buses for the other three major cities: Surat, Rajkot, and Vadodara.12 The Department of Heavy Industry had invited cities to submit proposals for EV charging infrastructure under FAME II. Under this plan, Gujarat received funding for 228 EV charging stations.13 With the simultaneous setting up of charging stations, the government would be able to attract further investment to the state.

In March 2018, AMC entered into its first contract with a private company for the procurement, supply, and maintenance of 50 electric buses for Ahmedabad.14 These included 18 buses based on battery swap technology and 32 buses with battery fast charging technology. A price of INR 63 per kilometer was derived in this contract with the company, and the buses would run on an operational expense (OPEX) model. Through BRTS, Ahmedabad was the first city in India to demonstrate the viability of electric buses.

In March 2019, AMC called the second bid for 300 electric AC Midi Buses under a gross cost contract (GCC) model of procurement, operation, and maintenance. After due procurement procedure, the work order

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has been awarded at INR 62 per kilometer, and the contract will be for eight years. Delivery of these 300 buses would start after March 2020 and was expected to be finished by June 2020. However, due to the Covid-19 lockdown, delivery is expected to be delayed.

The third bid for another 300 electric midi buses on the GCC model were invited in October 2019 under the FAME II scheme, wherein AMC would get a subsidy of INR 4.5 million (USD 0.06 million) per bus. Thus, based on three existing contracts, Ahmedabad should have 650 electric buses in the coming months, which will be the biggest EV bus fleet for a public transport system in any Indian city.

**IS GUJARAT’S EV STRATEGY SUCCESSFUL?**

Gujarat’s EV initiatives are showing promising early results. Gujarat is a leader in EV adoption in the country, with over 30,000 vehicles sanctioned under FAME. Nearly 8,000 students have already availed benefits under the state government subsidy scheme for electric two-wheelers. India’s first lithium-ion battery manufacturing plant is being set up in Gujarat as a joint venture by Toshiba Corporation, Denso Corporation, and Suzuki Motor Corporation.

The phased implementation plan has shown initial success, but the pace of uptake has been slow. The achievements on fuel savings and CO₂ emissions are marginal in comparison to the scale needed to achieve the global target of limiting warming to 1.5°C. This is expected given the low numbers of EVs and the current electricity mix in Gujarat. The second phase of FAME, with the lessons from the first phase, could focus on scalability. Benefits from unaccounted segments such as electric three-wheelers and electric rickshaws can potentially add to the results, but growth in these segments is unplanned.

Despite huge potential, there are significant challenges to upscaling. EVs are still very expensive relative to conventional vehicles, even with government subsidies. The cost of EVs continues to remain high, with battery cost being the major reason. Lithium-ion batteries are still not being manufactured in India, and Indian manufacturers of EVs are still dependent on imports for essential parts. Therefore, upscaling depends on a global reduction in the price of batteries.

Mainstreaming EVs depends on a robust network of smooth-running fast charging stations in cities and on major national and state highways. The NEMMP was launched in 2013 but after eight years has not been successful in developing adequate charging infrastructure. There are other external factors influencing EV penetration, including global market dynamics, cost of renewables, and more ambitious mitigation targets. Recent developments such as falling oil prices and Covid-19 could pose additional challenges for growth in the sector.

**Ahmedabad Bus Rapid Transit System**

Ahmedabad is the seventh-largest city in India and the largest in the state. It is a major economic hub and has led several successful initiatives on urban sustainability under the able governance of the AMC.

Over the years, the city has witnessed rapid population and economic growth and consequently a surge in ownership of private vehicles. The increased reliance on private transport has led to increasing congestion and poor air quality. In 2019, nearly a third of citizens in Ahmedabad used public transport and shared intermediate transport (three-wheelers). The AMC has run the Ahmedabad Municipal Transport Service (AMTS) since 1947. It started operations with 37 buses and by 2019 operated 700 buses and had a ridership of 600,000.

The discussions on high-capacity public transport in Gujarat began around 2004 in a high-level meeting chaired by Narendra Modi, the then chief minister of Gujarat. Participants agreed that no single system would be able to meet transportation demands and that a bus-based system would remain the most important element of a public transport strategy. Simultaneously, the National Urban Transport Policy was announced by the Ministry of Urban Development (MoUD) in 2006. Key focus areas of the policy included encouraging use of public transport and facilitating the introduction of high-quality multimodal public transport systems. In order to encourage BRTS in the country, the Ministry of Urban Development funded workshops and discussions in cities. The National Urban Renewal Mission (NURM) committed substantial funds for bringing about improvements in urban infrastructure, which included funding BRTS projects in the country.

Ahmedabad BRTS was developed by the Gujarat Infrastructure Development Board (GIDB) with planning and implementation assistance from the Ahmedabad Urban Development Authority (AUDA) and the AMC. A special-purpose vehicle, Ahmedabad Janmarg Ltd. (AJL), was constituted under the Companies Act to establish, operate, and manage the BRTS over a dedicated corridor and is fully owned by the AMC. It was designed as a network complimenting the spatial development of the city.

Ahmedabad BRTS began operations in 2009. During the initial months, AJL ran a massive publicity campaign to promote the BRTS brand. As a branding strategy, the system was called BRTS “Janmarg” (“people’s transport”). The company invited diverse groups on promotional rides during the initial months. During construction, BRTS faced protests from citizens mainly due to its impact on the heritage monuments along its route in the old city area. These were resolved by the AMC in consultation with local stakeholders. The BRTS network gradually expanded and presently is operated in a dedicated corridor of 100 kilometers. Its 255 buses serve nearly 150,000 passengers daily.

**WAS THE BRTS SUCCESSFUL?**

Ahmedabad BRTS has won several national and international awards for technology and implementation. It was given the 2010 Sustainable Transport Award for visionary achievements in sustainable transportation and urban livability in Washington. The project was awarded by Ministry of Urban Development as the Best Mass Transit Project under JNNURM in the year 2008-2009. Following its successful implementation, the model was replicated in several cities across the country, but other systems did not achieve the same level of success.

The reasons for the success of Ahmedabad BRTS may be attributed mainly to its effective institutional structure, which maximizes the quality of service, public benefit from public-sector investment, and opportunities for private investment to cash in on private-sector enterprise and minimizes the cost of service. It was a combination of the softer elements (e.g., regulatory structure, management, and chosen business model) with a robust technology, infrastructure, and rolling stock that made the project successful.

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17. Ibid.
Initial studies show Ahmedabad BRTS reduced travel times, increased revenues, and was perceived to be a better mobility option for public transport. However, some studies have contested these claims. A UNEP study in 2013 showed a majority of BRTS users (47 percent) shifted from the AMTS, which was running parallel to the BRTS; a quarter of the users shifted from three-wheelers; and only 11.7 percent switched from private vehicles. Mahadevia et al. contended that although the BRTS is promoted as a low-cost public transport alternative in Indian cities, it was not affordable to low-income groups due to high fares.

Recent studies show BRTS meets only a tenth of the total trips in the city. BRTS and AMTS in some cases compete for ridership along the same route instead of feeding into each other. There is poor integration between the two transport services, resulting in inefficient operations. Low frequency and lack of last-mile connectivity makes BRTS less attractive compared to two-wheelers.

**GREENHOUSE GAS EMISSIONS**

Ahmedabad BRTS has shown a reduction in CO₂ emissions mainly due to a shift from diesel buses to compressed natural gas buses and a minor shift away from public transport. Yet, it has also not achieved a significant shift away from private motorized modes, and therefore the mitigation benefits are marginal. One of the reasons is that the public transport plan relied on a supply-based approach. Such approaches would need to be complemented by demand-side policies to discourage private vehicle use. For example, parking charges are low—at INR 15 ($0.20) per hour for cars and INR 10 per hour for two-wheelers.

**FUTURE CHALLENGES**

Last-mile connectivity continues to be an issue with the BRTS. Without dedicated parking for two-wheelers or bicycles, the BRTS is not an attractive option for commuters residing beyond walking distance from BRTS bus stops. Two-wheelers and three-wheelers remain a convenient mode of transportation. For BRTS to become an attractive alternative to private vehicles, the city would need to integrate with feeder systems to fix the last-mile connectivity issue.

Ahmedabad Metro is under construction, and the first phase will be operational soon. There are ongoing efforts to integrate the BRTS and AMTS with the proposed Metro corridor, all of which form part of Ahmedabad’s Urban Development Plan. In the long run, this will create an integrated public transport network in the city. In order to gain maximum benefits, this will have to be complemented with demand-side incentives to facilitate the shift to public transport. More recent developments of adding electric buses on the BRTS could deliver a range of benefits for the city.

Urban mobility has not contributed to desired outcomes, largely due to car-centric policies adopted by successive plans and projects at the city level. Urban mobility is multidimensional in terms of policy and operational implications. Therefore, coherence in policy interventions and linkages among processes are essential.

In addressing complex urban mobility issues, a systems approach seems well suited for a thorough understanding of the issues and their causal linkages. Only after understanding the interdependencies between the system components can issues be addressed successfully with significant policy interventions. For example, mispricing leads to overconsumption of roads in peak periods; sprawling settlement patterns render public transport systems ineffectual; and business-as-usual approaches end up with cities for cars rather than for people.

**Key Lessons and Challenges Going Forward**

Studies have shown the advantages of making early interventions in preventing lock-ins into carbon-intensive infrastructures while also delivering health co-benefits from improved air quality. Both the interventions discussed in this paper—a mass public transport system and electrification policy—can co-deliver climate change mitigation and development benefits. In the case of the BRTS, provision of adequate and affordable transport can significantly enable socioeconomic development through better access to jobs and education. Environmental benefits of improved air quality and reduced greenhouse gas emissions can be achieved by a shift away from private modes of transportation to public transportation or other low- or zero-carbon modes.

EVs are promoted as clean transport solutions that will stimulate the development of a domestic manufacturing industry. A rapid uptake in EVs would benefit air quality in India, and a number of cities exceed national ambient air pollution standards. EVs will be an important part of India’s transport decarbonization strategy as electricity gets further decarbonized. In Gujarat, EVs offer a huge opportunity to align with the state solar plan. This could deliver co-benefits of green jobs and economic growth. EVs can promote renewable electricity generation and offer an opportunity to integrate the building, transport, and power sectors through vehicle-to-grid integration in the future.

In both cases, significant upscaling challenges remain. The BRTS offers potential to reduce emissions, especially with the introduction of electric buses, but this can only happen if complemented with demand-side measures (e.g., parking charges) that discourage private vehicle use. Going forward, the city needs to address issues of last-mile connectivity and integration into the future transport plan of the city. Similarly, EVs are constrained by the high upfront cost and underdeveloped charging infrastructure. Since meeting climate change mitigation targets is not the top priority for state and local governments, assessing and quantifying development and the local environmental benefits of clean transportation can make a strong case for speeding up action. The study shows clean transportation can deliver multiple benefits if aligned along other national and subnational policies.

Cities are constrained by managing population growth and consequent demands on infrastructure. Urban plans are constrained by challenges of financing. The Gujarat case studies show these can be overcome through a clear policy direction from the government. The implementation of the BRTS and EVs was initiated through a strong national policy and financing. The national EV policy and incentives were important signals to the states in developing state-level policies. This also provided impetus to the private sector in entering the market. Now, nearly a dozen states have announced EV policies to complement the national EV policy. Similarly, the initial impetus for the BRTS and EV buses in Ahmedabad was funded under

a national program. In the case of EVs, a “horses for courses” approach worked, as the state developed a range of strategies for electric 2-wheelers, 3-wheelers, and buses. This was complemented by the proactive approach of the state, strong subnational institutions, partnerships, and financial incentives to encourage private investments; these were the key success factors in Gujarat.

Several of these policies do not show immediate emissions reduction benefits. However, assessing these interventions through a single climate mitigation lens would undermine the value of these initiatives. Clean transport policies should be viewed in light of all the local benefits they generate. As upscaling takes place, emissions reduction can also emerge as a substantial benefit. This study argues that such assessments face limitations of data; an accurate assessment of benefits becomes difficult through conventional cost-benefit analyses, especially in cases where benefits are spread over the long term and impacts may not be evident during initial years.

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