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Empowering the Renewable Energy and Transport Nexus in Small Island Developing States

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Key Messages

- Decarbonizing the transport sector in Small Island Developing States (SIDS) enables testing transitions for climate change mitigation in spatially limited networks.
- Such a transition simultaneously addresses the question of energy security for these island states and aids the global phase out of fossil fuels. Targeted investments into SIDS should focus on vehicle fleet conversion to maximize economic and climate benefits.
- The decarbonization of SIDS is not only needed as a mitigation effort, but also as a strong signal to the global community to underline that a zero-carbon future is possible.

Every choice matters for Small Island Developing States (SIDS)

The SIDS community has long since realized that rising temperatures and climate change pose great risks to their livelihoods and – in certain cases – their very survival. Fittingly, it was a coalition of small islands, along with other vulnerable countries, which led the push for a lower warming limit of 1.5°C, now at the heart of the Paris Agreement [1]. SIDS continue to be at the forefront of global discussions on strong climate mitigation ambition, minimizing the risks from climate change, and on mechanisms addressing loss and damage. Although important, the emphasis on adaptation towards sea level rise, storm surges, and cyclones has tended to relegate climate mitigation and energy-related issues to the periphery in SIDS.

Political economy of energy dependency

The extreme reliance on fossil fuels is a key concern for SIDS [2]. With over 87% of primary energy needs met with imported petroleum fuels, islands are highly susceptible to price shocks in the global oil market and face periods of supply shortages [3]. This long-term dependence on imported fuels leads to a vicious cycle of accumulated dependence on foreign capital and energy [3], leaving less means for investment in low-carbon infrastructure. In particular, carbon-intensive energy and transport infrastructure with long lifetimes become relevant dimensions for mitigation [4]. There is often a huge renewable energy potential, and electric vehicles offer substantial cost savings [5]. The historical patterns of concentrated urban development along the coasts, with primary roads stemming from the capital, and resource insufficiency are additional stress factors on islands [6–8]. The ability for SIDS to withstand extreme climatic events is limited, and losses tend to be disproportionate, relative to the size of the island economy.

Uptake of transport electrification in SIDS can be faster than in larger countries. The key constraint of 'range anxiety' is removed given the shorter trip lengths and compact road networks. Similarly, with a lower daily electric demand the possibility of vehicle-to-grid might be enhanced. Hence, as early adopters, there is an opportunity to trial policies for global learning. This policy brief investigates how public transport in such islands can be both climate friendly and economically viable at the same time. We do so by selecting the case of Mauritius.

Island of Mauritius as experimental lab for fleet transition

The Mauritian case exemplifies the transport situation in Low and Middle-Income Countries (LMICs) [9], where there is a vast scope to address interconnecting policies (see **Figure 1**). This case moreover illuminates the high fuel costs and the carbon lock-in trap. Mauritius imports coal and liquid fuels to meet 83% of its energy needs, therefore rendering it vulnerable to rising and volatile world energy prices. Increased energy security and diversifying income from exports are key policy concerns. Mauritius has the potential to act as an experimental site for trialling emerging concepts: the island has been a leader among the African group of countries in promoting electric vehicles and restricting polluting second hand vehicles and encouraging the sale of hybrid vehicles by, for example, imposing a fee on vehicles above a CO_2 per kilometre threshold and providing a rebate for vehicles emitting below this amount (the "feebate" system) [10].

Through a comparative analysis of different scenarios we studied economic parameters as well as a GHG emission reduction estimation. These scenarios are:

- Base: the current public fleet
- Grid-Charged: 1,490 buses are electrified via the grid;
- Off-Grid: a scenario electrifying those 1,490 buses with renewable off-grid energy;
- Integrated and Electrified Transport System (IETS): a fleet optimization scenario for maximum alignment with the existing metro line.

Both the Off-Grid and Grid-Charged scenario result in a high amount of energy and costs, with the Off-Grid scenario generating higher Levelized Cost of Electricity (LCOE) (**Figure 2**). In the transport sector, ramping up electric vehicle penetration in the fleet can lower the end-user fuel bill, as costs per kilometre for electric vehicles (0.10$) are less than those of gasoline or diesel in nearly all regions and countries [11]. However, to achieve this incentives and policy measures for enabling the deployment of dispatchable renewables, storage, and reactive grids need to be put in place in the near-to-medium term. Otherwise, the deployment of large amounts of variable renewables will not be possible without endangering the stability of the distribution network. On the other hand, simply relying on fossil fuel technologies to support variable renewables risks leading to high-emitting stranded assets.

With the implementation of the metro line, it makes sense to restructure the entire public transport system and switch to electric buses, now functioning as a feeder service.

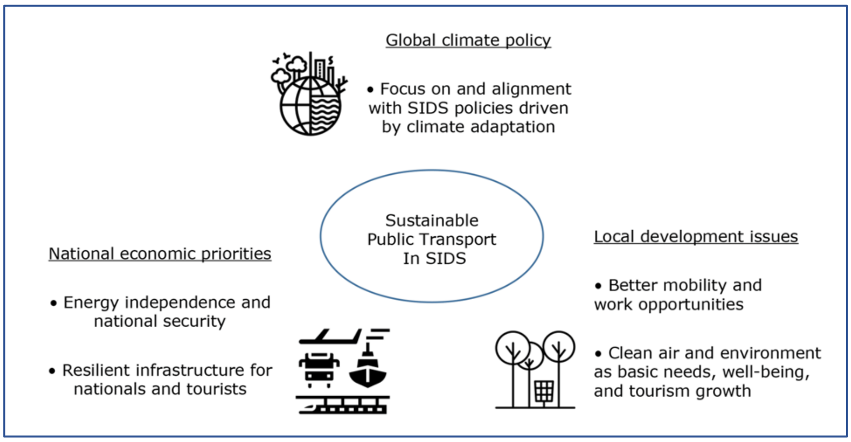

Figure 1: The global, national and local dynamics impinging on sustainable transitions of transportation in SIDS

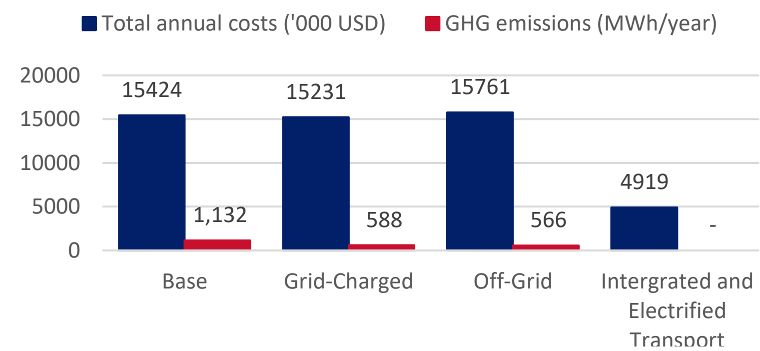

Figure 2: Economic and Environmental Benefits of Fleet Conversion in Mauritius

No transition will take place without addressing the particular challenges that the political economy of energy dependence places on small islands; and this intertwines with the geopolitical (country size, and geographical position) and economic role they play. There also needs to be a more prominent alignment between energy security and climate change mitigation. A focus on environmental sustainability has been more important than questions of energy security.

Mind the Gap: Public Transport on SIDS

The public transit system in LMICs is a low-hanging fruit for decarbonization. Historically in SIDS, the public fleet is subsidized and used as a social benefit for the population. SIDS have had larger public transport fleets (relative to population and comparable GDP per capita) than larger countries. However, in recent years, with growth incomes, private car fleets have substantially increased [9]. Strong policies to control congestion and give advantage to public transport would be required to reverse current trends.

The set routes and terminal locations of public fleets enable easier assessments of optimal locations for charging infrastructure. The predictability of daily consumer use profiles translates to maximum renewable energy integration profiles.

Upgrading to an electric fleet will mean upgrading to a smart fleet, resulting in greater efficiency and quality for both consumers and operators.

Recommendations:

The Mauritian government must strengthen the integration and coherence between energy security, and sustainability transition is insufficiently addressed at the governmental level. Fossil fuel imports, both for electricity and transport, comprise a large share of Mauritius' GDP and limit its capacity for capability building, further cementing the vicious cycle of imported capital through loans and aid and imported sources of energy [3].

The current need for decarbonization provides Small Island Developing States (SIDS) with an opportunity to break out of this cycle through **decreasing their reliance on imported energy**. Future financial support must aim to make the island more self-sufficient in the medium to long-term. Future decarbonization transition planning must **place greater emphasis on capacity building, training, and institutional strengthening.**

SIDS-wide, transport policies should be made to encourage the use of **digitalized (and perhaps open) data**, which will also result in supporting collection and dissemination of real-time scheduling. Our research experienced data collection as a great hindrance.

International donors must re-think **fostering low-carbon finance**. The current global finance frameworks present barriers to these finance flows and radical changes are needed so that capital is more equitably distributed. The high capital costs needed for decarbonisation transitions are reflected in a high weighted average cost of capital, as in our scenarios. These capital costs, which tend to be higher in LMICs, lead to considerably higher financing conditions therefore discouraging the switch to renewables.

Both on a national and global scale, inequities in access to transportation will become a major social justice issue. Individual (and electrified) transportation remains accessible for the privileged, while lower levels of accessibility and difficulties in commuting falls to low-income communities. Investment in transformation of the transport system — from mass transit to electrification and shared vehicles — is an important and necessary disrupter of the system.

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Notes

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