



Establishing baseline data to support sustainable maritime transport services



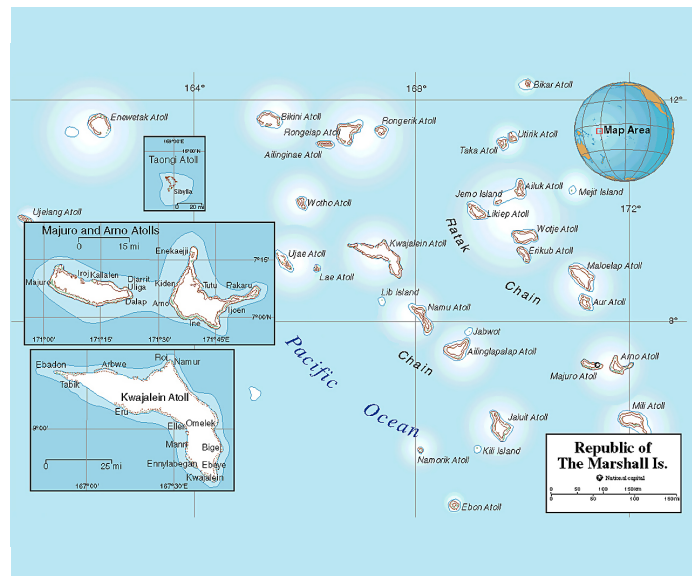
This paper, which focuses on the Republic of the Marshall Islands (RMI), is part of a series of technical assistance initiatives that the PRIF Transport Sector Working Group is conducting to improve maritime transport in Pacific island countries.

Background

Responding to the impact of climate change is high on the agenda of all Pacific island countries. Communities that live on low-lying atolls, like the Republic of the Marshall Islands (RMI) are particularly vulnerable. RMI's Nationally Determined Contribution (NDC), under the United Nations Framework Convention on Climate Change, is to reduce its 2010 greenhouse gas domestic transport emission levels by 16% by 2025, including efforts to reduce emissions from its shipping fleet. However, the shipping industry, an economic lifeline for the country, is lagging behind other transport sectors in modernising its fleets and improving the sustainability of its services.

Achieving sustainable maritime services will reduce the country's dependence on fuel imports which is exacerbated by the high cost of transporting fuel to many small atolls throughout the country. Actions are therefore needed to review the traditional ship propulsion and management methods to reduce the overall fuel consumption. This study establishes baseline data to support future improvements to maritime transport services in RMI. The baseline data will be used to establish benchmarks for the performance assessments as part of a 9m euro project funded by the Government of Germany and managed by Deutsche Gesellschaft für

Internationale Zusammenarbeit (GIZ), the German aid agency. This 'Transitioning to Low Carbon Sea Transport' project will investigate new clean technologies in commercial trading ships and in small craft used between atolls in the Pacific. The project is also a cornerstone of the framework of activities of the Micronesian Center for Sustainable Transport (MCST), to enable the use of baseline data for further projects that are proposing new technological and operational improvement concepts.



Domestic shipping in RMI

RMI's domestic commercial shipping fleet comprises approximately 30 ships and over 500 motorised and 600 non-motorised intra-atoll small craft. Four of the ships are operated by the Marshall Islands Shipping Corporation (MISC), nine are similarly large ships (privately owned) and the remaining are mostly smaller inter-atoll ships, and ships engaged in fishing support, tourism and ship servicing. The ships provide cargo and passenger services throughout RMI and are mostly based in Majuro.

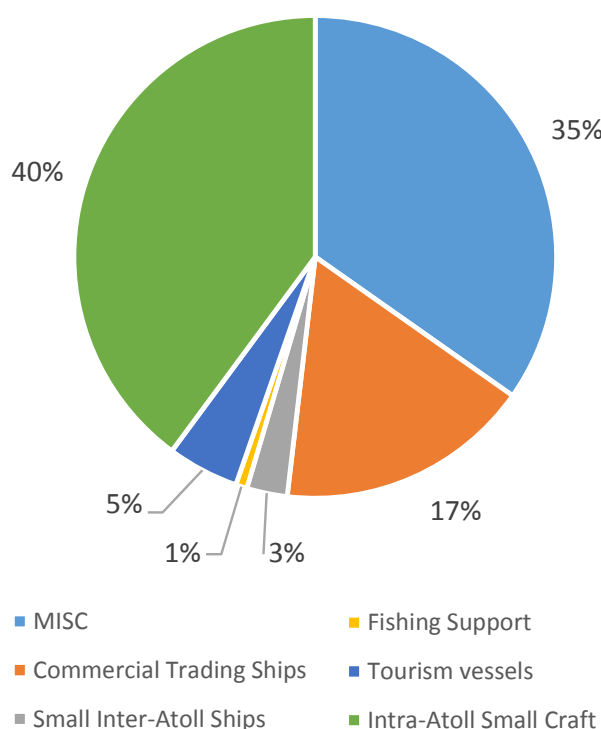
MISC's four ships serve the most island locations and completed 70 voyages in financial year 2017, covering nearly all atolls and islands on a regular basis.

The small intra-atoll craft play a vital role in sustaining the livelihood of communities and are located throughout the country. They are mostly engaged in fishing and in light transport tasks within the lagoons.

Greenhouse gas emissions

Throughout the year, the domestic commercial ships covered about 112,500 nautical miles, consumed about 1,710,000 litres of diesel and their CO₂ emissions totalled 4,600 tonnes of CO₂. Motorised intra-atoll small craft are in general powered by gasoline (petrol) outboard engines and are estimated to have consumed 1,277,000 litres of gasoline and emitted 3,038 tonnes of CO₂. The total CO₂ emissions for all domestic shipping (including small intra-atoll craft) therefore amounts to about 7,600 tonnes.

Proportions of CO₂ emissions – All domestic commercial ships, FY2017



It is interesting to observe that emissions from 500 small intra-atoll crafts are equivalent to those produced by the operations of four MISC vessels as shown in the chart on the left. This suggests that improvements in both types of vessels will yield benefits to the local economy.

The study also highlighted significant differences in the fuel efficiency of the four MISC vessels, measured by their capacity to carry cargo over a given distance, and demonstrated the economies of scale in using larger ships.

All domestic commercial shipping fuel consumption & CO₂ Emissions, FY2017 – breakdown by activity

Shipping activity	Distance pa (nm)	Consumption (litres pa)	CO ₂ emissions (t CO ₂ -e)
MISC	49,535	989,074	2,648
Commercial Trading Ships	29,740	486,719	1,303
Small Inter-Atoll Ships	26,721	77,452	207
Fishing Support	6,678	21,682	58
Tourism vessels	-	136,260	365
Intra-Atoll Small Craft		1,277,000	3,038
Grand Total	112,674	2,988,188	7,619

Efficiency measures to reduce emissions

To measure how changes to the ships' operations could influence the current fuel consumption and CO₂ emissions, a range of alternative practices were investigated for ship routes and scheduling, as well as for their operations and maintenance activities.

The most promising of the alternative operating practices were:

- Slow steaming techniques such as 'Just in time' arrivals and slower demand speeds on passage and Single engine operations (for MV Majuro and MV Ribuuk Ae ships)
- Improved turn around times in Majuro
- Blending low-emission fuels with diesel
- Optimising trim to reduce resistance
- Frequent in-water hull cleaning and propeller polishing
- Engine tuning and shaft alignment

These operating practices would result in cost reductions of up to USD 400,000 per year, and CO₂ emission reductions of about 900 tonnes as shown in the following table.

Measure	Fuel saving	CO ₂ reduction (t CO ₂)	Cost Saving (USD pa)	Comment
Majuro Turn Round	3.8%	103 t	\$232k	Consist in more efficient use of fleet for Copra collection. May allow disposal of one ship.
Slow steaming	5%-15%	300 - 500 t	\$100k	Consist in slowing speed at strategic times in routes.
Hull & Prop cleaning	7%	200 t	\$50k	
Engine Tuning	1%	25t	\$6k	
Low-emission fuels	-	135 - 200 t	-	Using 10% blend with diesel
Total		~900 t	\$400k	

If applied to the MISC fleet, this level of emission reduction represents a significant 33% reduction in the FY2017 CO₂ emissions levels, from 2,700 tonnes to 1,800 tonnes, through improved operational practices alone. The greatest potential lies in considering slower operating speeds, i.e. slow steaming and low-emission fuels blended with diesel, neither of which have any additional direct costs. The operating cost saving corresponds to a 20% reduction in the nearly USD2m that it costs to operate the MISC ships each year.

Given the structural and operational constraints of the existing MISC ships, examples of key propulsion technologies to explore further include direct thrust from a Flettner rotor and using an electric motor powered by a wind turbine through a gearbox.

For the small craft, the current practice of using gasoline fuelled outboard engines results in high expenditures and large greenhouse gases emissions for the relatively small size of tasks undertaken. There is a wide range of alternative low carbon solutions that can be deployed and current thinking is toward combining new technologies and traditional solutions, bringing together safety, efficiency and low maintenance advantages. Considering that up to 500 gasoline powered maritime craft may need to be modified or replaced, mass production of new craft should also be considered. Capital cost might appear a barrier, but this will be partially offset by long-term fuel savings. Some of the small craft improvement options may include clever integration of photovoltaic cells and electric outboards, small Flettners, hydrofoils, bio fuel outboards as well as traditional sail systems.



The MV Aemman moored in Majuro

PRIF support was much appreciated throughout the baseline data collection exercise. The findings are useful and will guide on assessing the most effective low-carbon solutions that we will test and implement here in RMI.

GIZ team leader

Recommendations and conclusions

PRIF's work developed several assessment tools to calculate effective savings from emissions and fuel consumption that can be obtained by introducing operational improvements and low carbon technology solutions to mid-size fishing, passenger and cargo vessels.

Future efficiency gains are highly dependent on improving operational and management practices by strengthening the overall framework for ship operations:

- Training for personnel and crew
- Supporting implementation of energy efficiency management plans
- Introducing benchmarking to monitor and improve performance
- Strengthening management functions (incl. data collection).

Specific recommendations for MISC improvements in operational efficiency include:

- Introducing performance monitoring
- Analysing performance

- Improving the management policies to give more emphasis to performance analysis and ship maintenance
- Implementing the recommended ship operating efficiency measures.

The above initiatives will be possible through the combined support of development partners and regional organisations currently active in the maritime sector in the Pacific.

The fuel consumption tools developed for the project can simulate the effect of various improvement practices and new technologies. For example, it can evaluate the impact of alternative routes and scheduling, improved operating practices, and alternative fuels and propulsion technologies.

MISC is likely to save up to 20% of operating costs from reduced fuel consumption and a reduction of about 33% of CO₂ emissions, while at least maintaining the same level of service.

The baseline data study sets the parameters by which new technology solutions should be assessed for Pacific fleets like those used by MISC and highlighted the importance of reducing emissions from small craft through smart integration of new technologies, traditional and low-cost solutions.

PRIF is pleased to have had the opportunity to support the Low Carbon Sea Transport project. That project fully aligns with PRIF strategic assistance objectives by introducing new technologies adapted to the Pacific islands marine environment. This work in RMI will make an important contribution to reduce not only greenhouse gases but also, indirectly, all other air pollutants generated by ships in the Pacific.



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