The Case for low carbon sea transport transition in the Pacific

Dr. Peter Nuttall
Alternative energy and new technology

Since 2007 shipping has begun an unprecedented search for energy efficiency. All sources agree that there are 4 basic categories of options:

• Technology change
• Operational change
• Alternative fuels
• Renewable energies
Why should we transition to low carbon shipping globally?

The Paris Agreement “aims to ... Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C“

[Article 2]

→ CO₂ is the most important greenhouse gas emitted by ships
→ Increase energy efficiency and transition away from fossil fuels
→ Deliver sustainable maritime transport
Global CO₂ scenario closest to avoiding 2°C

Range of CO₂ scenarios from 3rd GHG study

Gap to be closed

• For shipping to remain at 2-3%, emissions would need to peak soon and then rapidly decline

• Because of expectations of rising demand, this could mean fleet average EEOI’s reducing to 10% of 2012 average by 2050 (2 degrees)

• 1.5 degrees sets an even more stringent objective and could require a zero carbon shipping industry by 2045

• Acknowledging recent trends and regulations, and allowing for discussion on what is a ‘fair’ for shipping, a significant challenge remains for shipping

• The sooner the planning starts for the inevitable transition, the less rapid the required rate of change
Illustrative pathway for a CO₂ budget

A = B for same climate impact

Trajectory becomes steeper

2050 target shifts
Global case for low carbon shipping

• International shipping is undergoing an unprecedented search for efficiency of fuel use, driven primarily by:
  – fluctuating but escalating fuel costs
  – international agreements to reduce GHG emissions
  – increasing awareness of the environmental and public health risks associated with shipping

• IMO’s 2014 GHG study forecasts shipping CO₂ emissions to increase by 50% to 250% by 2050, which would then represent between 6% to 14% of total global emissions, under ‘business as usual’ conditions.

• Rapid advances in technology:
  – ship designs (especially hull, waste heat recovery and propeller related technology)
  – use of alternative fuels such as LNG and methane and renewable energies, including wind power (kite sails, soft sails, fixed wing sails and rotors)
  – photovoltaics
  – biofuels
Why should we transition to low carbon shipping locally?

- The global investment in low carbon transport transition has lagged significantly behind electricity decarbonisation. The investment in low carbon maritime transition has lagged significantly behind road, rail and even aviation.

- In the Pacific there is currently $2b+ of donor assistance for electricity – none yet for sea transport.

- But for the Pacific, maritime is at at least as big a fuel user as electricity.

- If the Pacific does not transition to low carbon pathways we risk being stranded with outdated technologies that will become ever more expensive to operate.

- A low carbon transport transition provides an opportunity to introduce more affordable and appropriate transport modes.
The Transport/Climate Change Nexus

Pacific Leaders consistently identify two critical barriers to sustainable development:

1. **Climate Change – “no more than 1.5°”**
   - rapid decarbonisation of the global economy must start now
   - all sectors must contribute their “fair share”
   - all countries, big and small, need to lead

2. **Extreme imported fossil fuel dependency**
   - Most dependent region on imported fuel in the world (95%+)
   - Majority is for transport – sea and air both use more than land
   - Crippling for national budgets, highest world transport costs
   - Vulnerable to oil price and security changes

**Transport is critically linked to both:**

- If firm targets for decarbonisation of international ship and air transport are not set now, a 1.5° threshold will be exceeded
- Transport ~75% of the region’s fossil fuel and is largest contributor to the region’s GHG emission

---

**S.A.M.O.A. Pathway 2014**

67. In this regard, we are committed to continuing and enhancing support for the efforts of small island developing States:

(a) To gain access to environmentally sound, safe, affordable and well-maintained transportation;

(b) To advance the safety of land, sea and air transportation;

(c) To develop viable national, regional and international transportation arrangements, including improved air, land and sea transport policies that take a life-cycle approach to the development and management of transport infrastructure;

(d) To increase energy efficiency in the transport sector.

---

**Pacific Islands Regional Fossil Fuel Use by Sector**

- Transport
- Electricity
- Other

**Transport Fuel by Sector (Fiji)**

- Marine
- Land
- Air
Transport – Pacific transition to low carbon transport

Pacific transition to low carbon transport requires a paradigm shift

Access to clean, affordable reliable transport underpins any transition to a blue/green economy.

Opportunity for cleaner, more appropriate, affordable solutions.

Transition is a substantive challenge. It is additional to the already high workload needed across this sector.

Time is not our friend. A long term strategy is needed but it must begin now.

Global transport initiatives and priorities don’t match Pacific realities. A ‘Pacific’ design solution is needed.

The initial work occurring in this sector needs to be scaled quickly and as a priority.

S.A.M.O.A. Pathway 2014

67. In this regard, we are committed to continuing and enhancing support for the efforts of small island developing States:

(a) To gain access to environmentally sound, safe, affordable and well-maintained transportation;

(b) To advance the safety of land, sea and air transportation;

(c) To develop viable national, regional and international transportation arrangements, including improved air, land and sea transport policies that take a life-cycle approach to the development and management of transport infrastructure;

(d) To increase energy efficiency in the transport sector.
Transport sector features in the NDC target sectors of eight PICs

Only PIC to set a target for transport sector - 16% in 2025 and by 27% in 2030.
Transport - largest fuel user for Pacific countries

What is the path forward?

• A range of solutions required – whole of sector, multiple stakeholder and multidisciplinary approach needed that builds long term in-region capacity.

• A coordinated regional strategy to support national country low carbon transition plans is required.

• RMI supported by neighbouring states has called for a Micronesian Center for Sustainable Transport as a catalyst for change.

• Leading international researchers are offering technical, research and capacity support.

• Especially for shipping, our small scale makes us the ideal testing ground for new technologies and approaches.
Micronesian Sustainable Transport Centre

• RMI has requested USP establish a Centre of Excellence to support a whole of country strategy to transition to low carbon transport.

• Micronesian Presidents Summit July 2015 communiqué calls for action to transition Micronesia to low carbon transport, with sea transport as a starting point.

• Federated States of Micronesia and Palau have endorsed following the lead of RMI. Tuvalu, Kiribati and Solomons have expressed strong interest.

• Priority actions for transition to low carbon transport include establishment of MSTC to develop/implement national transition plan for RMI and then to cascade to neighbouring Micronesian states.
Sea transport issues in the Pacific

• The unique characteristics of Pacific island shipping:
  – long distances, thin routes, minute economies, low cargo volumes, high freight rates, financing barriers, and high infrastructural costs

• There has been a long history of the region struggling to find long-term, sustainable, and cost-viable solutions for sea transport, even in periods of relatively low energy costs
  – particularly true for domestic shipping

• Ships are often old, poorly maintained and inefficient

• Fossil fuel is often the largest single operating cost for shipping operators. Long distances and small loads make many routes unviable and uneconomical.
6. Averaged results

(assuming a constant ship speed of 11.7 knots or 6.0 m/s)

Wind power contribution in kW:

<table>
<thead>
<tr>
<th>Route (and back) \ Technology</th>
<th>rotor</th>
<th>kite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auckland → Suva</td>
<td>303 (339)</td>
<td>304 (135)</td>
</tr>
<tr>
<td>Suva → Majuro</td>
<td>291 (320)</td>
<td>181 (130)</td>
</tr>
<tr>
<td>Majuro → Avatiu</td>
<td>246 (174)</td>
<td>19 (186)</td>
</tr>
<tr>
<td>Avatiu → Auckland</td>
<td>297 (339)</td>
<td>307 (190)</td>
</tr>
<tr>
<td>Auckland → Majuro</td>
<td>333 (368)</td>
<td>262 (156)</td>
</tr>
<tr>
<td>Suva → Avatiu</td>
<td>239 (186)</td>
<td>55 (218)</td>
</tr>
</tbody>
</table>

3. Models of wind power technologies

1. Flettner rotor
   - height = 35m; width = 5m
   - $C_L=12.5$; $C_D=0.2$; $C_M=0.2$

2. Towking kite
   - width = 50m; chord = 10m
   - $C_L=1.0$; $C_D=0.29$

3. Solid body sail
   - height = 40m; chord = 10m
   - $C_L=1.2$; $C_D=0.12$
Offshore Hub Ems-Achse

The project Offshore Hub Ems-Achse addresses the potential of offshore wind energy in the Ems-Axis region. Thus, the project Offshore Hub Ems-Achse is contributing to strengthen the region in terms of offshore wind energy.
You can **not** have Green Growth in the Pacific ..... 

.... without a transition to Low Carbon Transport
Island Ventures Ltd - S.V. Kwai

- Operating since 2008
- Regularly services routes from Hawai‘i, Line Islands, and Cook Islands
- Uses profits to retrofit soft sail rig, and thus further reducing fuel use (and cost)
- Operation is based on community need and support for the venture
- Local crews and communities benefit
- 60% fuel savings
- Commercially viable wind hybrid propulsion shipping operation

Source: www.svkwai.com
S.V. KWAI - Private Sector, non-subsidised, profitable, sustainable
Greenheart Ship – Prototype

- 32m, 220 tonne multipurpose ship,
- single A-frame mast/crane.
- Primary propulsion comes from 300 m² of sail, fore and aft rigged
- Hull speed = 10-11 knots, unlimited range.

Shallow draft design for beach landing

Roll-on/roll-off port ramp, hinged just above the waterline in the stern.
Is the SV Kwai Model replicable or scalable?
Wingship also offers a potential solution
WSH Series

High Speed Craft

Normal Ferry

*Speed is determined by size of craft

Increased Lift (By Air cushion)

Air cushion
What is a Wingship?
A boat that flies!
Three times cheaper price and no additional infrastructure

Three times faster speed: 100+ knots

Three times less fuel consumption and CO₂ emission

※ Comparison to High Speed Craft (HSC)
Speed & Fuel Consumption

- Lower fuel cost & Faster speed
- 51g/pkm at 180km/h
- 143g/pkm at 80km/h

g/pkm: fuel consumption in gram to transport one passenger for one kilometer

Payload

- Same Engine
- More Capacity

Price per seat

- Lowest price
- 0.2M USD WINGSHIP
- 0.25M USD HSC
- 0.67M USD Helicopter
- 0.74M USD Aircraft
Kommol tata