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In-Water Hull Cleaning System Cost & Cost Benefit Analysis

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Report 2

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Government of **Western Australia**
Department of **Fisheries**

Franmarine Underwater Services

Fish for the future

Department of Fisheries
3rd floor SGIO Atrium
168 - 170 St Georges Terrace
PERTH WA 6000
Telephone: (08) 9482 7333
Facsimile: (08) 9482 7389
Website: www.fish.wa.gov.au
ABN: 55 689 771

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Title: In-Water Hull Cleaning System Cost & Cost Benefit Analysis

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Prepared by Franmarine Underwater Services Pty Ltd

Australian Marine Complex
13 Possner Way
Henderson WA 6166
Australia

Tel: (08) 9437 3900
Fax: (08) 9437 3933
reception@franmarine.com.au
ABN: 81 059 653 459

www.franmarine.com.au

Abbreviation	Description
AMC	Australian Marine Complex [Henderson, WA]
ANZECC	The Australian and New Zealand Environment Conservation Council
DoF	[Western Australia] Department of Fisheries
DSTO	Defence Science and Technology Organisation
DSV	Dive Support Vessel
FUS	Franmarine Underwater Services Pty Ltd
GHG	Greenhouse Gas
LOA	Length Overall
MUA	Maritime Union of Australia
NIMS	Non-Indigenous Marine Species
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
RAN	Royal Australian Navy
RNZN	Royal New Zealand Navy
UV	Ultra-Violet Light
WA	Western Australia

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Executive Summary

Across shipping and other maritime industries, a clean hull provides significant economic and environmental value. Biofouling on a hull, even a primary slime, will increase skin friction and drag that leads to increased fuel consumption and GHG emissions, and it also facilitates the translocation of harmful marine species. The prevention of biofouling is largely achieved by the application of biocidal antifouling coatings to most of a vessel's wetted surface, but these coatings are rarely 100% effective in preventing the attachment and growth of all biofouling. At best, the underwater hull will quickly become coated with a biofilm of microorganisms; at worst, the paint will fail and become coated with a diverse assemblage of marine plants and invertebrates. Maintaining a clean hull requires either regular dry-docking for cleaning and restoration of the antifouling system, or in-water husbandry to remove biofouling from underwater surfaces and to regenerate the antifouling coating. In-water cleaning of hulls has, and continues to be, a common biofouling management practice in Europe and the Americas and the demand for cleaning is increasing worldwide as vessels endeavour to reduce their CO_2 emissions.

In Australia the in-water cleaning of vessel hulls was effectively banned under the 1997 ANZECC Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance (ANZECC 1997). However, this Code has recently been reviewed (Floerl et al. 2010, 2011), with a recommendation that in-water cleaning be permitted, but with appropriate regulation to ensure that a clean will not pose any chemical and/or biological risks to the marine environment.

The limited ability to perform, or prevention of, in-water cleaning can place considerable financial burden upon the marine industry in terms of increased fuel costs, unproductive labour costs, expensive dry docking costs and a loss of income during relocation and docking time.

The ANZECC Code had the good intent of protecting the environment, but by leaving biofouling on a vessel whilst it sails to dry dock can cause environmental harm by increasing both fuel use and GHG emissions, and increasing the likelihood of potentially harmful biofouling species reaching reproductive maturity and sporulating or spawning in ports of call.

Against this background, the development of a local in-water hull cleaning technology that meets all water discharge quality and all government in-water hull cleaning guidelines presents as a very cost effective means of reducing both that biosecurity threat and the carbon emission footprint of ship movement.

The Franmarine In-water Hull Cleaning and Filtration System, incorporating the *Envirocart*, is a new technology that enables in situ in-water cleaning to be conducted in a manner that causes no biological risk to the environment – it does so by the capture, containment and treatment of the biological waste generated by the cleaning process. The cost of deploying this system to clean ship hulls in either Fremantle or Dampier Ports can be expected to provide substantial cost savings when compared to the costs for dry-docking the same vessel for cleaning out-of-water. It is estimated that dry-docking will range up to 5 times the cost of the in-water clean depending upon the location and size of the vessel. Therefore, current technology now has the potential to greatly reduce unnecessary cost burdens and to also massively reduce Industry carbon emission footprint.

Furthermore, it has been estimated that in-water cleaning to maintain biofouling free vessel hulls across navy, merchant and fishing fleets in Australia and New Zealand could save more than 300 million litres of fuel annually with an estimated cost saving of close to $320 million per annum.

Introduction

Western Australia (WA) is now recognised as Australia's leading State economy.

Much of the State's wealth comes directly or indirectly from maritime industries, either from gas or oil extraction, or ship-borne exports of minerals and farm produce. Substantial wealth also flows from the fishing and aquaculture industries. However, the environmental downside of broad, ocean-based industrial activity, whether fixed or mobile, is that the biofouling on hulls and structures can harbour invasive and other harmful NIMS that could cause adverse environmental, economic, social and human health impacts if introduced to Western Australian waters.

In Australia the in-water cleaning of vessel hulls was effectively banned under the 1997 ANZECC Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance (ANZECC 1997). The Code had the intent of protecting the environment but, perhaps less intuitive, leaving biofouling on a vessel can cause greater environmental harm by increasing fuel use and GHG emissions, and increasing the likelihood of potentially harmful biofouling species reaching reproductive maturity and sporulating or spawning in ports of call.

The Code has recently been reviewed (Floerl et al. 2010, 2011), and a recommendation made that in-water cleaning should be permitted, albeit with management conditions to ensure any clean will not pose any added chemical and/or biological risks to the marine environment.

Across shipping and other maritime industries, a clean hull provides significant economic and environmental value. Biofouling on a hull, even a primary slime, will increase skin friction and drag that leads to increased fuel consumption and GHG emissions (see references in Schultz et al. 2011). The economic impact of biofouling on vessel operation is evident in the studies undertaken by Schultz et al. (2011), in which the effect of frictional drag on a DDG Destroyer was calculated to increase fuel consumption by 10.3% to 20.4% at a cost of between 1.2 million and 2.3 million US dollars per year.

The prevention of biofouling is largely achieved by the application of biocidal antifouling coatings to most of a vessel's wetted surface, but these are rarely 100% effective in preventing the attachment and growth of all biofouling. At best, the underwater hull will quickly become coated with a biofilm of microorganisms, at worst the paint will fail and become coated with a diverse assemblage of marine plants and invertebrates. Maintaining a clean hull requires either regular dry-docking for cleaning and restoration of the antifouling system, or in-water husbandry to remove biofouling from underwater surface and regenerate the antifouling coating. In-water cleaning of hulls has, and continues to be, a common biofouling management practice in Europe and the Americas and the demand for cleaning is increasing as vessels endeavour to reduce their CO_2 emissions.

In-water cleaning technology is poised to revolutionise the way in which marine growth is removed from vessels and structures, with potential savings to local industry and government that could run to hundreds of millions of dollars each year, and billions of dollars world-wide.

The companion paper to this report (Lewis, 2013) provides a comprehensive review and analysis of in-water cleaning trials of the Franmarine "*Envirocart*" in-water hull cleaning and filtration system. These trials were conducted by Franmarine as part of its test obligations for the WA Department of Fisheries.

The purpose of this second report is to demonstrate the cost benefit potential offered by this method of in-water cleaning system.

Background

In Western Australia, the Department of Fisheries (DoF) is the lead Agency responsible for managing the aquatic biosecurity threat and in response to a significant increase in commercial vessel activity, DoF is presently implementing a range of measures to minimise the risk and contain this biosecurity threat. As part of that response, DoF sought tenders in June 2011 for the design and evaluation (trial) of in-water hull cleaning systems that could potentially be deployed to remote location to manage this threat.

Franmarine Underwater Services P/L (FUS) had recently designed and built a lightweight, portable fully enclosed suction and filtration hull cleaning system which it considered capable of meeting all DoF criteria with only minor change, and Franmarine was subsequently awarded a contract to complete system design and to proceed to trial.

Those trials have now been successfully completed and the results are separately reported (Lewis, 2013). This second report compares the cost of in-water hull cleaning on site against the costs of current quarantine cleaning requirements, where a vessel is obliged to off-hire and move into dry dock or slip for cleaning.

Dry docking Cost

Presently the only permitted method of removing biofouling from a vessel's hull in Australia or New Zealand is to dry-dock or slip the vessel and physically remove the growth by high pressure water blasting, grit blasting and/or manual scraping. All debris is contained within the dock and disposed of on-shore.

WA has three ship-lift facilities capable of lifting vessels in excess of 45 metres LOA. These are the BAE Systems facility at Henderson, able to lift vessels up to 130 metre Length over All (LOA), the AMC facility also at Henderson, for vessels up to 120 metre LOA, and Mermaid Marine Supply Base in Dampier, for vessels up to 55 metres LOA.

If vessels are too large for, or cannot be accommodated in any of these three yards, the only alternative for WA vessels operators is to send the vessel overseas for dry-docking (e.g. to Singapore), as facilities are similarly limited in other Australian states.

As a base for our cost comparison the following tables establish the total cost of a Quarantine action including dry docking, steaming and loss of charter revenue.

Table 1: Dry Docking Costs in Perth

	Dry Docking Cost – Perth $AUD			
Time required for:	Shipyard A 45 metre vessel 4 days lost	Shipyard B 45 metre vessel 4 days lost	Shipyard A 70 metre vessel 6 days lost	Shipyard B 120 metre vessel 6 days lost
Line Handling/Towage	4,600	4,600	9,200	9,200
Docking	13,500	17,500	13,500	35,000
Docking Block Alignment – Dive Team.	3,000	3,000	3,000	3,000
Hard Standing	20,000	4,000	30,000	12,000
Pressure Clean and wash	6,000	6,000	12,000	12,000
Waste Disposal	5,000	5,000	9,000	9,000
Undocking	13,500	17,500	13,500	35,000
Line Handling/Towage	4,600	4,600	9,200	9,200
Total	$70,200	$62,200	$99,400	$124,400

Note: Dry Dock costing's were provided by senior management at both the AMC and BAE Systems facilities however they requested to remain anonymous.

The sea route from Dampier to Perth is approximately 870 nautical miles. At 10 knots (economical mode) the steaming time required to reach Perth from Dampier Port is therefore about 87 hrs. or 3.6 days each way (8 days total return).

The daily hire rate for commercial vessels in the range 45 – 70m LOA is typically between $25,000 and $80,000 AUD per day, plus fuel and consumables etc.

The following table lists the costs in relocating a vessel from Dampier to Perth for dry docking. Costs for towed plant, such as barges, would be considerably higher as steaming times are much slower.

Table 2. Lost Charter, Steaming time return Dampier to Perth and Dry Docking costs:

	Charter, Steaming and Dry Docking Costs $AUD			
Vessel Costs	**Cost Per day**	**Vessel A 45 metre**	**Vessel B 70 metre**	**Vessel C 120 metre Frigate**
A. Loss of Charter - 12 days	25,000	300,000		
B. Loss of Charter - 14 days	50,000		700,000	
C. Operational Replacement	600,900			600,900
A. Crew wages (10 man @ cost) p/d x 8 days	9,750	78,000		
B. Crew wages (12 man @ cost) p/d x 8 days	11,700		93,600	
C. Crew wages (160 man) p/d (Navy) x 5 days	32,180			160,900
A. Fuel consumption 30 tonnes each way @ $120.00 per tonne		60,000		
B. Fuel consumption 60,000 litre each way @ $1.00 per litre			120,000	
C. Fuel consumption 200,000 litre each way @ $1.00 per litre				400,000
Meals @ $50.00 p/d per man		4,000	4,800	40,000
Dry Docking Cost - Perth		62,200	99,400	124,400
Total		$504,200	$1,017,800	$1,326,200

Note: Charter rates, wages and fuel cost/usage have been verified (at cost) through Industry Sources such as Vessel Charter Companies, the MUA and Chief Engineers.

"Operational Replacement" (Vessel C) covers a replacement frigate to maintain Navy operational requirements.

In-water hull cleaning cost

Franmarine's system is a lightweight, portable in-water hull cleaning and filtration system, built around the "*Envirocart*" brush cart. The *Envirocart* is capable of removing, capturing and containing marine biofouling from biocidal and biocide-free underwater coatings without damage to the hull or hull coating system. The system incorporates twin shrouded cleaning disks that contour to flat, curved or convex hull surfaces. The disks may be fitted with abrasive brushes or non-contact blades that create a powerful vortex to clean primary and early secondary stage fouling from the surface.

In addition to the *Envirocart,* a range of hand tools have been designed for cleaning and capture of biofouling from niche areas (anodes, sea suction grates, propellers etc.) and other irregularly-shaped underwater appendages and surfaces.

After removal, the captured biofouling waste is pumped to the surface and processed through a multi-stage, high-speed filtration system that separates and contains all material. Primary filtration removes material greater than 50 micron and secondary filtration can remove material down to 5 micron. Filtrate is then treated with ultra-violet radiation before discharge.

The combined weight of the whole system is less than 2500 kg and skid mounted, which enables all components, including the hydraulic power pack, electrical generator, filtration system and cleaning tools, to be easily packed into a standard 20 ft. shipping container for transport or storage.

The *Envirocart*" may be deployed directly onto the "target vessel", onto a small dive tender vessel (fishing vessel / workboat), or set up on wharf directly adjacent to the target vessel.

An estimate of the total cost of an in-water hull clean requires inclusion of the capital cost of equipment, dive team wages, the time required to clean various hull configurations, and site-specific costs. Costs will also vary between mobilising the equipment from a central storage location, or placing dedicated units at strategic locations around Australia and New Zealand.

Capital Cost of Equipment

Two differently-sized systems are considered necessary to address the varying time required for cleaning various hull configurations, lengths and logistics:

- One for vessels less than 50m LOA, and
- One for vessels greater than 50m but less than 200m LOA

Each unit would be containerised in a dedicated 20 ft. container built to stringent offshore specifications. The required modifications would include rated lifting frames and emergency escape hatches to enable the systems to be deployed offshore in areas controlled by National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)

Estimated capital costs for each unit are calculated below.

Table 3. Capital Cost of Equipment:

	Equipment Capital Costs $AUD		
	Requirement	45 metre Vessel	120 metre Vessel
Engineering – Design and Fabrication	Various	35,000	45,000
Offshore Rated 20 ft. Sea Container	1 off	100,000	120,000
Filtration System, Baleen, 3 M and UV	1 off	125,000	175,000
Envirocart	1 off	105,000	185,000
Genset (50 KVA and 100 KVA)	1 off	20,000	50,000
HPU (90 ltr and 150 ltr)	1 off	45,000	70,000
Hoses, Ancillary Tools	various	12,000	18,000
Electrical – Design and Fabrication	various	20,000	40,000
Frames, Testing and lifting Slings	various	25,000	50,000
Total		$487,000	$753,000

The operating criteria for each unit have been established based on optimum performance. However, each unit is capable of cleaning larger vessels i.e. 50 – 70 m LOA and 200 – 280m LOA with decreased efficiency.

Table 3 provides a capital cost that would be projected for recovery over each systems life expectancy of 3 years.

In-water Hull Cleaning Times

In-water cleaning is carried out by divers using a variety of cleaning tools for specific tasks:

- Flat bottom and vertical sides: *Envirocart*.
- Anodes, grates and recesses: Magic Box.

- Sea chest: blanking plate to enable chemical dosing and containment with an approved with an approved chemical treatment (e.g. disinfectant containing benzalkonium chloride).
- Bilge keel, waterline, propeller and nozzles: Shrouded hand scraper.

The tools are simple and safe to operate and only require divers to undertake a short period of training required to become proficient in system operation.

Factors influencing the time and therefore cost of a clean are:

- The time required to clean a vessel will vary depending on the type of clean (Quarantine or maintenance), hull configuration, size, location, degree and type of marine biofouling and site conditions such as weather and sea state.
- The number of divers required with, typically, an in-water hull cleaning operation will require two divers operating together in the water: one diver cleaning the flat bottom/vertical sides, the other cleaning niche areas. In addition to divers in the water, an operating dive team would also include a standby diver and dive supervisor.
- Diver bottom times which will vary according to operating depth. This is generally dictated by the draft of the "target vessel". Vessels less than 100 m LOA typically have a draft of less than 8 m. Diver bottom times would be in the acceptable range of 150 – 180 minutes.
- Cleaning times vary depending on the degree of fouling encountered e.g. The *Envirocart* has the capacity to clean approximately 1000 m^2 per 8 hr day (micro fouling) and in full containment mode 600 m^2 per 8 hr day (macro fouling). On that basis the current prototype is capable of cleaning a vessel of up to 70 m in length in 3 x 8 hr. days.

Table 4 below lists the cleaning time estimated for vessels up to 200 m LOA.

Table 4: Diver In-water Cleaning Times

	Diver In-water Cleaning Times (hours)			
In-water time required for:	**45 metre vessel**	**70 metre vessel**	**120 metre vessel**	**200 metre vessel**
Hull	6	14	18	24
Grates	2	3	7	10
Anodes	2.5	4	6	8
Propeller	3	5	8	12
Niche Areas (other)	6	10	16	20
Sub Total	19.5	36	55	74
Divide by 2 (Divers)	9.75	18	27.5	37
Set out Break down on site (Team)	4	5	6	7
Induction/Port passes (Team)	1	2	3	4
Total Dive Team hours on site: Number of days:	14.75 2 x 8 hr days	25 2 x 12 hr days	36.5 3 x 12 hr days	48 4 x 12 hr days

Note: Typical maintenance cleans (flat bottom and sides only) can be completed in considerably less time.

Dive Team Costs

Legislative controls for diving operations in Australia fall within two distinct categories:

- Onshore - AS/NZ 2299:1 2007 administered by the Dept. of Worksafe.
- Hydrocarbon/exploration administered by NOPSEMA under the Petroleum and Submerged Lands Act.

Pay rates and site allowances vary considerably depending on which category the operation fall into. These can generally be defined as "Offshore" (oil & gas exploration/development) and "Onshore" (all other applications).

The size of a dive team will increase depending on the complexity of the task, type of equipment engaged, and depth and site conditions. The minimum number of diving personnel (Onshore) for underwater operations using Hydraulic tools is 4 men. With the addition of one surface technician to operate and monitor the filtration equipment a minimum (5 man) team would be required to clean a 45 metre vessel onshore. Offshore the minimum dive team is 6 men, with one additional surface technician requiring a minimum 7 man team to clean a 45 metre vessel offshore.

Table 5 breaks-down the dive labour costs (mobilisation, demobilisation, transport, crane hire, waste disposal etc.), Table 6 adds costs for a dive support vessel for near-shore diving operation, and Table 7 establishes the cost of an offshore clean conducted in an oil and gas exploration lease area.

Pay rates in each table are based on the standard hourly pay rates, inclusive of allowances (depth, wetsuit and living away) as agreed under existing union and EBA agreements. These rates of pay have been extrapolated in each table to reflect site specific pay ratios and to provide an 8 hour and 12 hour team rate.

There are many other cleaning scenarios likely e.g. Table 5 provides for cleaning 45, 120 and 200 metre vessel's, however a 70 metre vessel would require 2 x 12 hour days with a 5 man team and cost approximately $44,254.00 AUD to clean.

Table 5: Dive Team Costs (Onshore)

		Onshore Dive Team Cost ($AUD)		
	Cost Per day	**45 metre Vessel 2 days Fremantle**	**120 metre Vessel 3 days Dampier**	**200 metre Vessel 4 days Dampier**
1. Mobilise/Demob		2,000	5,000	10,000
2. Vehicle Hire	300	600	900	1200
3. Trailer Hire	130	260	390	520
4. Crane	750	750	1,500	2,250
5. Dive Equipment	150	300	450	600
6. Chamber	750	N/A	2,250	3,000
7. Envirocart 50 m	1,500	3,000		
8. Envirocart 200 m	3500		10,500	14,000
9. 4 Man Dive Team + 1 Technician (2 x 8 hr days)	4,800	9,600		
10. 5 Man Dive Team + 1 Technician (3 x 12 hr)	8,932		26,796	
11. 6 Man Dive Team + 1 Technician (3 x 12 hr)	10,420			41,680
12. Consumables (fuel etc.)	300	300	900	1,200
13. Waste Disposal		2,000	4,500	7,500
Cost of Wharf-Side Clean		$18,810	$53,186	$81,950

Note: The time required to clean each vessel is derived in Table 4.

Table 6: Onshore Dive Team Cost with 20 m Dive Support Vessel (DSV)

		Onshore Dive Team with DSV ($AUD)		
	Cost Per day	45 metre Vessel 2 days Fremantle	120 metre Vessel 3 days Dampier	200 metre Vessel 4 days Dampier
1. Mobilise/Demob		4,000	8,000	13,000
2. Vehicle Hire	300	600	900	1200
3. Trailer Hire	130	260	390	520
4. Crane	750	1500	2250	3000
5. Dive Equipment	150	300	450	600
6. Chamber	750		2,250	3,000
7. Envirocart 50 m	1,500	3,000		
8. Envirocart 200 m	3500		10,500	14,000
9. 4 Man Dive Team + 1Technician (2 x 12 hr)	5,900	11,800		
10. 5 Man Dive Team + 1 Technician (3 x 12 hr)	8,932		26,796	
11. 6 Man Dive Team + 1 Technician (3 x 12 hr)	10,420			41,680
12. Consumables (fuel etc.)	300	300	900	1,200
13. Waste Disposal		2,000	4,500	7,500
14. DSV - Perth	6,000.00	12,000		
15. DSV - Dampier	12,000.00		36,000	48,000
Cost of Near Shore Clean		$35,760	$92,936	$133,700

Note: In most instances, an offshore vessel can be moved outside the hydrocarbon/exploration lease area and cleaned using an onshore team.

Table 7: Offshore Dive Team Cost with 30 m Dive Support Vessel

		Offshore (Dampier) Dive Team Cost ($AUD)		
	Cost Per day	45 metre Vessel 3 days	120 metre Vessel 5 days	200 metre Vessel 6 days
1. Mobilise/Demob		5,000	10,000	15,000
2. Vehicle Hire	300	900	1500	1,800
3. Trailer Hire	150	450	750	900
4. Crane	1500	4,500	7500	9,000
5. Dive Equipment	500	1,500	2,500	3,000
6. Chamber	750	2,250	3,750	4,500
7. Envirocart 50 m	1,500	4,500		
8. Envirocart 200 m	3500		17,500	21,000
9. 6 Man Dive Team + 1Technician	17,864	53,592		
10. 7 Man Dive Team + 1 Technician	20,137		100,685	
11. 8 Man Dive Team + 1 Technician	22,411			134,466
12. Consumables (fuel and air etc.)	750	2,250	3,750	4,500
13. Dive Support Vessel	20,000	60,000	100,000	120,000
14. Waste Disposal		4,000	7,500	10,500
Cost of Offshore Clean		$138,942	$255,435	$324,666

Note: Table 7 assumes one or two day steaming times to target vessel.

In-water Clean v Dry-Dock Cost Comparison

Table 8 compares the total cost, and cost savings of in-water cleaning compared with dry docking the vessel in Perth.

Table 8: Cost Comparison

	Hull Cleaning v Dry Docking Cost Comparison $AUD				
	Dry Docking Perth	Wharf-Side In-water Clean	Near-Shore In-water Clean	Offshore In-water Clean	Cost Savings
Fremantle Vessels					
- 45 m	62,200	18,800			43,400 (69%)
- 120 m	124,400	53,186			71,214 (57%)
Dampier Vessels					
- 45 m	504,200		35,760		468,440 (93%)
- 120 m	1,326,200		92,936		1,233,264 (93%)
Dampier Vessels					
- 45 m	504,200			138,942	365,258 (72%)
- 120 m	1,326,200			255,435	1,070,765 (81%)

By far the most economical in-water cleaning scenario involves placing units at key strategic Ports throughout Australia and New Zealand and utilising local diving teams.

Other Considerations

Clean hull v dirty hull

As biofouling on a vessel hull can increase operating (increased fuel consumption) and environmental (GHG emissions and NIMS cartage), regular in-water cleaning contributes additional indirect cost savings.

There is little available data on the total number of commercial vessels operating in Australia and New Zealand. However, the Royal Australian Navy (RAN) has 53 commissioned warships and the Royal New Zealand Navy (RNZN) has 11. These vessels comprise a range of large transport and supply vessels (8), frigates (14), smaller patrol craft/mine sweepers (27) and submarine and other support and ancillary vessels (15).

The Defence Science and Technology Organisation (DSTO) have advised that the RAN use on average 100,000,000 litre of diesel fuel per annum, at a cost of $1.20 per litre. Assuming the RNZN warships conservatively use 15,000,000 litre p.a., the total combined fuel consumption would be 115,000,000 litres per year, at a cost of $138,000,000 AUD.

Schultz et al. (2011) estimated that a bio fouled hull uses between 10 – 20% more fuel, so maintaining a clean hull technology could save the RAN and RNZN between $13 – 27 million AUD per annum.

Different vessels can use different fuel types; e.g. bunker oil for most merchant ships, and marine diesel for navy frigates, workboats and fishing vessels. The price of fuel can also vary at any given period. Currently, a barrel of oil (159 litres) is currently selling at $94.00 USD (or 59 cents/litre) and diesel fuel (less rebates) at around $1.20 AUD (note: figures supplied by DSTO).

In the following scenario we calculate a number of commercial vessels operating in Australia and New Zealand, the number of operating days per annum and projected fuel usage for each size vessel.

Table 9: Vessel estimate, fuel consumption at 15% saving

	Commercial Vessels in Australia and New Zealand					
	Estimated Vessel Number	Vessel Operating days per year	Fuel Use per day (Litres)	Fuel Use per annum (Litres)	15% Fuel Saving (Litres)	Fuel Cost ($AUD)
200+ m Tankers / Supply Vessels	50	150	120,000	900,000,000	135,000,000	106,650,000*
100+ m Frigates / Coastal Traders	100	100	85,000	850,000,000	127,500,000	153,000,000
45+ m Workboats / Tugs	200	150	8,000	40,000,000	36,000,000	43,200,000
20+ m Trawlers / Fishing Vessels	300	150	2,000	90,000,000	13,500,000	16,200,000
Total				1,880,000,000	312,000,000	$319,050,000

On the above basis, considering the many thousands of commercial and private vessels operating in Australia and New Zealand, and reduction in fuel consumption of between 10 – 20% per annum, in-water hull cleaning could save the maritime industry several hundred million dollars each year in operating costs.

There are also other projected benefits from maintaining clean hulls, including:

- Improved steaming time and reduced labour cost.
- Reduced dry docking cost.
- Improved Biosecurity response mitigating the risk of NIMS to our Marine Tourism and Aquaculture industries.

The cost of providing an in-water cleaning service to achieve these fuel savings on the 350 larger vessels (> 45 m LOA) would be approximately $23,305,000 AUD per annum.

Carbon credits

Australia has the highest per capita emissions of any advanced Western economy and is the most dependent on coal-generated electricity. The Kyoto Protocol and subsequent international dialogue related to climate change have arisen in response to mounting concerns regarding carbon and greenhouse gas emissions around the globe, and the impact of these emissions on the world's climate. There is general agreement in the scientific and political arenas that unless carbon and greenhouse gas emissions are reduced, the impact of climate change and global warming on the planet could be disastrous.

The Australian Federal Government has again (2012) reconfirmed their commitment to the Kyoto Protocol, and implemented a carbon tax with associated rebates. Companies who undertake regular in-water hull cleaning may be eligible for a carbon credits offset against the fuel saved.

These offsets would provide a compelling commercial argument to maintain a clean hull policy.

Safety

Vessels operating in Australian and New Zealand require a periodic In-water survey in lieu of dry dock once every 4 years. The CCTV Survey is completed by divers under the supervision of a Class surveyor who checks all weld seams and appendages to ensure the vessel is sea worthy. Upon a satisfactory outcome the vessel gains an extension to operate for a further 12 months.

A dirty hull makes it virtually impossible to visually inspect weld seams and appendages for faults. Given that vessels such as FPSOs have an expected 20 year docking cycle; it is possible that surveying uncleaned vessels may lead to undetected faults that could compromise vessel safety.

Conclusion

Regulated, in-water hull cleaning can provide a safe, cost effective strategy to deal with biosecurity threats. In addition, regular in-water cleaning can provide considerable operational cost savings for vessels.

The Franmarine in-water cleaning and capture system provides the technology to perform this in-water cleaning is an environmentally safe and cost effective manner. The advent of this new technology provides a useful management tool for managing biosecurity threats, reducing industry costs, and shipping's carbon footprint.

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