Modular Solar-Electric Propulsion System for Indian Artisanal Fishing Vessels

Regenerative Charging + Hot-Swappable Batteries + Bifacial Solar

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NIOT Collaboration Proposal
Chennai, India

Response to Dr. Raju Abraham's Technical Requirements

Presentation Overview

The Problem in Numbers

Why India's Fishermen Need This Now

Fuel Cost Crisis

540,000

Fuel cost per boat over 5 years

900 daily $\times$ 240 days $\times$ 5 years

Affected Population

3.5M

Artisanal fishermen

Operating 5–15 HP outboard motors

Environmental Impact

78%

CO reduction potential

375 kg per boat annually

Economic Viability

20–26

Months to payback

40,000–50,000 annual savings

Not Just Electric—Three Breakthrough Innovations

Modular, Self-Charging, and Practical

Hot-Swappable Batteries

- 30-second swap time
- Like power tool batteries
- Unlimited range
- One charging, one in use

4.32 kWh per pack

28 kg portable weight

Regenerative Charging

- Water spins propeller
- Motor = generator
- Charges during operation
- 13–15% recovery

600 Wh recovered

Per 4-hour trip

Bifacial Solar Panels

- Front + rear capture
- Water reflection bonus
- +15–25% gain
- Works cloudy days

2.15 kWh daily

Sunny day generation

Directly Addressing Your Questions, Dr. Abraham

Complete Technical Response

- ✓ **Detailed Schematics for Medium Fishing Boats**
  System architecture, motor unit design, battery configuration
- ✓ **Complete Power Calculations (5–6m Vessel)**
  Hull resistance, propeller efficiency, Froude method analysis
- ✓ **Bifacial Solar Panel Analysis**
  Marine optimization, water reflection gains, performance data
- ✓ **Micro-Inverter Integration Strategy**
  Independent operation, shading tolerance, MPPT $>$97%
- ✓ **Minimum Control System Design**
  Only 3 physical controls—zero technical training needed
- ✓ **Budget Estimates with Market Validation**
  184,000 production | 132,000 with subsidy

System Architecture Overview

Modular Design for Easy Integration

Key Components

Battery Pack	**Motor Unit**	**Solar Panel**	**Controller**
Hot-swappable	Tool-free	Bifacial 400W	Minimal

Key Features

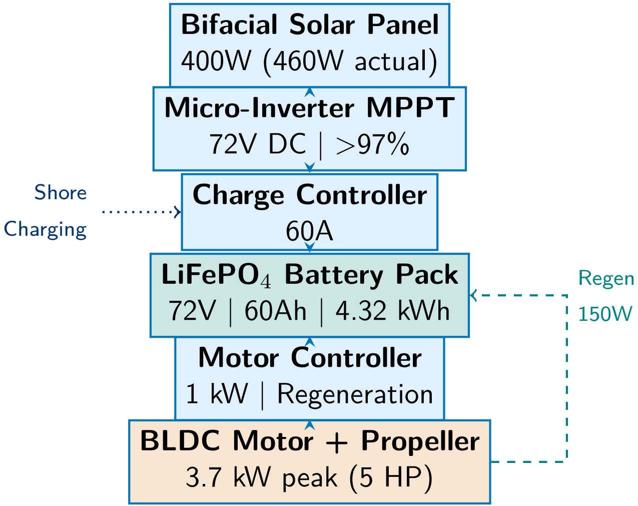
- Tool-free removal: 2 min
- 30-second battery swap
- IP67 waterproof
- Fits any transom boat
- No hull modification

Specifications

- Power: 3.7 kW (5 HP)
- Voltage: 72V DC
- Current: 60A continuous
- Motor weight: 18 kg
- Battery weight: 28 kg/pack

System Schematic—Complete Power Flow

Electrical Architecture & Component Integration



Target Vessel: Medium Fishing Boat Specifications

Dimensions & Performance Requirements

Boat Dimensions

Waterline Length:	5.5 m
Beam:	1.8 m
Displacement:	1100 kg
Crew Capacity:	2–3 persons
Payload:	300–400 kg

Performance Requirements

Cruising Speed:	5 knots (9.26 km/h)
Daily Operation:	4 hours/day
Annual Days:	240 (monsoon adjusted)
Current Diesel Range:	10–25 km

Target Vessel: Medium Fishing Boat Specifications

Dimensions & Performance Requirements

Boat Dimensions

IX **Waterline Length:** 5.5 m
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Performance Requirements

IX **Cruising Speed:** 5 knots (9.26 km/h)
Daily Operation: 4 hours per day
Annual Usage: 240 days/year (after monsoon adjustment)
Diesel Range: Typical operation 10–25 km

Target Vessel: Medium Fishing Boat Specifications

Hydrodynamic Profile & Electric Power Match

Hydrodynamic Data

Froude Number:	0.367
Hull Resistance:	164 N @ 5 kr
Effective Power:	421 W
Motor (Continuous):	1 kW
Motor (Peak):	3.7 kW

Electric System Match

Range (single pack):	32–40 km
Range (dual pack):	80–90 km
Coverage:	Meets 99% of tri

Validation Required

NIOT towing tank testing required to finalize resistance coefficients.

Power Requirements—Complete Derivation Chain

From Froude Number to Battery Power Demand

Step-by-Step Calculation

Given: 5.5m boat, 1100 kg displacement, 5 knots (2.57 m/s)

Step 1: Froude Number

$$F_n = \frac{v}{\sqrt{g \times L_{wl}}} = \frac{2.57}{\sqrt{9.81 \times 5.0}} = \mathbf{0.367}$$

(Determines hull resistance regime: displacement mode)

Step 2: Total Hull Resistance

$$R_{total} = 0.014 \times m \times g \times (1 + 2F_n^2) = 0.014 \times 1100 \times 9.81 \times 1.269 = \mathbf{164\ N}$$

Step 3: Effective Power (at propeller)

$$P_{effective} = R_{total} \times v = 164 \times 2.57 = \mathbf{421\ W}$$

Efficiency Chain—Where Power is Lost

From Battery to Propulsion: 44.5% Overall Efficiency

Power Conversion Chain — Part 1

Step 4: Propeller Power (efficiency $\eta_{prop} = 0.55$)

$$P_{propeller} = \frac{P_{effective}}{\eta_{prop}} = \frac{421}{0.55} = \mathbf{765\ W}$$

Loss: 344 W (slip, turbulence, cavitation)

Step 5: Motor Shaft Power (efficiency $\eta_{motor} = 0.87$)

$$P_{shaft} = \frac{P_{propeller}}{\eta_{motor}} = \frac{765}{0.87} = \mathbf{879\ W}$$

Loss: 114 W (copper losses, friction, heat)

Efficiency Chain—Where Power is Lost

From Battery to Propulsion: 44.5% Overall Efficiency

Power Conversion Chain — Part 2

Step 6: Battery Power (efficiency $\eta_{battery} = 0.93$)

$$P_{battery} = \frac{P_{shaft}}{\eta_{battery}} = \frac{879}{0.93} = \mathbf{945\ W \approx 1\ kW}$$

Loss: 66 W (internal resistance, BMS)

Overall Efficiency Comparison

Electric: 44.5% (421W useful / 945W battery)
Diesel Outboard: 25–35% (mechanical losses higher)
Electric is 27% MORE efficient than diesel!

Range Analysis—Step-by-Step Calculation

From Battery Capacity to Actual Kilometers

Single Battery Range Calculation — Part 1

Step 1: Usable Energy

$$
\begin{aligned}
E_{usable} &= E_{total} \times \text{DoD} \\
&= 4.32 \text{ kWh} \times 0.80 = \mathbf{3.46\ kWh}
\end{aligned}
$$

(80% Depth of Discharge protects battery life)

Step 2: Runtime at 1 kW

$$t_{runtime} = \frac{E_{usable}}{P_{continuous}} = \frac{3.46 \text{ kWh}}{1 \text{ kW}} = \mathbf{3.46\ hours}$$

Range Analysis—Step-by-Step Calculation

From Battery Capacity to Actual Kilometers

Single Battery Range Calculation — Part 2

Step 3: Distance Covered

$$\begin{aligned}\text{Range}_{base} &= t_{runtime} \times v_{cruise} \\ &= 3.46 \text{ h} \times 9.26 \text{ km/h} = \textbf{32.0 km}\end{aligned}$$

Step 4: With Variable Speed Buffer

$$\text{Range}_{practical} = 32.0 \text{ km} \times 1.25 = \textbf{32–40 km}\checkmark$$

(Accounts for slower speeds increasing efficiency)

Regenerative Charging—Energy Recovery Analysis

Quantifying the 13–15% Recovery

Regeneration Calculation — Part 1

Daily Energy Consumption:

$$E_{daily} = P_{continuous} \times t_{operation} = 1 \text{ kW} \times 4 \text{ h} = \mathbf{4.0\ kWh}$$

Regenerative Power at 5 Knots:

$$\begin{aligned} P_{regen} &= \eta_{prop} \times \eta_{motor} \times P_{water} \\ &= 0.35 \times 0.80 \times 536 \text{ W} = \mathbf{150\ W} \end{aligned}$$

(Water flow spins propeller $\rightarrow$ motor acts as generator)

Regenerative Charging—Energy Recovery Analysis

Quantifying the 13–15% Recovery

Regeneration Calculation — Part 2

Energy Recovered (4-hour trip):

$$E_{regen} = 150 \text{ W} \times 4 \text{ h} = \mathbf{0.60\ kWh}$$

Range Extension:

$$\Delta\text{Range} = \frac{E_{regen}}{P_{continuous}} \times v_{cruise}$$
$$= \frac{0.60}{1.0} \times 9.26 = \mathbf{5.5\ km}$$

Total Single Battery Range: $32.0 + 5.5 =$ **37.5 km**
Recovery Percentage: $\frac{0.60}{4.0} =$ **15%** ✓

Solar Generation—Daily Energy Harvesting

Bifacial Panel Performance in Marine Environment

Daily Solar Energy Calculation — Part 1

Sunny Day (6 peak sun hours):

$$
\begin{aligned}
E_{solar,sunny} &= P_{panel} \times t_{sun} \times \eta_{system} \\
&= 460\ \text{W} \times 6\ \text{h} \times 0.85 = \textbf{2.35 kWh}
\end{aligned}
$$

(460W = 400W rated + 60W bifacial gain from water reflection)

Cloudy Day (25% effectiveness):

$$E_{solar,cloudy} = 460\ \text{W} \times 6\ \text{h} \times 0.25 \times 0.85 = \textbf{0.59 kWh}$$

Solar Generation—Daily Energy Harvesting

Bifacial Panel Performance in Marine Environment

Daily Solar Energy Calculation — Part 2

Average Daily Generation (50% sunny):

$$E_{solar,avg} = \frac{2.35 + 0.59}{2} = \mathbf{1.47\ kWh/day}$$

With 2 Panels:

$$E_{total,solar} = 1.47 \times 2 = \mathbf{2.94\ kWh/day}$$

Daily Requirement Coverage

2.94 kWh covers 74% of 4 kWh daily consumption

Energy Self-Sufficiency Analysis

Alternative Energy vs Grid Dependency

Complete Daily Energy Balance

Source	**Energy (kWh)**	**Percentage**
Energy Consumption		
Daily operation (4 hours @ 1 kW)	4.00	100%
Alternative Energy Sources		
Solar generation (avg, 1 panel)	1.47	37%
Regenerative charging	0.60	15%
Total Alternative Energy	**2.07**	**52%**
Grid Requirement		
Grid supplement needed	**1.93**	**48%**

Key Findings

- **52% energy independent** (solar + regen)
- **48% grid supplemented** (4.82/day = 1,157/year)
- With 2 panels: **74% independent**

Economic Payback—Detailed Financial Analysis

From Investment to Break-Even

Annual Operating Cost Comparison

Item	Diesel	Electric
Fuel/Electricity	108,000	9,600
Maintenance	8,000	3,000
Oil/Lubricants	3,600	0
Engine service	5,000	1,500
Total Annual Cost	**124,600**	**14,100**
Annual Savings	**110,500**	

Payback Calculation

System Cost (with 40% PMMSY subsidy): 194,250

$$\text{Payback Period} = \frac{\text{System Cost}}{\text{Annual Savings}} = \frac{194,250}{110,500} = \textbf{1.76 years = 21 months}$$

5-Year Return on Investment Analysis

Long-Term Financial Benefits

5-Year Cost Comparison

Item	**Diesel System**	**Electric System**
Initial Investment	65,000	194,250
Fuel (5 years)	540,000	48,000
Maintenance (5 years)	40,000	15,000
Battery Replacement (Y4)	—	50,000
Resale Value	-15,000	-40,000
Total 5-Year Cost	**630,000**	**267,250**

5-Year Return on Investment Analysis

Long-Term Financial Benefits

5-Year Financial Metrics

- **Total Savings:** 630,000 - 267,250 = **362,750**
- **Net Benefit:** 362,750 - 194,250 = **168,500**
- **ROI:** $\frac{362{,}750}{194{,}250} \times 100 =$ **187%**
- **Annual Return:** 37.4%/year (compound)

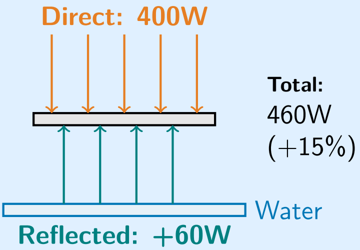
Investment Grade

ROI $>$ 150% qualifies as "Excellent Investment" by Indian banking standards

Bifacial Solar Technology—Marine Advantage

Why Bifacial for Marine? Water Reflection Bonus

Bifacial Panel on Water



Bifacial Solar Technology—Marine Advantage

Reflection Benefit + Panel Specifications

Why Water Works

- High albedo (reflectivity)
- Bifacial captures rear side
- Monofacial wastes reflection
- +15–25% gain over land

Specifications

- Rating: 400 W (front)
- Size: 1720×1140 mm
- Actual Output: 460–500 W
- Marine-grade frame
- Tilt: 15–20° optimal
- IP67 waterproof

Bifacial Solar Technology—Marine Advantage

Daily Energy Calculations

Daily Generation

Sunny (6 peak hrs):

$$E = 460 \times 6 \times 0.85 = \textbf{2.35 kWh}$$

Cloudy (25% eff.):

$$E = 460 \times 6 \times 0.25 \times 0.85 = \textbf{0.59 kWh}$$

2 panels: 4.7 kWh sunny | 1.18 kWh cloudy

Micro-Inverters—The Smart Choice for Marine

Why Independent Panel Operation Wins

Micro-Inverter vs String Inverter (Marine Environment)

Feature	**Micro-Inverter**	**String Inverter**
Individual Panel MPPT	**YES (>97%)**	**NO (shared)**
Shade Tolerance	**Excellent**	**Poor**
Add 2nd Panel Later	**Easy plug-in**	**Complex rewire**
Marine Shading (nets)	**Handles well**	**Degrades all**
Reliability	**Module-level**	**Single point fail**
Cost per Panel	10,000	15,000 (central)

Micro-Inverters—The Smart Choice for Marine

Shading Reality & Module-Level Electronics

Fishing Boat Reality

Common Shading Sources:

- Fishing nets draped
- Rigging & masts
- Equipment storage
- Crew shadows
- Bird droppings

Micro-Inverter Specs

Enphase IQ7 Marine-Grade:

- Input: 60–96 V DC
- Output: 72 V DC bus
- Efficiency: >97%
- IP67 waterproof
- MPPT per panel
- Temp: -40 to +65°C

Micro-Inverters—The Smart Choice for Marine

The Modular Advantage

Modular Advantage

Start with 1 panel → Add 2nd panel later without replacing charging system

Module-level design = best for small boats with unpredictable shading

UV Panels for Cloudy Conditions

Future-Ready Technology

The Challenge You Identified

"Solar panels might not work without solar energy (during overcast)"

UV Panel Principle

- Standard: 400–700 nm
- UV: 100–400 nm
- **UV penetrates clouds**

AuREUS Innovation:

(Dyson Award 2020)

- Crop waste particles
- UV $\rightarrow$ visible conversion
- 50% cloudy efficiency

Performance

Panel Type	Cloudy
Standard solar	15–22%
Bifacial (water)	25%
UV-enhanced	40–50%

Current Design

High-efficiency bifacial

+ **upgrade path to UV**

Minimum Controls — Simplicity by Design

Zero Technical Training Required

Only 3 Physical Controls

1. **Throttle Lever**
   - Forward / Neutral / Reverse
   - Works exactly like a traditional outboard
2. **Power Switch**
   - ON / OFF via key ignition
3. **Mode Selector**
   - Motor / Regen / Auto

Minimum Controls — Simple Display

Clear Information at a Glance

Simple LCD Display

- Battery A (%)
- Battery B (%)
- Power (kW)
- Range (km)
- Solar Input (W)
- Regeneration (W)
- Fault Indicators

Design Philosophy

No touchscreens ▪ No menus ▪ Simple, reliable controls

Cost Breakdown — Transparent & Realistic

Market-Validated Pricing (Nov 2025)

Motor & Battery Costs

Motor Unit: 95,000

- BLDC Motor (5kW): 60,000
- Controller: 20,000
- Propeller: 8,000
- Mounting hardware: 7,000

Batteries (2 units): 65,000

- $LiFePO_4$ cells: 50,000
- BMS (2×): 8,000
- Battery enclosures: 5,000
- Connectors: 2,000

Cost Breakdown — Solar, Controls & Final Total

Market-Validated Pricing (Nov 2025)

Solar & Control Systems

Solar System: 42,000

- Bifacial solar panels (2×): 22,000
- Micro-inverter: 10,000
- Mounting frame: 5,000
- Shore charger: 5,000

Controls: 15,000

- Control panel: 7,000
- Throttle: 4,000
- Safety components: 1,500
- Wiring + connectors: 2,500

Pricing Strategy & Economic Viability

Retail Pricing

Production: 247,000 | Margin (15%): 37,050 | Distributor (10%): 24,700 | Install: 15,000

Retail: 323,750 | **With PMMSY Subsidy (40%): 194,250**

Diesel (5 Years)

- Initial: 65,000
- Fuel: 540,000
- Maintenance: 50,000

Total: 655,000

Electric (5 Years)

- Initial: 194,250
- Electricity: 57,600
- Maintenance: 18,000
- Battery: 50,000

Total: 319,850

Financial Results

Savings: 335,150 | **ROI: 172%** | **Payback: 20–26 months**

Environmental Impact at Scale

National-Level Benefits

Per Boat Annually

- CO reduction: 375 kg (78% reduction)
- Diesel saved: 2,400 liters (240 days $\times$ 10L)
- Oil spill prevention: $\sim$5 liters
- Noise: 70 dB lower (marine life benefit)
- Zero microplastics (no 2-stroke oil)

If 10,000 Boats Adopt (1% of Fleet)

Impact	**Annual Benefit**
CO reduction	3,750 tons
Trees equivalent	170,000
Diesel saved	24 million liters
Cost savings	2,160 crores

Why NIOT Partnership is Critical

Four Essential Pillars

1. Technical Validation

- Hydrodynamic testing in towing tank
- Materials and corrosion testing (ASTM B117)
- Battery thermal management validation
- Bifacial gain measurement in marine environment

2. Field Testing Infrastructure

- Access to coastal research stations
- Deployment through fishing communities
- 6-month field trials with data logging
- Real-world performance validation

NIOT Partnership (Continued)

3. Policy Support

- Government subsidy alignment (PMMSY integration)
- BIS certification guidance
- Blue Economy initiative inclusion
- Priority vendor status for procurement

4. Credibility & Knowledge Transfer

- NIOT endorsement essential for fishermen trust
- Joint publication in marine technology journals
- Patent application support
- Mentorship on commercialization pathway

Specific Testing Requests from NIOT

Detailed Validation Requirements

Hydrodynamic Tests

- Propeller optimization
- Blade configuration
- Efficiency vs. speed
- Regeneration validation
- Cavitation analysis

Materials Testing

- Saltwater (ASTM B117)
- Galvanic corrosion
- UV degradation
- Anode consumption

Battery & Thermal

- Chamber testing
- 20–50°C performance
- Passive cooling
- Thermal runaway risk

Solar Optimization

- Bifacial gain measure
- Optimal tilt (8–20°N)
- Shading analysis
- Micro vs string

Development Roadmap

Phased Implementation with NIOT

Phase 1: Detailed Engineering (Months 1–6)

With NIOT Collaboration: Motor-propeller-gearbox selection | CAD design and FEA | Battery pack design | Control system PCB

Phase 2: Prototype & Lab Testing (Months 7–12)

At NIOT Facilities: Build 3 alpha prototypes | Towing tank trials | Environmental testing (IP67, thermal) | 1000-hour saltwater immersion

Development Roadmap — Continued

Phases 3 and 4

Phase 3: Field Trials (Months 13–18)

NIOT-Supervised Deployment

- 10 beta units deployed: Chennai, Nagapattinam, Kochi, Veraval, Visakhapatnam
- Full data logging: energy, range, solar input, regeneration
- Monthly user interviews with fishermen
- Targets: 90% uptime, >4/5 user satisfaction

Phase 4: Certification (Months 19–24)

- BIS certification application
- Marine equipment type approval testing
- Formalize manufacturing partnership (capacity: 100 units/month)

Development Roadmap — Commercial Rollout

Phase 5

Phase 5: Commercial Launch (Months 25–36)

- Initial rollout in Tamil Nadu & Kerala
- Distribution expansion across east and west coasts
- Fishermen training sessions via NIOT field centers
- 500 units in Year 1
- **Scale-up target: 10,000 units by Year 4**

Impact Outlook

Reduced diesel dependency ▪ Lower operating cost ▪ Cleaner coastal air ▪ Improved livelihood stability for fishing communities

Risk Analysis & Mitigation

Comprehensive Risk Management

Technical Risks

Risk	**Mitigation**
Battery fire	LiFePO; active BMS; thermal fuses
Motor corrosion	316L SS; zinc anodes; IP67
Insufficient range	Dual battery; conservative ratings
Regen underperform	Not critical; bonus feature
Solar damage	Tempered glass; protective cage

Market & Financial Risks

User resistance: Pilot with influential fishermen | **High costs:** Volume discounts, local assembly | **Competition:** Local service, govt. preference | **Warranty:** 5% reserve fund, robust QC

Competitive Landscape

Our Unique Position

Market Comparison

Company	**Product**	**Limitation**
Torqeedo (DE)	Travel/Cruise	2–10L; no local support
NavAlt (IN)	MAKO + boats	Complete boats; 18–20L
ePropulsion (CN)	Spirit/Navy	Recreational; 1.5–4L
Haswing (CN)	Trolling	Low power (1–2HP)
Our System	**Modular**	**Retrofit; 1.3L; regen+solar**

Unique Value Propositions

Only modular retrofit in India | Integrated regenerative charging | Bifacial solar for marine | Hot-swappable batteries = unlimited range | Price 50–70% lower | Service in fishing villages

Social Impact

Beyond Technology—Empowering Communities

Economic Empowerment

40,000–50,000 annual savings per household | Women can operate (no heavy starting, simpler controls) | Reduced health issues (no fume exposure, less hearing loss)

Skill Development

Training 500 coastal youth as EV technicians | New employment: charging station operators | Technology adoption in traditional sector

Energy Independence

Reduced fuel supply chain dependence | Village-level solar charging = energy sovereignty | Protection from fuel price volatility

Success Metrics

How We Measure Success Together

Field Trial Success Criteria

Metric	**Target**
System uptime (6 months)	>90%
User satisfaction rating	>4/5
Validated range	30–40 km
Warranty claims rate	<3%
Energy self-sufficiency	>60%
Recommendation rate	>80%

Commercial Success Targets

Year 1: 500 units (TN, Kerala) | **Year 2:** 2,000 units (Gujarat, AP) | **Year 3:** 5,000 units (national) | **Year 4:** 10,000 units + export (Sri Lanka, Bangladesh, SE Asia)

Key Technical Findings

Validated Engineering Solutions

Performance Metrics

Power: 1 kW continuous for 5 knots (validated) | **Range:** 32–40 km single | 80–90 km dual battery | **Energy Recovery:** 13–15% from regen (600 Wh/trip) | **Solar:** 2.15 kWh sunny | 0.54 kWh cloudy (2×200W bifacial) | **Grid Supplement:** 31% daily (4 kWh consumption)

Economic Viability

Investment: 194,250 (after 40% subsidy) | **Annual Savings:** 40,000–50,000 vs. diesel | **Payback:** 20–26 months | **5-Year Savings:** 335,150 | **ROI:** 172% over 5 years

Vision Beyond Technology

A National Mission

This Project Represents:

1. **Empowerment:** 3.5 million fishermen with sustainable technology
2. **Leadership:** Position India as global leader in marine electric propulsion
3. **Compatibility:** Demonstrate that environmental sustainability and economic prosperity go together
4. **Replicability:** Create a model for developing nations worldwide

The Modular Philosophy

Inspired by smartphones and power tools

Democratizes advanced marine technology

Making it accessible to India's most vulnerable coastal communities

The Ask—NIOT Partnership

Next Steps for Collaboration

Seeking NIOT Partnership For:

1. Technical Validation & Testing Facilities
Towing tank for hydrodynamic optimization | Materials testing lab | Environmental chamber for thermal validation

2. Field Trial Deployment Network
Access to coastal research stations | Connection to fishing communities | Data logging equipment and supervision

3. Policy Guidance & Subsidy Alignment
PMMSY integration support | BIS certification guidance | Blue Economy initiative inclusion

4. Joint Publication & IP Support
Co-authorship in marine journals | Patent application guidance | NIOT co-branding opportunity

Proposed Next Steps

Immediate Actions (Next 30 Days)

Action Plan

1. **Week 1:** Submit formal collaboration proposal to NIOT
2. **Week 2:** Technical review meeting with your team
3. **Week 3:** Discuss testing protocols and facility access
4. **Week 4:** Finalize MoU and project timeline

Proposed Next Steps

First Quarter Deliverables

Deliverables

- Complete engineering drawings and specifications
- BOM with supplier contacts
- First prototype components procurement
- Testing protocol documentation

Key Question for Dr. Abraham

Does this timeline align with NIOT's current projects?
Are there any technical concerns to address before proceeding?

Request for NIOT Position Consideration

My Background & Qualifications

Recent NIOT Internship Experience

Autonomous Surface Vehicle (ASV) Development

- GPS navigation + BNO055 IMU + ESP32 microcontroller
- Kalman/APF-based path-planning algorithms
- Hands-on exposure to NIOT's marine testing facilities

Technical Skills

Electronics Engineering
Autonomous Systems
Sensor Fusion
Sustainable Hardware Design
Marine Propulsion Systems

Request for NIOT Position Consideration

Formal Employment / Project Request

Formal Request

I respectfully request consideration for:

1. **Opportunity to contribute or lead** the Solar–Electric Marine Propulsion project under NIOT
2. **Position consideration** for:
    - Scientist–B
    - Project Scientist–I

    in the domains of:

    - Marine propulsion systems
    - ASV development
    - Sustainable blue-tech initiatives

Let's Transform India's Coastal Economy

One Fishing Boat at a Time

With NIOT's partnership,

we can turn this vision into reality.

Thank you for your time and consideration, Dr. Abraham.
I look forward to contributing to NIOT's sustainable
blue-economy and marine propulsion initiatives.

Contact Information

Available for Follow-up Discussion

Get in Touch

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Available for follow-up meeting at your convenience
Ready to present detailed technical walkthrough

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BACKUP: Detailed Power Calculations

Complete Calculation Chain

Step 1: Froude Number $F_n = \frac{v}{\sqrt{g \times L_{wl}}} = \frac{2.57}{\sqrt{9.81 \times 5.0}} = 0.367$

Step 2: Total Resistance

$R_{total} = 0.014 \times 1100 \times 9.81 \times (1 + 2 \times 0.367^2) = 164$ N

Step 3: Effective Power $P_{effective} = R_{total} \times v = 164 \times 2.57 = 421$ W

Step 4: Propeller Power ($\eta = 0.55$) $P_{propeller} = \frac{421}{0.55} = 765$ W

Step 5: Motor Shaft Power ($\eta = 0.87$) $P_{shaft} = \frac{765}{0.87} = 879$ W

Step 6: Battery Power ($\eta = 0.93$) $P_{battery} = \frac{879}{0.93} = 945$ W ≈ 1000 W

BACKUP: Battery Pack Specifications

LiFePO Battery Configuration

- **Chemistry:** Lithium Iron Phosphate (LiFePO)
- **Configuration:** 20S3P (20 series, 3 parallel)
- **Nominal Voltage:** 72V (64V discharged, 73V charged)
- **Capacity:** 60 Ah per pack
- **Energy Storage:** 4.32 kWh per pack
- **Weight:** 28 kg (portable by one person)
- **BMS:** 20S 60A with cell balancing, temperature monitoring
- **Connector:** Aviation plug (3-pin, 150A rated)
- **Swap Time:** $<$30 seconds (lever-lock mechanism)
- **Cycle Life:** 3000–5000 cycles @ 80% DoD
- **Safety:** Thermal fuses, overcurrent protection, IP67

BACKUP: Installation Process

Installation Steps (15 Minutes Total)

1. **Remove old outboard** (if present) - 5 min
2. **Mount transom bracket** - 4 bolts, no drilling - 3 min
3. **Attach motor unit** - Quick-release clamp - 2 min
4. **Connect battery** - Single aviation plug - 1 min
5. **Mount control panel** - 2 screws - 2 min
6. **Route throttle cable** - Standard marine cable - 2 min

No Special Tools Required

Standard wrench set | Screwdriver | No welding | No hull modification | Reversible installation