TELETC SYSTEMS AG RENEWABLES
& SOLARBOAT MARITIM INDONESIA

Supported by

Levers for effective and efficient climate protection

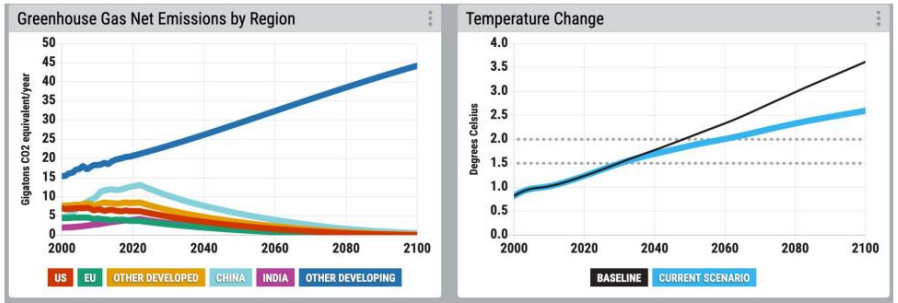
Globally effective climate protection made in Switzerland

We enable low-carbon technology transfer in developing countries by linking innovative ideas with local needs, providing effective and efficient leverage for global climate change mitigation and global sustainable development.

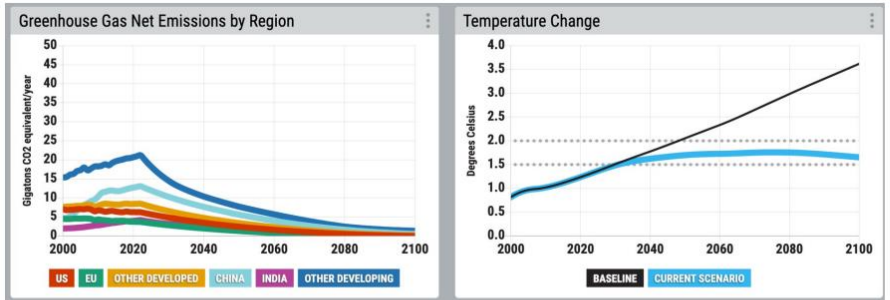
Supported by
zh aw School of Engineering
INE Institut für Nachhaltige Entwicklung

Why we need to get involved in global climate protection?

Simulation of long-term effects of climate protection measures (C-Roads):
Even if all developed countries, as well as India and China, do their homework on climate protection, it will not be enough to reach the 2 degree target.



	Emissions Peak Year	Reductions Begin Year	Annual Reduction Rate	Prevent Deforestation	Promote Afforestation
United States	2022	2022	3%	100%	100%
European Union	2022	2022	3%	100%	100%
Other Developed Nations	2022	2022	3%	100%	100%
China	2022	2022	3%	100%	100%
India	2022	2022	3%	100%	100%
Other Developing Nations	2100	2100	0%	0%	0%



	Emissions Peak Year	Reductions Begin Year	Annual Reduction Rate	Prevent Deforestation	Promote Afforestation
United States	2022	2022	3%	100%	100%
European Union	2022	2022	3%	100%	100%
Other Developed Nations	2022	2022	3%	100%	100%
China	2022	2022	3%	100%	100%
India	2022	2022	3%	100%	100%
Other Developing Nations	2022	2022	3%	100%	100%

Heureka!

Only by supporting clean technology transfer to developing countries through the joint development of innovative business models and attractive environmental conditions can lead to a required global technological change!

TELETC SYSTEMS AG RENEWABLES
& SOLARBOAT MARITIM INDONESIA

Supported by

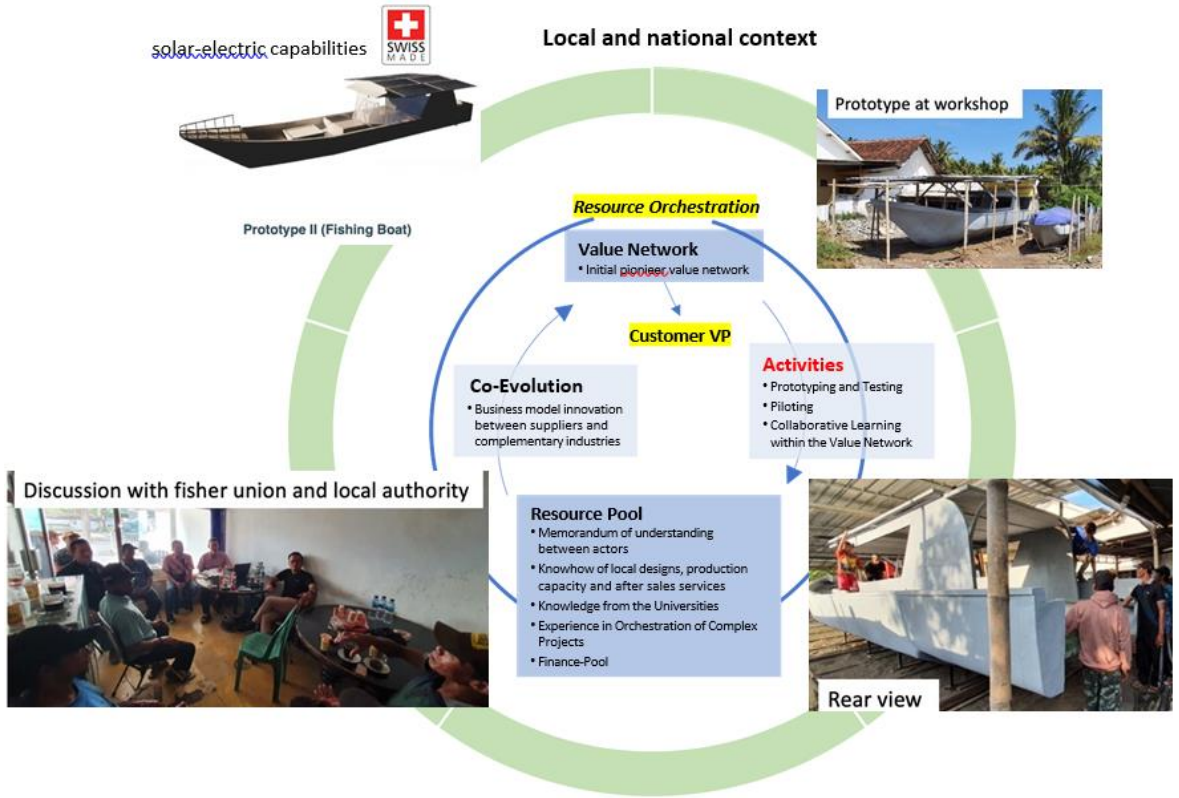
School of Engineering
INE Institut für Nachhaltige Entwicklung

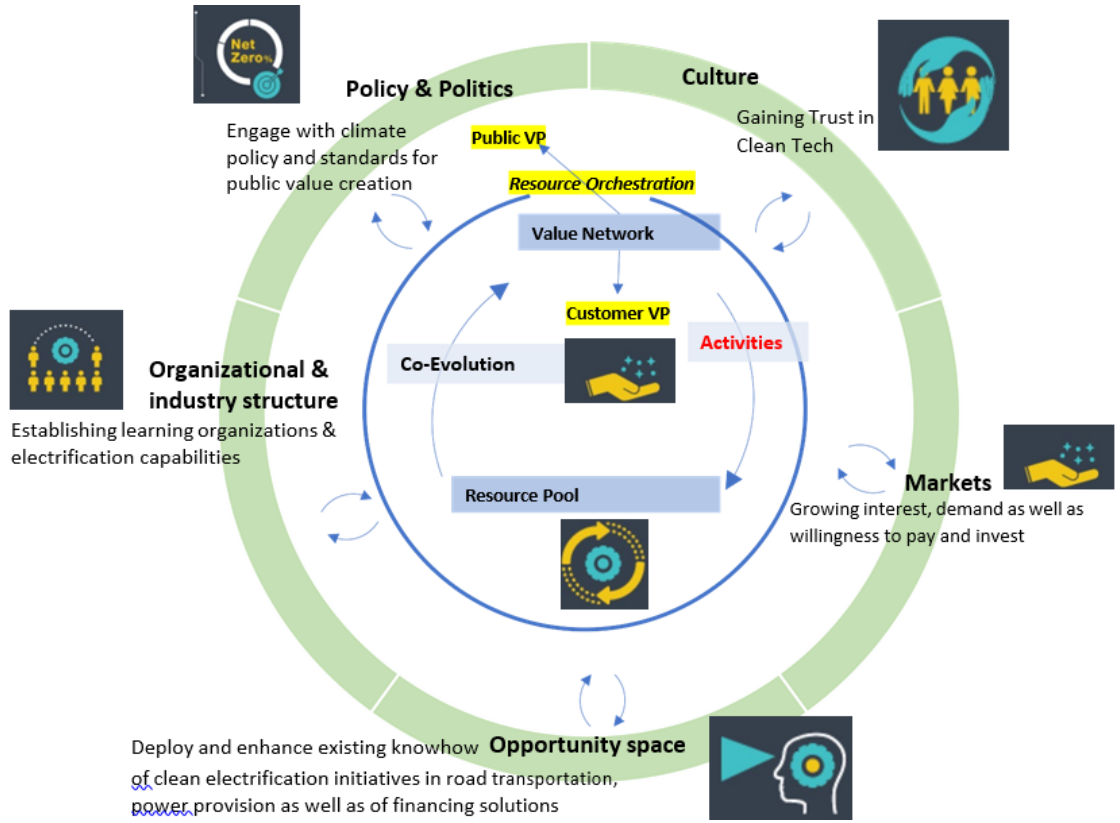
And how we should get involved in global climate protection?

Clean tech solutions must be developed together with local stakeholders

&

attractive environmental conditions for CleanTechsolutions must be developed together with regional and national actors





Impact / how we can make a difference:

- ✓ New markets for greenhouse gas-free solutions emerge locally
- ✓ Developing countries can participate in economic growth and prosperity
- ✓ Climate protection in developing countries is perceived as an opportunity to achieve global sustainability goals
- ✓ Climate protection solutions are experienced as an investment with a high NPV and become an attractive strategy for Swiss companies

TELETC SYSTEMS AG RENEWABLES
& SOLARBOAT MARITIM INDONESIA

Supported by

School of Engineering
INE Institut für Nachhaltige Entwicklung

Our contribution as part of the solution and to serve as an illustrative example for hopefully many successor projects:

Solar Electric Fisher Boat for Indonesia

The solar boat project is aligned with following UN Sustainable Development Goals

TELETC SYSTEMS AG RENEWABLES
& SOLARBOAT MARITIM INDONESIA

Supported by

Problem

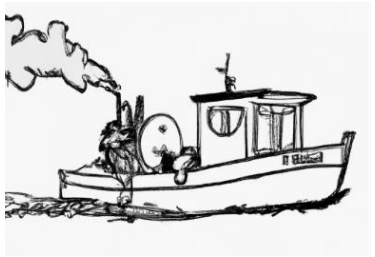
For small-scale fishermen in Indonesia, around 50% to 70% of the total operation cost for a fishing trip is fuel cost and in remote areas fuels are not always available. The coastal area is suffering from air pollution and oil particles into the water which damages the environment and fish ecosystem. Additionally, the diesel and gasoline engines contribute to CO2 emissions causing global warming.

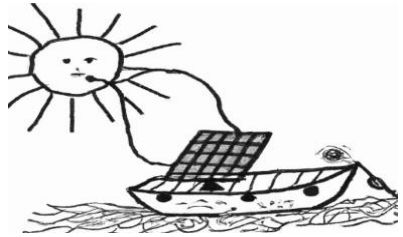
- **50% to 70% of the total operation cost for a sea trip for fishing is fuel cost**
- **Most fishermen have low-income between USD 70 and USD 270 per month**
- **CO2 emission of all small fisher boots in Indonesia is over 10 Mio. tones/year**

Solution

Low-cost solar fisher boot based on our **patented EVA foam construction** with **world leading solar boat technology** will:

- reduce a high amount carbon emission and the environmental impact
- significantly improve the living standard of fishermen





Less environmental pollution

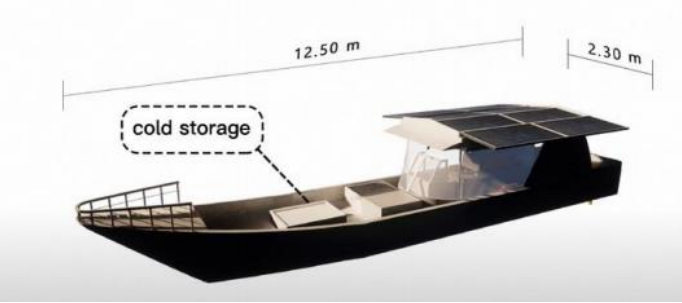
Save up to 50% on maintenance and repair costs

Save up to 70% on operating costs for a fishing trip

Product

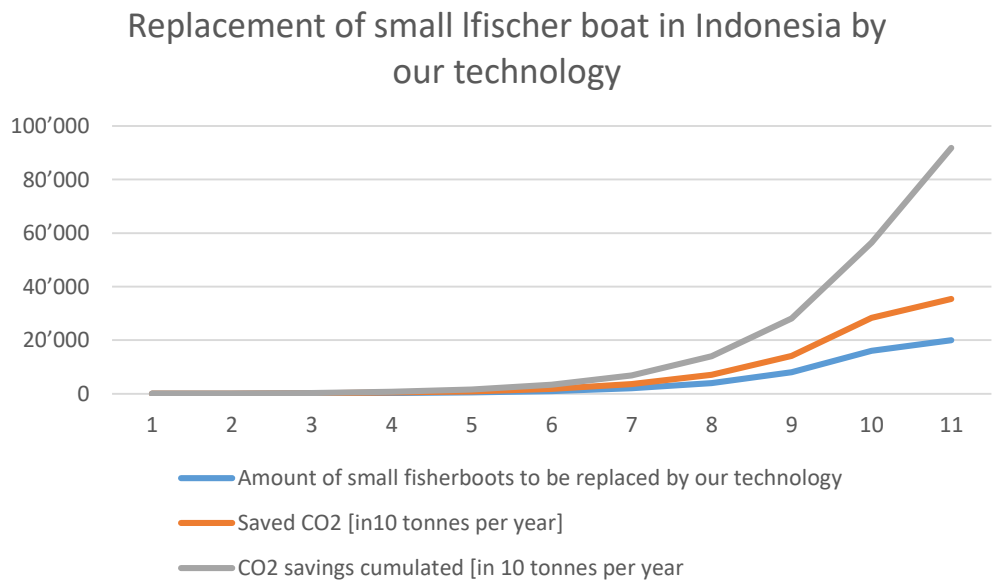
Our boat design is using our patented Ethylene-vinyl acetate (EVA) foam construction and addresses following specific needs and issues:

1. Reduce operational cost
2. Reduce dependency on fuel availability
3. Affordable boat price
4. Reduce negative impact on local environment and human health
4. Durable and strong stable design to overcome corrosive salty environment and offshore waves
5. Easy to operate and low repair cost
6. Allow for long sea trips and night fishing



Market

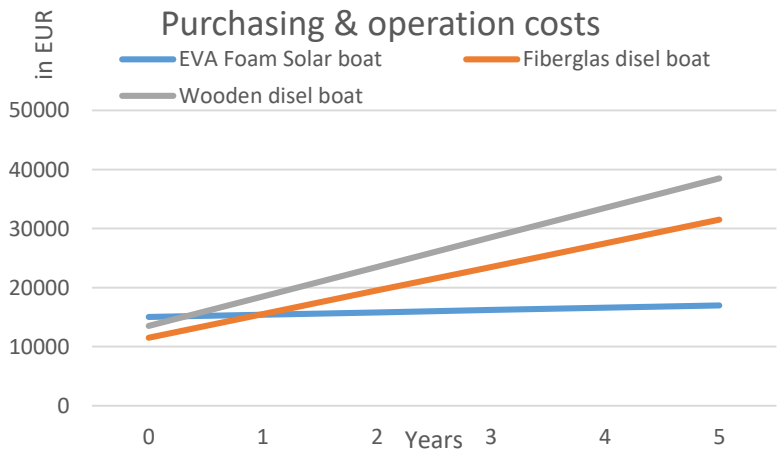
- high market potential of 25´000 new small fisher boats / year in Indonesia
- by replacing all small fisher boots in Indonesia over 10 Mio. tons of CO2 can be saved



Business Model

- own production only for local market and for continuous product improvement
- license to established boat builder - we take 7% license fee from selling price
- share form crediting a recognized standard to receive the highest market value for the CO2 emission reductions

Promotion for end customer



Licensee support

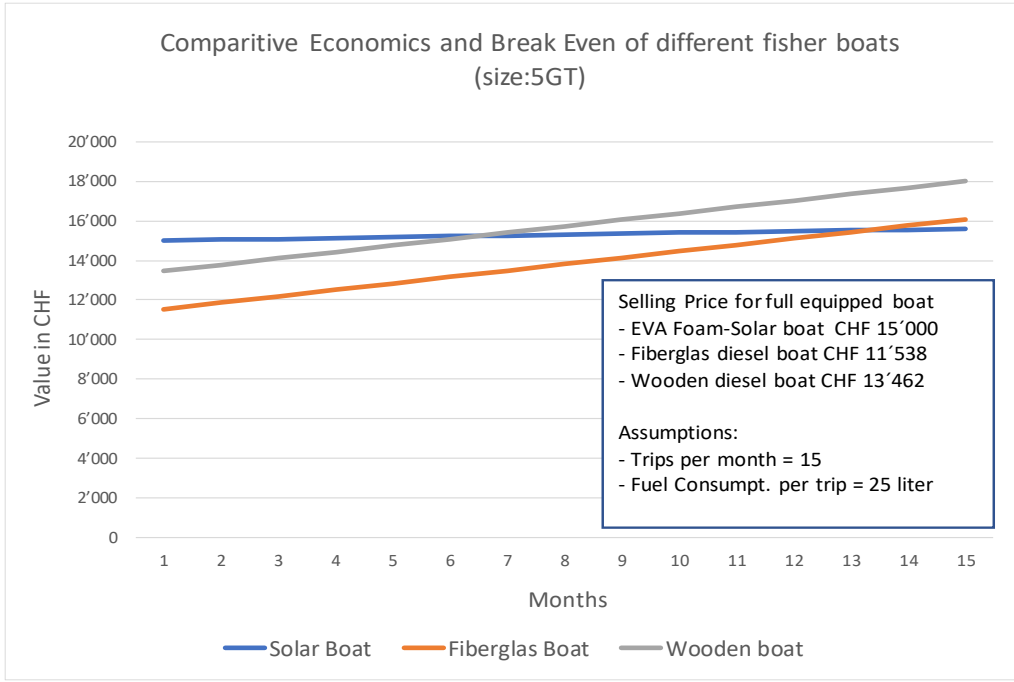
Tutorials

FaQ's

Services

Competitive advantage

- low in manufacturing cost, easier and cheaper to repair
- world leading solar boat technology knowhow
- lighter and strong characteristic against damaged compared to conventional boats
- due to the patented construction with the EVA material, a substantial part of the higher initial costs for the necessary solar technology can be compensated
- break even is already achieved after 1 year



Proof of concept and next steps

✓ Current engineering and development has reached TRL6 including hydrostatic tests of a low-fidelity prototype

➢ Next steps consist of engineering based on the evaluation of TRL 6 test results including optimization of resistance effects, stability, center of gravity of the boat and engineering battery design, autonomy at sea, battery capacity management and solar electric generation capacity as well as efficient control mechanism for electrical solar boat.

- This is done with world leading knowhow in solar boat making (TELTEC/Mark Wüest) combined with the new patent on solar boat construction using EVA-Foam material (SMI) considering all requirements defined by the Puger fisher community.
- The evaluation is followed-up by building a high-fidelity prototype including required measuring tools and test instrumentation. In closed collaboration with the Puger fisher team, the prototype will be ocean tested under real sea and fishing condition for providing recommendations regarding improvements of concept and design (TRL7).

- As a next step, the improved boat will be completed with fully integrated Hard- and Software and qualified through test and demonstration in an operational environment. Also, most user-, training – and maintenance documentation shall be completed and all functionally tested. Validation will be performed which leads us to the completion of the development phase (TRL8)

Supporting documentation

TELETC SYSTEMS AG RENEWABLES & SOLARBOAT MARITIM INDONESIA

Supported by

School of Engineering
INE Institut für Nachhaltige Entwicklung

Summary / Abstract

Based on Indonesian Ministry of Maritime Affairs and Fisheries (MMAF) there are almost 2 million people working as fishermen as main livelihood in Indonesia, which is the third largest income groups. Around 90% of them are small-scale fishermen, who are working on fisher boats smaller than 7 GT. There are more than 500´000 motorized small fisher boats (<10GT) operated in Indonesia

Around 50% to 70% of the total operation cost for a fishing trip is fuel cost and in remote areas fuels are not always available. The coastal area is suffering from air pollution emitted from two-stroke conventional engines that contains oil particles. The oil spillage from the oil leak of the motor into the water is a further major issue, which damages the environment and fish ecosystem. Additionally, the diesel and gasoline engines contribute to CO2 emissions causing global warming. In typical villages in coastal area, the people depend on the income from fishery with diminishing catches but rising fuel cost for diesel fisher boats. Consequently, the already low living standard and quality of life of fishermen is decreasing as well as the maritime ecosystem is increasingly endangered.

Thus, the most important local needs are to reduce the use of high-cost fuel for their fishing trips and to have solution of low-cost boat use to increase their margin of each fishing trip. To meet these needs, our project develops an efficient full solar electric boat for fishery to reduce CO2 emissions and damages to the environment and fish ecosystem while helping the small-scale fishermen to improve their net-income by significantly reducing the operational cost. Our boat design uses own-patented Ethylene-vinyl acetate (EVA) Foam construction, which is lighter and lower in manufacturing cost, and has a stronger characteristic against mechanical impact compared to conventional boats. Due to the construction with the EVA material, a substantial part of the higher costs of the solar-electric equipment can be compensated, so the break-even in comparison with fiberglass or wooden boat can already be achieved after approx. one year through avoiding the use of the fuel.

In order to develop this solar fishing boat, the Indonesian start-up SMI strongly collaborates with the Swiss company TELTEC SYSTEMS AG RENEWABLE for technology transfer in respect to a tailored design of fully integrated solar electric technology into the lightweight fisher boat and the production technology based on world leading solar boat technology knowhow. In addition, TELTEC will manage and supervise this new product development and drive the efforts for adjusting the value creation chain for successful market introduction within the complex fishery business ecosystem in Indonesia.

On-site Situation:

Our project is implemented in Puger, which is located in Jember Regency, East Java. It is a typical village in coastal area, where the majority of people depend on their income from fishery. There are around 3000 fisher boats majority are <7GT made from wood and fiberglas material in operation. The drivetrains are mostly diesel motors of various manufacturing years. Refueling is done manually by canister. The availability of fuels is also a limiting factors for the fishers to go and stay longer at sea and catch more fishes. Most of the boats belong to few private agencies or cooperatives who in turn rent the boats to small fishers and ask for considerable shares from the catch without transparency. Puger coastal are surrounded by reefs and rocks often causing damages to the boats. Fiberglass and wooden material are not easy to repair and very costly. The small fishers have to lend money for repair and need to pay it back in short term. The urgent local needs of Puger fishermen are therefore to reduce the use of and dependency from the high-cost fuels for their fishing activities and to have a solution for affordable boats with low operation and maintenance cost.

The use of fuels has negative impacts on the local environment. High air pollutions were measured in Puger especially during high traffic times. The oil spillages from leakages at motors contaminate the sea water and have negative impacts on marine ecosystem. Burning fuels contributes to the CO2 emissions and causes global warming, which in turn will impact the fish productivity (coral bleaching, drop of fish population).

In Indonesian context, the fuels are imported and subsidized goods, so every reduction of fuel consumption will reduce the national financial exposures and helps the country to meet its climate targets as expressed in Indonesian National Determined Contribution at the Paris Agreement.

Following specific needs and issues are to be addressed:

1. Reduce operational cost
2. Reduce dependency on fuel availability
3. Affordable boat price
4. Reduce negative impact on local environment and human health
5. Durable and strong stable design to overcome corrosive salty environment and waves.
6. Easy to operate and low repaid cost
7. Allow for long sea trips and night fishing.

Local beneficiaries are:

Fishermen, especially small-scale fishermen. They will save the high fuel cost and will not depend on fuel availability, so that they can go fishing more often.

Local businesses: As productivity and the income of the fishermen increase, the related local economics, e.g., small food process business, boat builders, boat service companies, etc. can benefit from the increased demand in fishery industry.

Local community: The use of Solar powered boat will reduce the environment impact, reduce the risk of oil spillage into the water and improve the air quality and human health.

Government will benefit from GHG reduction and less fuel consumption, so less fuels need to be imported and subsidized.

Existing Activities and Relevant Stakeholders

This project has emerged from a technology start-up team under the innovation program of Petra Christian University (Indonesia) which led to the spin-off Solarboat Maritim Indonesia (SMI). Based on the submitted patent on solar boat construction using EVA-Foam material, the project intends to build a solar boat that will be attractive to local fisheries due to the advantageous properties of EVA-Foam material in terms of purchase and operation costs.

Indonesia has a lot of knowledge in boatbuilding, but experience in using renewable energy in the context of boat building is only marginally available. That's why SMI strongly collaborates with the Swiss company TELTEC SYSTEMS AG RENEWABLE for technology transfer in respect to tailored design of solar electric boat to Indonesian fishers conditions and for adjusting the value creation chain for the supply of lightweight, solar fishing boats by mastering the dynamical complexity in the business ecosystem.

Indonesian Government has committed to reduce the greenhouse gas emissions of 29% until 2030 as per Paris Climate Agreement. In the fishery sector, there are initiatives by state institutions, universities, and private sectors to develop solutions with solar powered boats using electric motors. However, there is no coordinated approach or a comprehensive concept that systematically exploits these potentials and would enable the most efficient and effective use of solar electric boats in fishery. Also in other regions of the world, activities have started to build solar fishing boats, e.g. by NavAlt in India. Experiences exist to convert a conventional wooden boat by retrofitting solar panels and motor, but this is economically not viable. Giving the fact that thousands of boats will be replaced by new ones every year, our efficient and affordable light-weight solar fishing boats will play a considerable role.

Main Objectives and Approach

The overall objectives are to develop technology-based solutions to **improve the living standard of fishermen** through cost-effective solar fisher boats and to achieve successful integration of the new technology into Indonesian **fishery business ecosystem**.

The project specific objective are:

1. to enhance a Solar Electric Fisher Boat Concept from a low- to a high- Fidelity-Prototype and a validated product in distinct real life environments
2. to establish sufficient local capabilities and capacities and to develop and validate business strategies for a viable commercialization of solar boats (i.e. building a learning organization for solar boats)

The project team analyzed the current development status and compared it with the Technology Readiness Level (TRL) standards. Based on this, we identified risks, developed tasks to minimize them (see also appendix 3), and defined tasks to complete the development phase so that the solar boat can be qualified for the operational environment. Current engineering and development has reached TRL6 including hydrostatic tests of a low-fidelity prototype. Next steps consist of the evaluation of TRL 6 test results including optimization of resistance effects, stability, center of gravity of the boat and engineering battery design, autonomy at sea, battery capacity management and solar electric generation capacity as well as efficient control mechanism for electrical solar boat. This is done with world leading knowhow in solar boat making (TELTEC/Mark Wüest) combined with the new patent on solar boat construction using EVA-Foam material (SMI) considering all requirements defined by the Puger fisher community. The evaluation is followed-up by building a high-fidelity prototype including required measuring tools and test instrumentation. In closed collaboration with the Puger fisher team, the prototype will be ocean tested under real sea and fishing condition for providing recommendations regarding improvements of concept and design (TRL7).

As a next step, the improved boat will be completed with fully integrated Hard- and Software and qualified through test and demonstration in an operational environment. Also, most user-, training – and maintenance documentation shall be completed and all functionally tested. Validation will be performed which leads us to the completion of the development phase (TRL8). To perform these activities, we apply a user centric co-creation approach with partners of the Indonesian business ecosystem applying agile project management and lean prototyping as well as continuously enhancing local capacity and capability by training engineers and after-sales teams. We also started to involve authorities to review the boot building plans to enable efficient certification.

Main Sustainability Impacts

The solar boat project is aligned with following UN Sustainable Development Goals

The independency from fossil fuel will have a reduction in the cost of fishing while increasing the productivity of fishing activities. As most of the small fishers are living below poverty line, the increase of income will help them and their family improving overall wealth (SDG#1) and this is aligne withspecific needs#1, 3 & 7 (in page 11).

The air pollutions caused by fuel-motorized boats in coastal area like Puger are remarkable high especially at certain high traffic hours endangering human health. The substitution with solar electric boats will reduce air pollutions and improve the marine ecosystem by avoiding risk of oil spillages. In comparison with using fossil-fuel for similar fisher boat size, the use of a solar electric boat can save 17.7 tons CO2/year per boat, assuming the boat is used for 5 fishing trips per week with about 10 km distance each time. It is important to say that global warming has impact to marine biota, bleaching of coral reefs and regeneration of the fish (SDG#3,13 & 14; need#4)

Our patented EVA foam material is not only very robust but also any damage on the hull can be repaired easily with much lower cost. Due to its light weight, the boat can accommodate additional batteries and strong electric motor for ocean requirement. The EVA material has further low material cost (20% lower), thus compensating the higher cost of the solar electric equipment, partially. The savings from fuel cost the complete boat economics are more favorable than traditional boats (SDG#7 & 9 ;needs#3, 5 & 6).

Further, SMI will be able to offer interesting and future oriented jobs to about 20-25 people in the next 5 years (SDG#17). In addition, boat makers who build boat under license and their supplier and work forces will benefit from the raising new technology (SDG#8). To ensure the success, SMI with its networks is pro-actively building collaboration with local and international partners.

TELETC SYSTEMS AG RENEWABLES & SOLARBOAT MARITIM INDONESIA

Supported by

School of Engineering
INE Institut für Nachhaltige Entwicklung

The team behind it

Team Members accountability and experiences

Name	Key Competences	Reference projects	Education
Thomas Anner	Project lead, CEO teltec systems ag renewables	Workshop for renewable energy project developer. Renewable Energy Entrepreneurship Initiative in Saudi Arabia.	Ing. EurEta, , Post-graduate studies in Economics (NDS-FH), Master in Energy Management, PMP Project Management Professional
Christian Adinegoro	Requirement Management Risk Management Energy market & finance	Market Plan for SPS Stirling Machine Control system Retrofit of Power Plant. Smart grid in liberalized European Market.	Dipl.-Ing. Energy and Process Technology; Leibniz University Hannover. Master in Energy Management.
Mark Wüst	Marine Solar Technology, Technology Transfer, Boat building.	Constructed more than 40 solar boats with major classification societies such as Bureau Veritas or Rina for successful homologation. Engineered the first solar-powered boat for the first transatlantic crossing "Sun21" Construction manuals for shipyards.	Vocational Degree in Machine design, Boat design and construction
Silvia Ulli-Beer, Dr. oec.	Innovation management, Business Ecosystem analysis, Business Model Innovation, Actor orchestration for the Buildup of Future Energy Systems	Co-Leader of the Research Focus Sustainable Energy System, Work package Leader for Business Model Innovation and Modelling for Rooftop Solar prosumer communities of the SCCER CREST Research Program, Work package Leader for the socio-economic integration of decarbonization solutions of heating and cooling of the SWEET DeCarbCH Research Program	Lecturer and Research Group Leader at ZHAW Institute of Sustainable Development; Doctor of oeconomiae of the University of St. Gallen, Advanced Studies on Leadership

Team Members accountability and experiences

Name	Key Competences	Reference projects	Education
Felix Pasila	Inventor and Patent registration, Innovation management, Technology transfer leader.	Reference Project: Fast Charger for Electric Motor, Startup Indonesia; Motion Simulator based on Artificial Intelligence, Research Grant, Indonesia; Integrated Circular Maritime Economy Feasibility Study, Lombok, Indonesia; Prove of Concept Project in Electrical Vehicle Ecosystems, Bali, Indonesia	PhD Degree in Robotics, University of Bologna, Italy; MSc Degree, Information and Automation Engineering, Bremen University, Germany; BSc in Electrical Engineering, ITS Surabaya, Indonesia
Roche Alimin	Mechanical and material design, Manufacturing process, R&D Project leader.	HVAC consultant for building, Industrial automation designer.	B.Sc. in Mechanical Engineering, Petra Christian University, Surabaya; M.Eng. in Mechatronics, Asian Institute of Technology, Bangkok.
Hazmi Rahman	Boat design and construction, Boat testing & validation, Marine compliance and standards.	Salvage of grounded and sunken ships and barge, Underwater works and survey.	B.Eng. in Naval Architecture and Shipbuilding Engineering, Institut Technology Surabaya (ITS), Surabaya, Indonesia.
Denny Gultom	Solar panel integration, Electrical design, Drive controls and programming,	Schlumberger Project Manager for ExxonMobil PNG (Melbourne - Australia)	Vocational Degree in Electronics, Politeknik Elektronika Negeri Surabaya.
Aleh Suhendro & team	Boat making, Fishermen, Member of Fisher union in Puger.	Production of conventional boats in Puger	Senior High School in Jember, East Java.
Suksmoadji	Site Manager, Community development	Project manager in solar cell research in Rumah Inovasi Pasila.	B.A. in Economy, 17 Agustus 1945 University; M.A. in Missiology, STTII, Surabaya.
Frans Limbong	Boat certification & registration.	Community Outreach Program at Kediri, Kupang, Mojokerto. Survey and management disaster of tsunami and earthquake in Banyuwangi, Jember, Lumajang, and Malang Selatan.	B.Sc. in Mechanical Engineering, Petra Christian University; M.A. in Public Policy, Brawijaya University.