ENVIRONMENTAL, ANIMAL AND PUBLIC HEALTH EFFECTS OF DIESEL: A PHOTOVOLTAIC RENEWABLE ENERGY AS AN ALTERNATIVE TO THE CONVENTIONAL DIESEL SYSTEM TO PUMP WATER IN SHRIMP FARMS OF ECUADOR FOCUSED ON REDUCING CARBON DIOXIDE EMISSIONS

Génesis Solórzano, Lisett Herrera, Marcelo Pozo Escuela Politécnica Nacional, Quito-Ecuador.

HIGHLIGHTS

Shrimp farms are ground areas with ponds filled with seawater where shrimp is grown. They are situated in mangroves and estuaries in the coastal area of Ecuador. Mangroves are essential ecosystems and habitat of many aquatic organisms. Additionally, mangroves store Carbon (C) in the biomass in its deep sediments



SHRIMP FARM	AREA (ha)	NUMBER OF PUMPS	CALCULATED PUMP POWER (THEORETICAL) (hp)	CALCULATED ENGINE POWER (THEORETICAL) (hp)	EXCESS OF DIESEL CONSUMPTION	COST OF EXCESS FUEL CONSUMPTION	TOTAL CO2 EMISSIONS (CO2 TONS/YEAR)	EXCESS OF CO2 EMISSIONS (CO2 TONS/YEAR)
Α	728	5	229 (280)	306 (338)	27.988	\$25.209	4.069	277
		2	144 (200)	218 (275)	20.967	\$18.885	1.395	207
		3	310 (400)	417 (425)	0	0	3.070	0
В	900	5	228 (280)	305 (338)	27.988	\$25.209	4.069	277
		4	180 (180)	240 (338)	62.569	\$56.356	2.790	619
		5	323 (400)	422 (425)	0	0	5.116	0
C	304	3	200 (240)	269 (338)	30.231	\$27.229	2.093	299
D	1.495	2	180 (300)	242 (338)	36.498	\$32.874	1.628	361
		4	402 (550)	534 (550)	0	0	5.479	0
		4	180 (180)	241 (338)	62.569	\$56.356	2.790	619
		2	119 (180)	181 (275)	53.392	\$48.091	1.395	528
		1	230 (280)	309 (338)	5.598	\$5.042	814	55
	·	5	219 (240)	294 (338)	30.135	\$27.143	4.069	298
E	550	1	227 (230)	266 (275)	0	0	897	0
		1	228 (230)	266 (275)	0	0	897	0
		1	205 (210)	235 (235)	0	0	749	0
F	980	2	215 (230)	250 (275)	15.638	\$14.085	1.794	155
		1	205 (210)	235 (235)	0	0	749	0
G	465	2	228 (230)	275 (275)	0	0	1.794	0
		2	214 (230)	244 (245)	0	0	1.628	0
				TOTAL	373.573	\$ 336.479	47.285	3.695

Table 1 Oversizing Results

Total Excess 3.696 CO2 tons/year

CO2 EMISSIONS

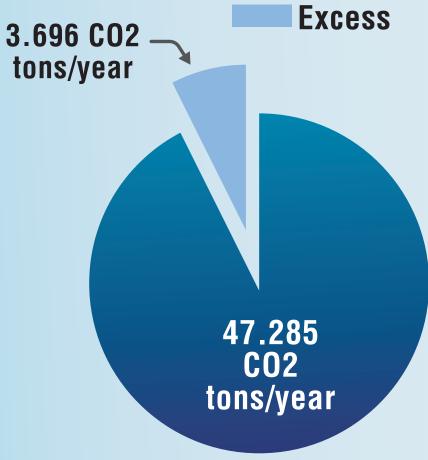


Fig. 1 CO2 emissions of oversizing

Pumping is one of the most important processes within the shrimp production. It aims to renew water, fill and aerate pools. These pumps work each day and during the whole year. Most of the diesel used in shrimp production (84%) [1] is used in this process. It leads to a high diesel consumption and negative impacts to the environment due to CO2 emissions [2]. Moreover, diesel constituents have been found in wetlands at levels exceeding limit values. They affect water quality and health of aquatic organisms (algae, rainbow trout, flounder, grass shrimp) with detrimental impacts by impairing immune function and increasing susceptibility to pathogenic bacteria. Diesel constituents are considered endocrine disrupting chemicals (EDCs) associated with diseases such as autism, obesity and diabetes

OBJECTIVES

Reduction of the use of diesel fuel. Reduction of the CO2 emissions.

This project analyses 7 shrimp farms which are rated by their size as: Big (250-1000 ha) and Special (>1000 ha). These ones require high power pumps between 235hp to 550hp, thus high diesel consumption. Two important aspects were studied in this project, the first one is based on a hypothesis of a potential oversize in water pumps that are actually used in the farms and which would mean an excess of CO2 emissions to the environment. Additionally, the second aspect is to propose a photovoltaic renewable energy alternative to the conventional pumping system within one shrimp farm of the sample. This alternative replaces diesel pumps with electric pumps which are fed of solar energy. This option would avoid the use of diesel and the CO2 emissions associated to this process.

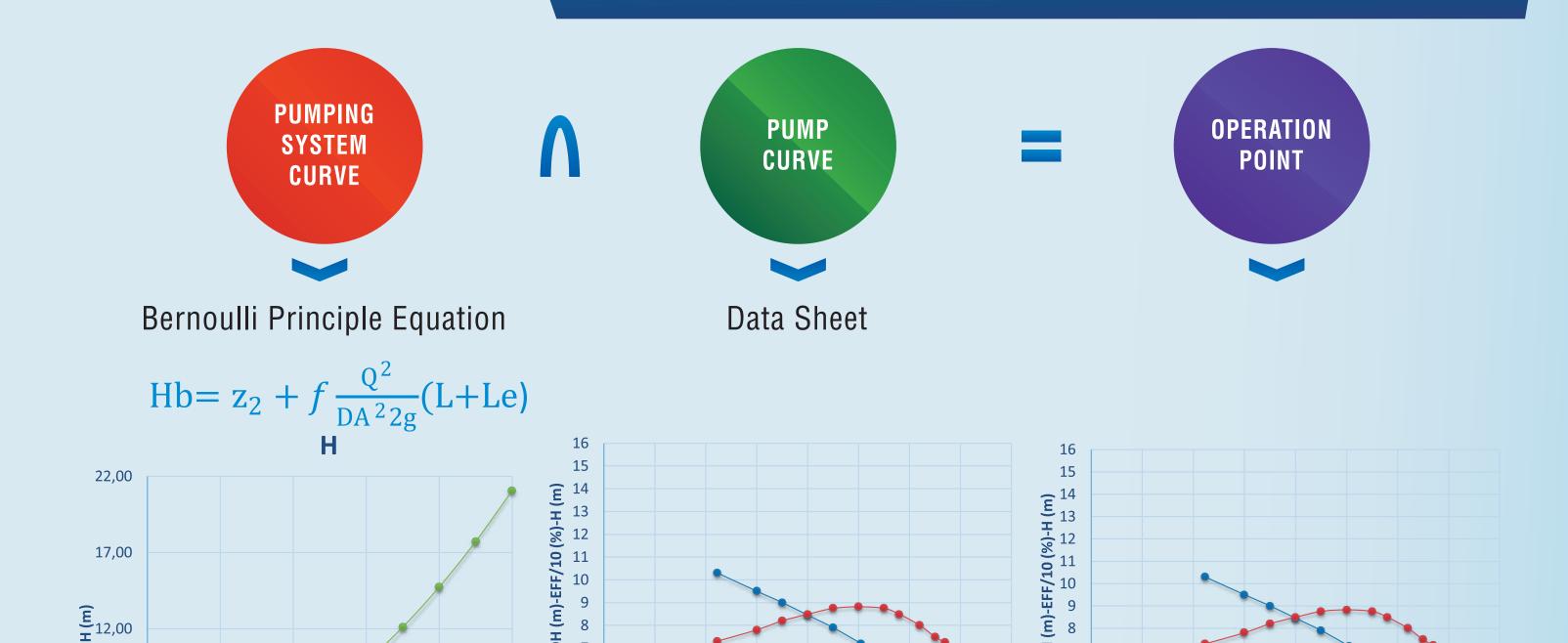
REFERENCES:

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PROPOSAL 1:

Decrease the Oversizing and Improve the Operation Point



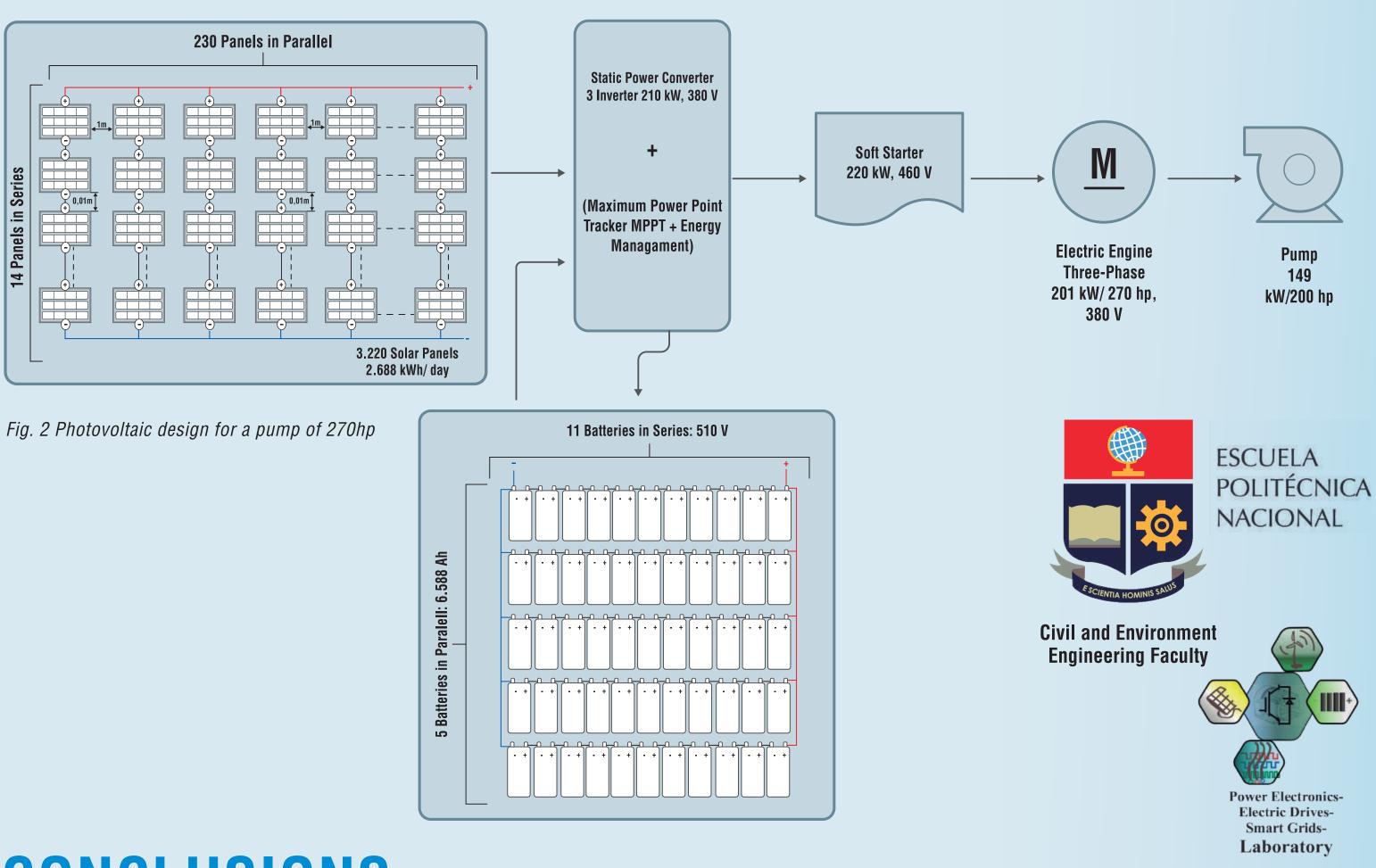
PROPOSAL 2:

7,00

Decrease the CO2 emissions by means of an electric pump-engine system fed by photovoltaic energy

Operation

— TDH (m) — EFF — Hb



CONCLUSIONS

- To avoid that there is an oversizing of the power required for the motor-pump in the pumping stations, a detailed study of the real hydraulic requirements should be made of the farms.
- By using the proposed photovoltaic pumping system, we avoid the emission of 13,960 tons of CO2 generated by a 200 HP pump and a 270 HP engine for 20 years. The cost of implementation of this system is \$4,410,905.51.





Dr.-Ing. Marcelo Pozo P.