

ASSESSMENT OF A BUSINESS MODEL FOR POWER EXCHANGE BETWEEN VESSELS AND ASHORE ELECTRICITY DISTRIBUTION NETWORK

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Background

- The international shipping shows a strong interest to supplying of vessels with electricity from the ashore distribution network (so-called "cold ironing")
- Today's solutions are not-standardised and have limited transmission capacity
- The connection is very time and labour consuming and does not meet the LNG safety requirements

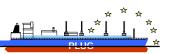




PLUG

Power Generation During Loading and Unloading (PLUG) Specific Targeted Research Project (STREP) in the FP6

- The main objective is to develop and put on the market a standard physical power interface between cargo vessels and electricity distribution network at harbour terminals
 - The specifications:
 - Establishment of the connection: 15 minutes
 - Safe emergency release in less than 60 seconds
 - 8 MW / 6600 V capability for cold ironing, scalable to up to 25 MW for power generation towards the shore
 - Watertight (20 m) connector when disconnected
 - Seamless transfer between on board and on shore supply

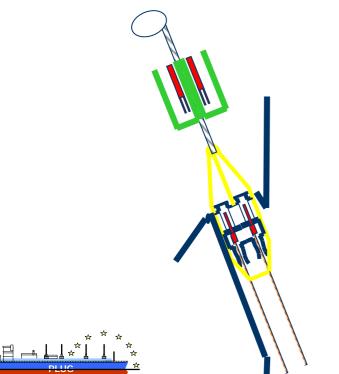


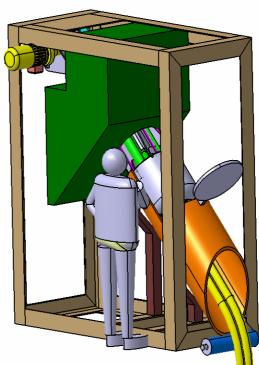
The project partners

Partner	Country	Responsibility in the project
Snecma	France	Project coordinator
Converteam S.A.S	France	Electrical architecture
WAVESPEC Limited	United Kingdom	Crew and terminal operation procedures
SINTEF Energy Research	Norway	Demonstrator "link to the market "
Stäubli SCA	France	High voltage /high power connector
Leduc	France	Demonstration tests

The technical concept

- Use vessel's generators to feed power into the local electricity distribution network
- Use local network to supply the vessel's electricity demand during loading/unloading





List of assumptions for the development of the Business Model

- None or minimum modifications, to the existing rules, regulations and information exchanging routines are required
- Creation of preferably none or minimum new market actors
- The existing actors will continue to carry out their core functions

Example of power exchange



Refers to Melkøya terminal in the Northern Norway (50-60 shipments pr. year)

- Uses data for LNG carriers, which are planned for operation at Melkøya
- Refers in general to rules, regulation and pricing for Norway



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Value

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LEGEND

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Segment Activity Interface exchange object port Central grid DSO tariff TS0 Metering and Billing Electricity transport **Balancing** services and distribution and access to MO 5 1.1 the cenral grid 5 Balancing Operation of services the market metering metering The networDistribution tariff tariff ton (consu tarift services (consumption) -AY **Business** v FC Model Electricity Electricity Electricity Payments Consumption Generation Consumption (e3value) electricity electricity consumption (consumption) ayment payment payment payment Purchased and electricity sold electricity fuel (feeding) FS EB Supplying Purchasing and a fuel selling electrcicity www.e3value.com Scenario Start End AND fork OR fork stimulus path stimulus LEGEND

Value

Market

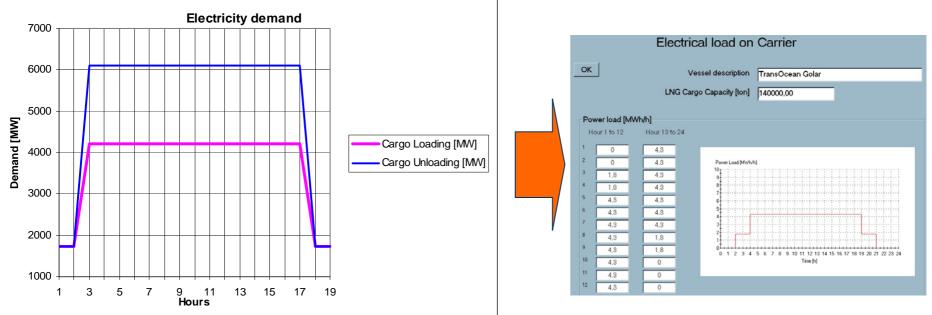
The Demonstrator

	rs Electrical lo	ad data	Contract data Emissions	Tariffs	Simulate
eal-time data ower exchange	0,00	MW	Simulation period status Marg. production price	0,00	€/MWh
ccumulated energy	75,30	MWh	Market power price	37,92	€/MWh
ime	00:00	h	Av. power exchange	3,14	MW
ower Consumption	0,00	MW	Total hours	24	h
			Pov	sel consumption MW ver exchange MW uumulated Transmission	

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Input data to the simulation

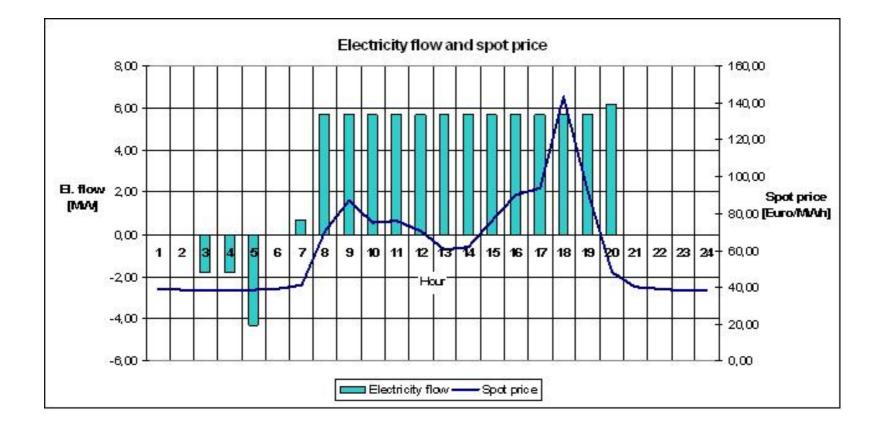
- Generator data (availability, capacity, production costs)
- Electrical Load (own)
- Contract data (prices for 24 hours, direct download or manual)
- Distribution network tariff data
 - Emission data (the generation mix onboard and ashore)

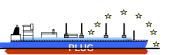


Input data: Generation Specificaiton

	Generator	s specification					
ОК	Generators	Generator 1					
	Capacity [MW]	5					
	Production cost [€/MWh]	40					
	Generator production cost		Production c	apacity check list			
	Production price [€/MW/h]		Hour	Gen1	Gen2	Gen3	Connection
	60T		1	Active	Active	Active	Active
	50		2	Active	Active	Active	Active
			3	Active	Active	Active	Active
	40		4	Active	Active	Active	Active
	30		5	Active	Active	Active	Active
	-		6	Active	Active	Active	Active
	20		7	Inactive	Active	Active	Active
	10		8	Inactive	Active	Active	Active
	10		9	Inactive	Active	Active	Active
			10	Inactive	Active	Active	Active
	0 1 2 3 4 5 6	7 8 9 10	11	Active	Active	Active	Active
	Production volume [MWh]		12	Active	Active	Active	Inactive
			13	Active	Active	Active	Inactive
			14	Active	Active	Active	Inactive
	Generator production cost		15	Active	Active	Active	Inactive
			16	Active	Active	Active	Inactive
			17	Active	Active	Active	Active
	Production capacity [MWh/h]		18	Active	Active	Active	Active
	⁴⁰ T : : : : : : : : : : : : : : : : : :		19	Active	Active	Active	Active
			20 21	Active Active	Active	Active	Active Active
			22	Active	Active	Active	Active
			22	Active	Active	Active	Active
	20		23	Active	Active	Active	Active
	10 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 1 How	6 17 18 19 20 21 22 23 24					

Example of 24-hours simulation





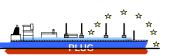


Input data for a one-year long simulation

- Historical electricity prices for Hammerfest in 2006
- 73 calls in the harbour pr year with 19 hours duration
- Historical distribution network tariffs for 2006 (disconnectable consumption and feeding)
- Historic generation costs:
 - 30 Euro/MWh for the generator with 5 MW capacity
 - 35 Euro/MWh for the generator with 3 MW generation capacity
 - 40 Euro/MWh for the generation with 2 MW generation capacity

The simulation results

Title	Value
Electricity export from the Vessel to the electricity market ashore	7.703,90 MWh
Electricity import from the electricity market ashore to the Vessel	8,60 MWh
Gross revenues for the electricity export	396.724,83 Euro
Fuel costs for the exported power	270.654,00 Euro
Network tariff costs for feeding and consumption	2.760,86 Euro
Total expected incomes pr year	123.309,97 Euro



Conclusions, limitations and discussion

- Surprising results: it would be fairly profitable to export surplus electricity generation from a vessel to the conventional electricity market ashore
 - Low fuel prices in 2006
 - High distribution network tariffs for the consumption
- Limitations in the present tariff structure
 - The existing capacity charge is simply prohibitively high for this type of consumption
 - Need for a special tariff for a two-way connection
- Uncertainty about the present legislation



The End

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