Interreg
EUROPEAN UNION
Danube Transnational Programme
GRENDEL

Development of innovative and greening inland vessel concepts

FLUVIUS

GRENDEL Final Event
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Greening! What to do first?

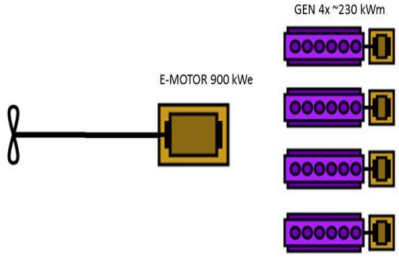
- **Made a brainstorming at start of project and following issues found to be investigate:**
- **1. change of main engines?**
- **2. hybrid ship, diesel-electric ship?**
- **3. greening of auxiliary power generation?**
  - a) solar panels
  - b) developing performance optimized electric system with phase correction devices
- **4. Hull conversion?**

- We carried out environmental survey for the fleet: Air loads (emissions), water pollution, wastewater generation, noise and vibration protection, waste management, energy management, material flow, hazardous material use, total emissions – surveyed the total ecological footprint

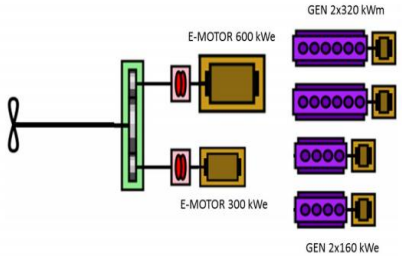
1. Modern engines (+ higher cargo carring capacity) versus old engines fuel consumption

	2018			
ship	**tokm**	**bunker (liters)**	lit/tokm(1000)	**extra consumption**
Elsava	19 631 394	196 059	**9,99**	144%
Johanna	20 336 803	257 587	**12,67**	183%
Ulm	16 761 717	167 003	**9,96**	144%
Melanie H	16 339 371			
SL Melanie	16 313 860			
SL 1043	1 643 814			
SL 1433	624 178			
54 barge (Melanie H)	6 980 324			
997 barge (Melanie H)	10 684 399			
	52 585 946	364 925	**6,94**	100%
modern truck	***2400***	***33***	***13,75***	

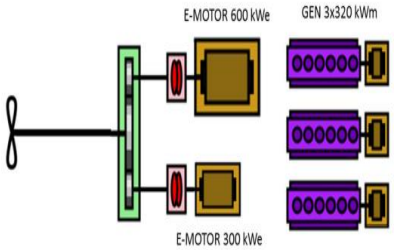
2. Diesel-electric and hybrid layouts



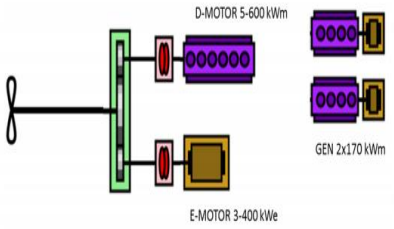
11. ábra: A DE1 hajtásrendszer sémája



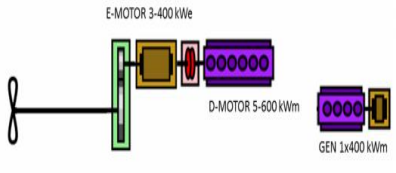
12. ábra: A DE2 hajtásrendszer sémája, A változat



13. ábra: A DE2 hajtásrendszer sémája, B változat



14. ábra: A HIBRID hajtásrendszer sémája, A változat

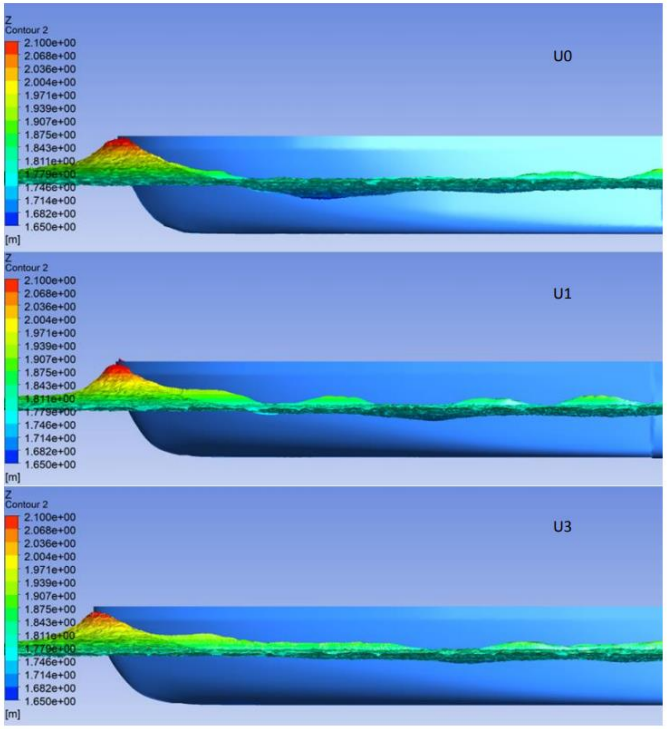


15. ábra: A HIBRID hajtásrendszer sémája, B változat

3. Optimizing electric system

	MS ELSAVA	MS ULM	MS JOHANNA	MS MELANIE-H
calculated yearly electric consumption now	34 485	32 958	63 230	15 984
development of engine type eletric usage	13%	25%	3%	22%
development of lighting system	‹1%	‹1%	‹1%	‹1%
development of heating, cooling, water supply system	25%	27%	38%	18,7%
estimated yearly consumption after development (KVAh)	21 380	15 813	37 308	9 749
decrease of yearly consumption after development %	62%	48%	59%	61%
auxiliary engines consumption % of total, now	19%	12%	12%	12%

4. MS Ulm hull conversion



Findings on hull conversion:

1. **Either cargo carriing capacity decrease or ship should be extended to make better hydrodinamic bow**
2. **There is no significant difference at draft of 1,8 or 2,3 meters**
3. **Ideal floating circumstance is at 5m water depth (????)**
4. **If structure of the ship will be changed, it must be under register company's approval**
5. **Change of bow might bring 15% decrease in output needs, but it does not mean automatically same spare in fuel**

Results:

1. change of main engines

   possible reduction in bunker consumption abt 10%, which means reduction in quantity of exhaust gases.

2. hybrid ship, diesel-electric ship,

   very expensive idea for reconstructing an old ship, only in case of hybrid ship might find some advantage, when passing habited area, accu stored electricity enough for abt 1 hour slow steaming/manouvering, any layout is too large for MS Johanna's engine room, no spare in bunker (even +), only if batteries charged from other source

3. greening of auxiliary power generation with solar panels and developing performance optimized electric system with phase correction devices,

   can reduce total consumption of a vessel with upto 7%, low investment cost, fast return on investment.

4. Hull conversion,

   reduction in fuel consumption (not 15%)

1. Installation of solar panels concept (MS Melanie)

- **Investment cost: 200 322,22 EUR +VAT**
- **GBER Article 36:**
  - The aid intensity shall not exceed 40 % of the eligible costs
  - It may be increased by 20 percentage points for aid granted to small undertakings like FLUVIUS
- **Grant amount requested: 118 393,33 EUR**
- **Aid intensity: 59%**
- **Internal financial rate of return: 33%**
- **The implementation of the project does not require additional resources**

2. Hibrid propulsion vessel concept (MS Johanna)

- **Investment cost: 1 319 625,41 EUR +VAT**
- **GBER Article 36:**
  - The aid intensity shall not exceed 40 % of the eligible costs
  - It may be increased by 20 percentage points for aid granted to small undertakings like FLUVIUS
- **Grant amount requested: 352 575,25 EUR**
- **Aid intensity: 27%**
- **Internal financial rate of return: -3%**
- **The implementation of the project does not require additional resources**

3. Hull conversion concept (MS Ulm)

- **Investment cost: 281 000 EUR +VAT**
- **GBER Article 38 Investment aid for energy efficiency measures:**
  - The aid intensity shall not exceed 30 % of the eligible costs
  - It may be increased by 20 percentage points for aid granted to small undertakings like FLUVIUS
- **Grant amount requested: 88 000 EUR**
- **Aid intensity: 31%**
- **The implementation of the project does not require additional resources**

4. Main engine replacement concept (MS Elsava)

- **Investment cost: 732 000 EUR +VAT**
- **GBER Article 36:**
  - The aid intensity shall not exceed 40 % of the eligible costs
  - It may be increased by 20 percentage points for aid granted to small undertakings like FLUVIUS
- **Grant amount requested: 349 200 EUR**
- **Aid intensity: 48%**
- **Internal financial rate of return: 2%**
- **The implementation of the project does not require additional resources**

5. Electrical network renovation concept (MS Johanna)

- **Investment cost: 59 605,41 EUR + VAT**
- **GBER Article 36:**
  - The aid intensity shall not exceed 40 % of the eligible costs
  - It may be increased by 20 percentage points for aid granted to small undertakings like FLUVIUS
- **Grant amount requested: 34 368,66 EUR**
- **Aid intensity: 58%**
- **Internal financial rate of return: 348%**
- **The implementation of the project does not require additional resources**

Lessons learnt by Fluvius:

1) **Such a complex, comprehensive environmental survey has not been carried out for the fleet before: Air loads (emissions), water pollution, wastewater generation, Noise and vibration protection, waste management, energy management, material flow, hazardous material use, total emissions - ecological footprint**

2) **Old engines (carbon) emission values are not dramatically different from the Stage5 engine (No_x are higher) according to new engines datasheet?**

3) **In 2020 stage5 engines does not exist by their own, exhaust gas treating equipment must be added**

4) **The price of the exhaust treater system is almost the same (90%) as the price of the main engine**

5) **Ulm hull design: too expensive investment for uncertain result**

6) **Installing a phase corrector is a must on all ships**

7) **Installation of solar panels feasible, technically possible, we would do it on our vessels**

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Photo: © NAVROM

GRENDEL “Green and efficient Danube fleet”

Towards modernisation & greening of Danube inland waterborne sector and strengthening its competitiveness

www.interreg-danube.eu/grendel

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