Co-financed by the European Union
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Real – Time Energy Consumption Monitoring System

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Green Technologies and Eco-Efficient Alternatives for Cranes and Operations at Port Container Terminals

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- Container terminal machinery and energy balance
- Planning the prototype
- Installation and programming: Challenges of an ad-hoc system
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- Conclusion and future challenges

Introduction – Port of Koper/ Container Terminal, key facts

- Quayside 596 m
- Max. allowed draft – 11.4m
- Berths: 3
- Railway tracks: 2x 671m, 1x 647 m, 2x 270 m
- Total terminal area: 270,000 m2
- Storage capacity: 26,500 TEUs (full & empty)
- Est. total annual capacity: 750,000 TEUs

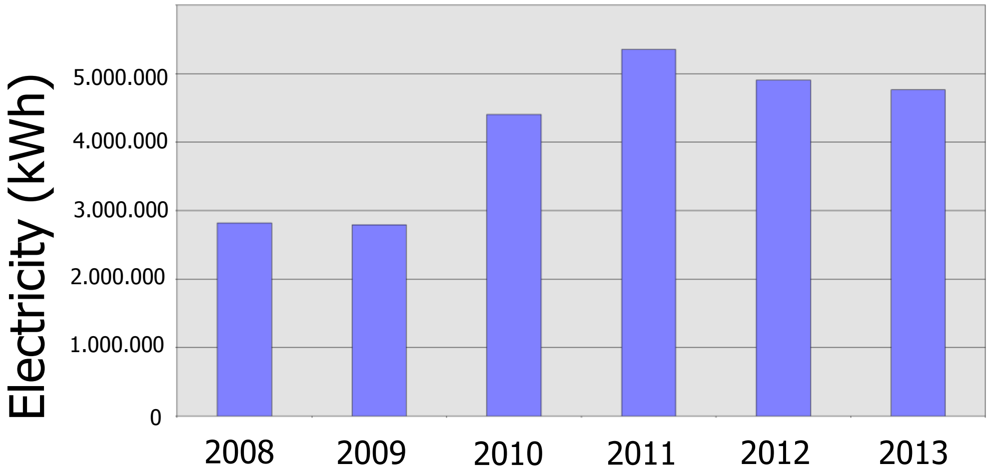
Green Cranes

Container terminal machinery

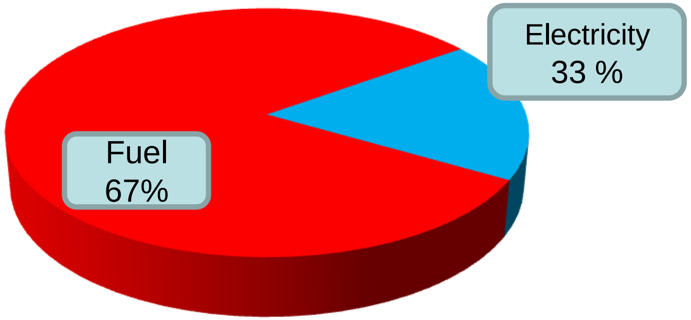
	Lift capacity (in tonnes)
▪ 4x STS panamax cranes	40/45 under spreader
▪ 4x STS post-panamax cranes (outreach 51m)	51/65 under spreader
▪ 16x rubber-tyred G/C (storage area)	40
▪ 2x rubber-tyred G/C (railway tracks)	40
▪ 11x reach stackers	42 - 45
▪ 7x ECH – empty container handler	7 - 9
▪ 46x yard trucks and 49x trailers	
▪ 3x tugmaster (tractor)	25 (on 5th wheel)

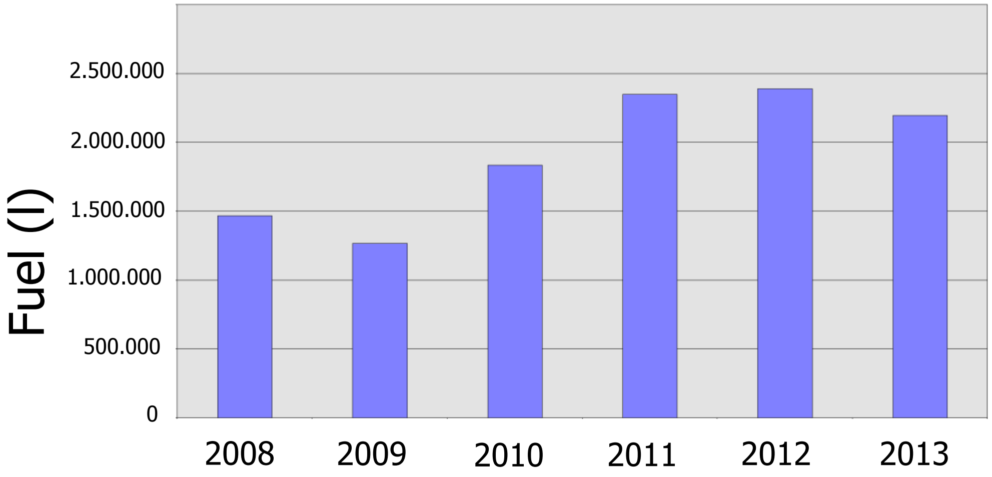
Container terminal energy balance

Energy balance:

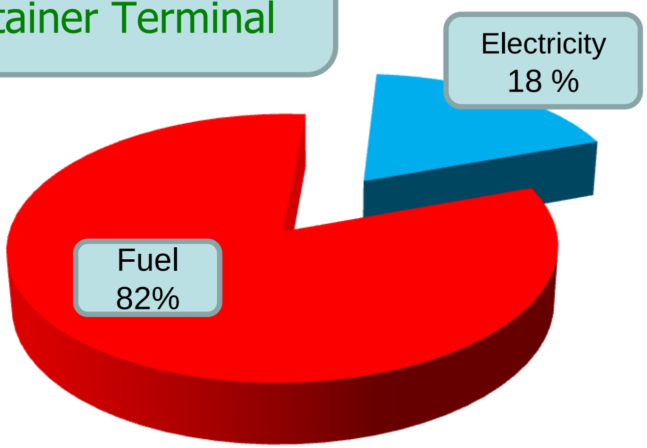


Energy in 2013; Port of Koper: Fuel and Electricity

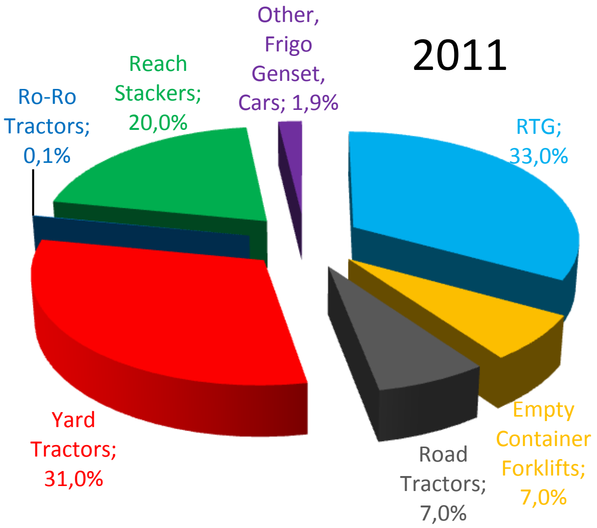


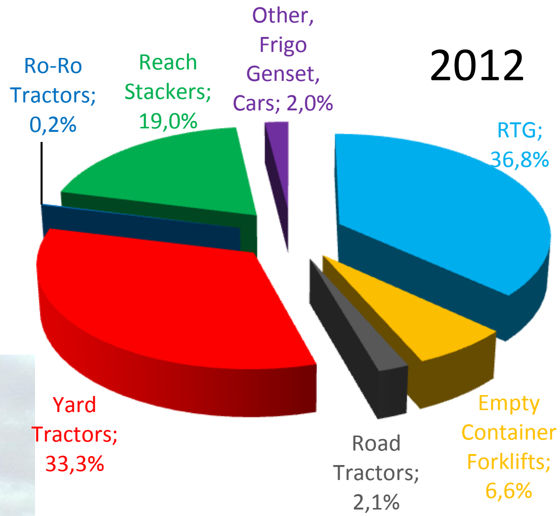


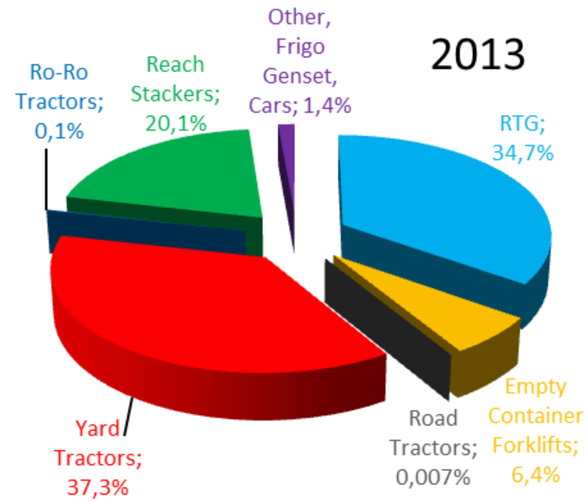
Consumption on the Container Terminal



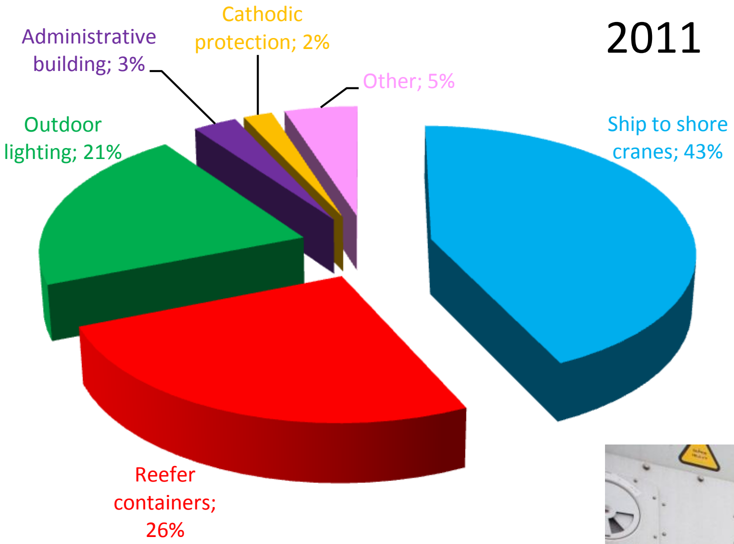
Container terminal energy balance (2)

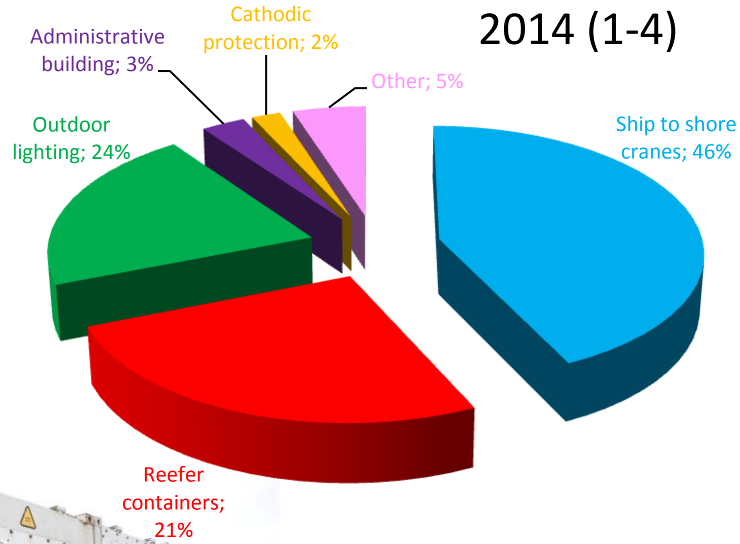


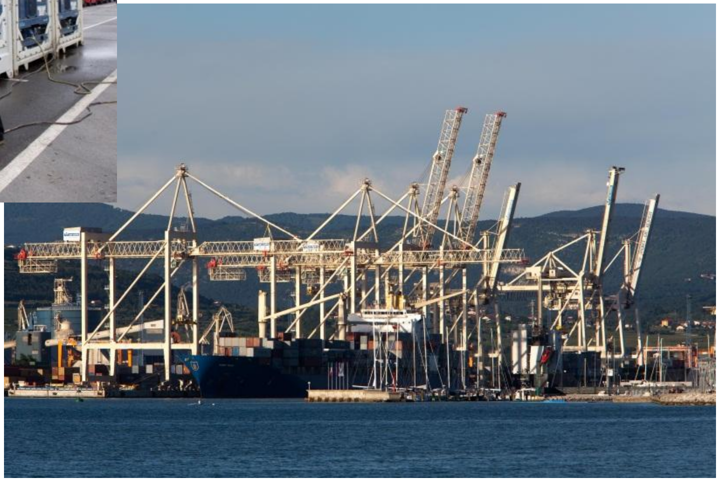




Container terminal energy balance (3)



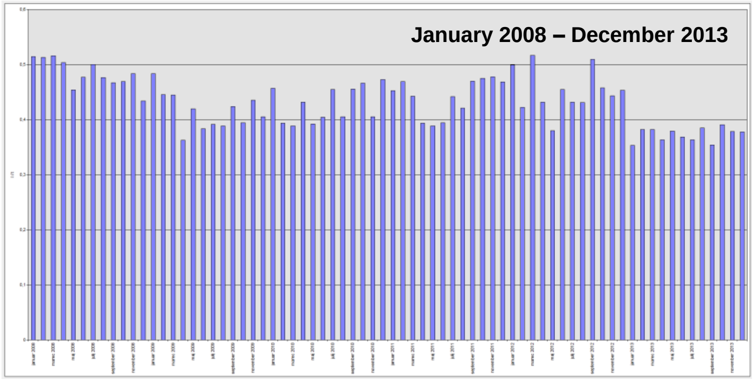




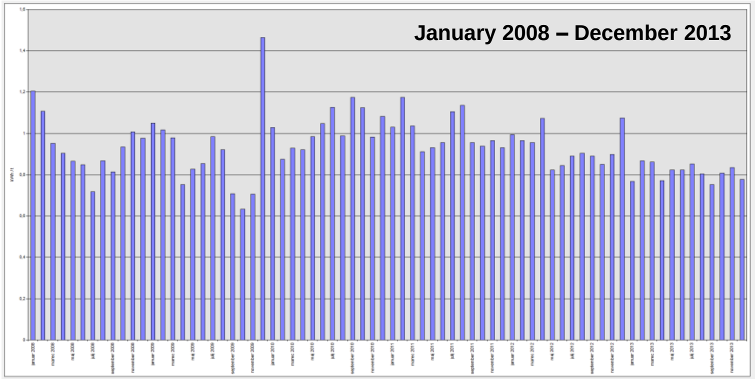
Container terminal energy balance (4)

2011	Consumption	Unit	TJ	GWh	CO_2 emissions T	Cost EUR	Specific price EUR/MWh	Specific price EUR/GJ
Container terminal								
Electrical energy	5.350.325	kWh	19,26	5,350	2.943	447.199	83,6	23,2
Fuel	2.349.483	l	82,21	22,837	6.166	2.409.963	105,5	29,3
Water	4.174	m^3	-	-	-	7.886		
Total:			101,47	28,19	9.109	2.865.048		

2013	Consumption	Unit	TJ	GWh	CO_2 emissions T	Cost EUR	Specific price EUR/MWh	Specific price EUR/GJ
Container terminal								
Electrical energy	4.767.256	kWh	17,16	4,767	2.622	392.496	82,3	22,9
Fuel	2.193.889	l	76,76	21,325	5.758	2.465.698	115,6	32,1
Water	6.368	m^3	-	-	-	14.652		
Total:			93,93	26,09	8.380	2.872.846		



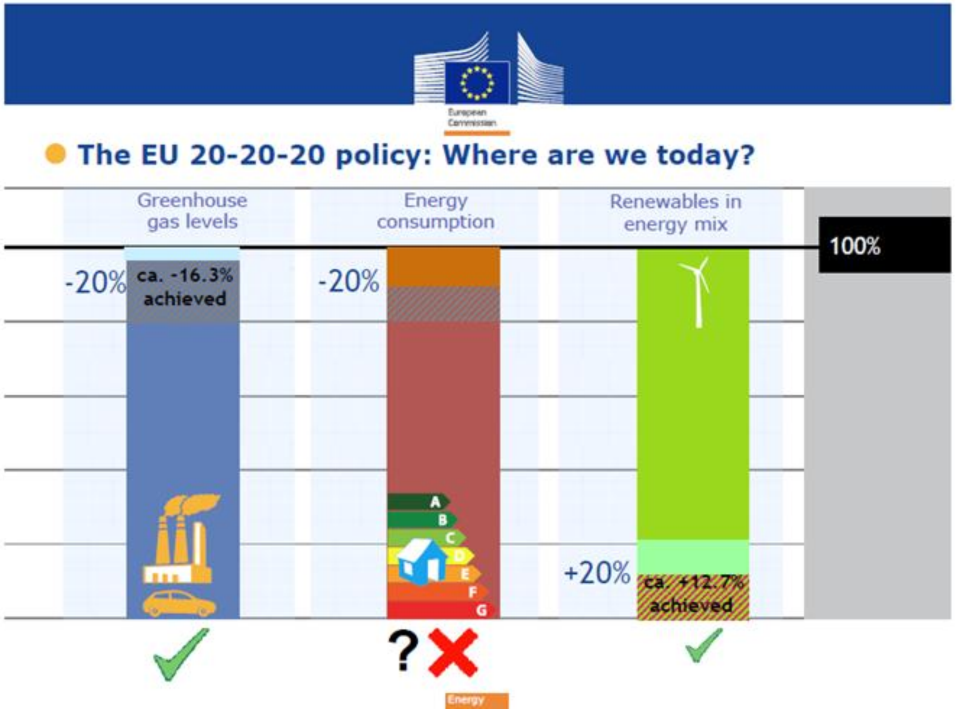
Specific fuel consumption



Specific electrical energy consumption

Role of the energy efficiency

- Despite huge policy efforts, the EU is far from reaching its 2020 energy savings target



- Projected gap in Mediterranean countries is even bigger (having in mind consequences of the economic and financial crisis)
- There is a need for **new, innovative, efficient and effective instruments and measures**

Role of the energy efficiency (2)

- There is a need for Integrated Performance Measurement System – **Energy and Environmental Management System** (EEMS)

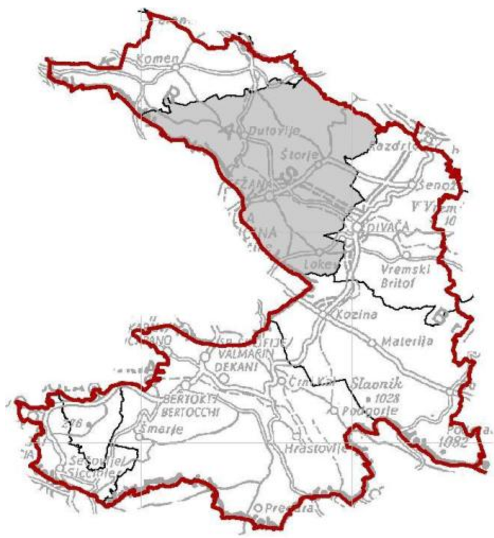
- Port of Koper sees **EEMS** as a tool for achieving targets and objectives related with the overall competitiveness through the **system of metering, monitoring, and evaluation of energy and environmental performance**

- Implementation in phases, bottom – up approach, in the first phase EEMS has been implemented on the Container Terminal

Alternative fuels and scenarios

Future opportunities: gas

- Alternative – fuel switch, use of the compressed natural gas or LNG instead of diesel fuel
- Natural gas network in the Obalno-Kraška (Coastal-Karst) region - current situation, no natural gas network (left) and expected future situation in 2020, new connection M6* (right)



* Source: Geoplin plinovodi, Družba za upravljanje s prenosnim omrežjem d.o.o. Razvojni načrt prenosnega plinovodnega omrežja za obdobje 2011 – 2020 (Razširjeni povzetek)

Alternative fuels and scenarios (2)

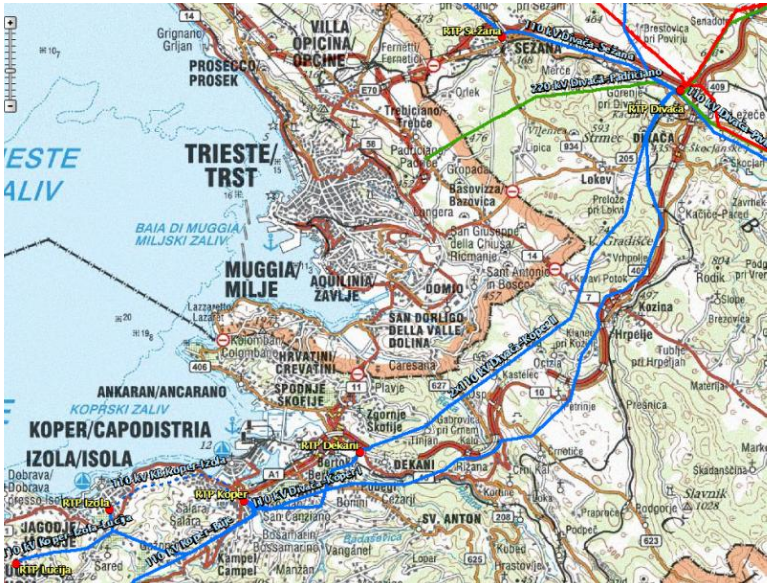
Future opportunities: electrification

- Another alternative – **Electrification of all operation at the Container Terminal**
- Excellent potential for the energy and environmental improvements
- In comparison with the current situation electrification can bring **energy savings** and **emission reductions** for **up to 80%**
- Significant noise level reduction
- Problem - Connection on the 110 kV grid:
  - High costs
  - Insufficient spatial planning – slow procedures

Alternative fuels and scenarios (3)

Future opportunities: electrification

- Two possibilities for the connection on the 110 kV grid – RTP Dekani and/or RTP Koper



- It is estimated (according to the initial consultation with system operator) that this connection can be realized in next 5 to 7 years (up to 2020)

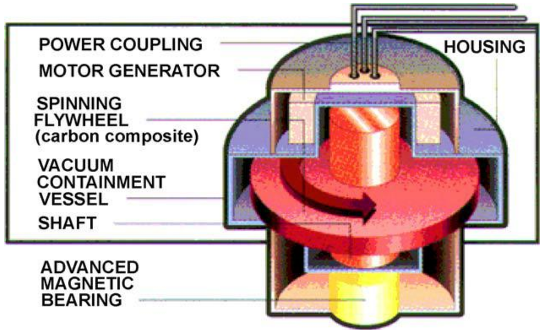
Alternative fuels and scenarios (4)

Case study: flywheel technology

Evaluation of the **flywheel technology** in the process of energy recovery and storage in a mobile gantry cranes

- Investigation of the energy recovery and storage technologies for electric power applications in ports – flywheel biggest potential for applicability on RTG cranes
- Already some implementations in transport/ports
- The main advantages of flywheel storage systems are the high charge and discharge rates for many cycles

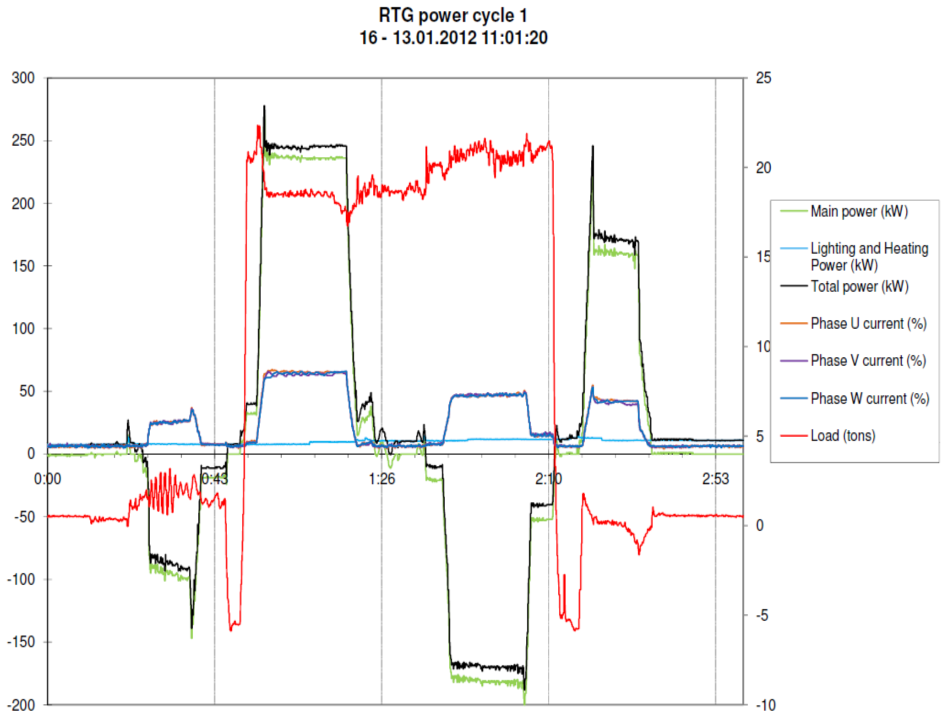
Main components of the flywheel storage system

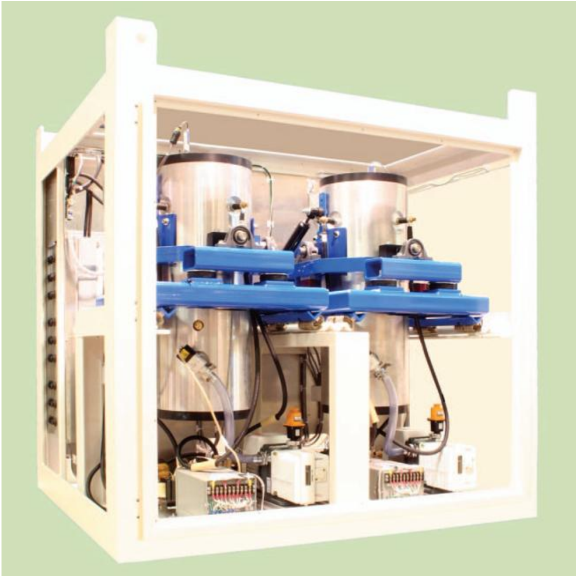


Alternative fuels and scenarios (5)

Case study: flywheel technology

When flywheels are used with an RTG crane, two units are employed; a single unit provides isolated energy storage to an individual hoist motor drive. The two units are packaged together and installed underneath a crane support beam.



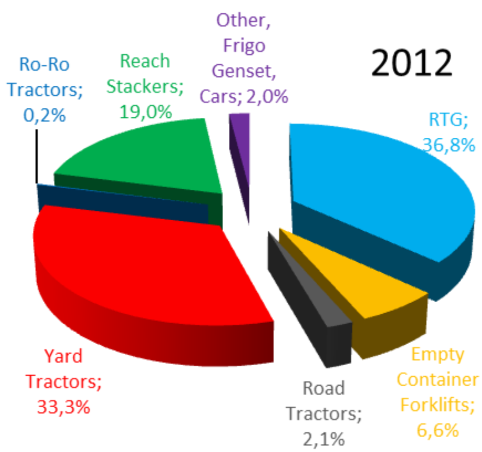


Alternative fuels and scenarios (6)

Case study: flywheel technology

- **RTG cranes – main consumers** of diesel fuel and major contributor of diesel emissions at the Port of Koper

- Cost benefit analysis:
  - Without genset change - ***not commercially justifiable***
  - with genset downsizing – ***payback period 7 – 10 years***

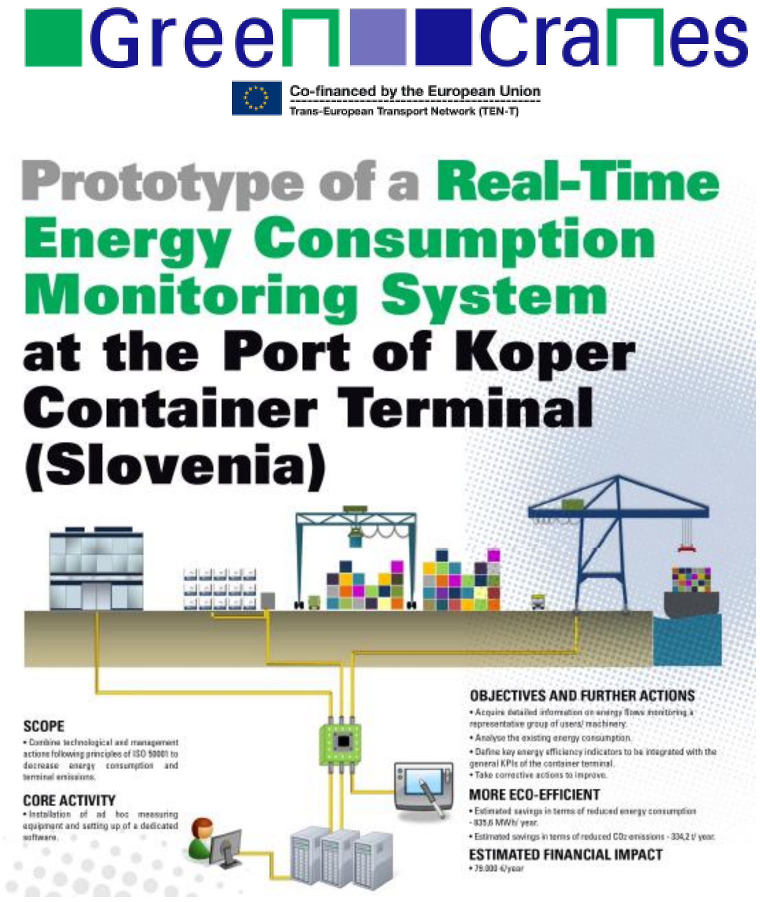


Planning the prototype

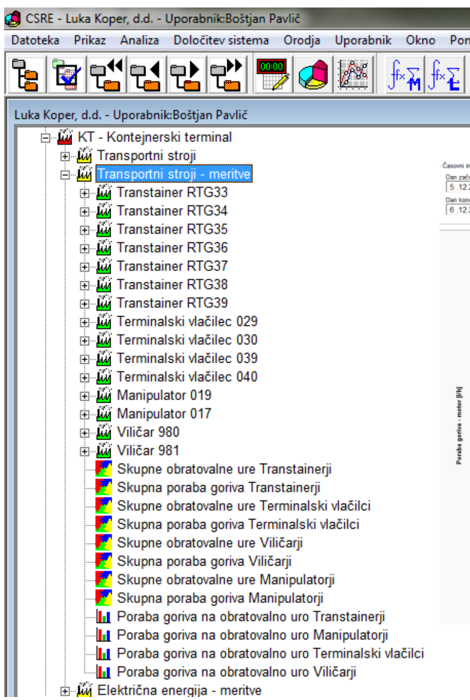
- Establishing a system for measuring fuel consumption in the transport machinery (10 meters)
- Establishing a system for detailed monitoring of electricity use (17 measuring points)
- Establishing a system of measurement and transmission of data on energy use from 7 RTG
- Integration of existing information systems to support energy management

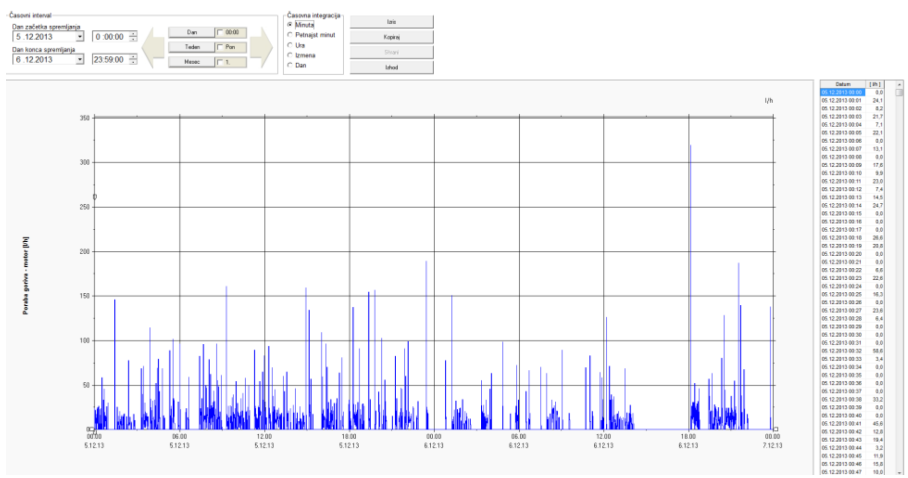
Objectives of the project:

- Clear definition of responsibilities and empowerment of workers, who operate machines and work on the shop floor, to achieve enduring performance improvements
- Introduction of new indicators (KPIs) that will accurately show the quality of the organization and work at the Container Terminal
- Preparation of methodology for the introduction of ISO 50001 at the Container Terminal



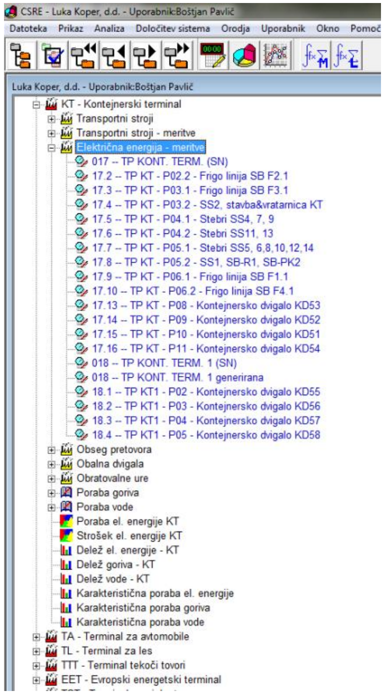
Installation the prototype - fuel

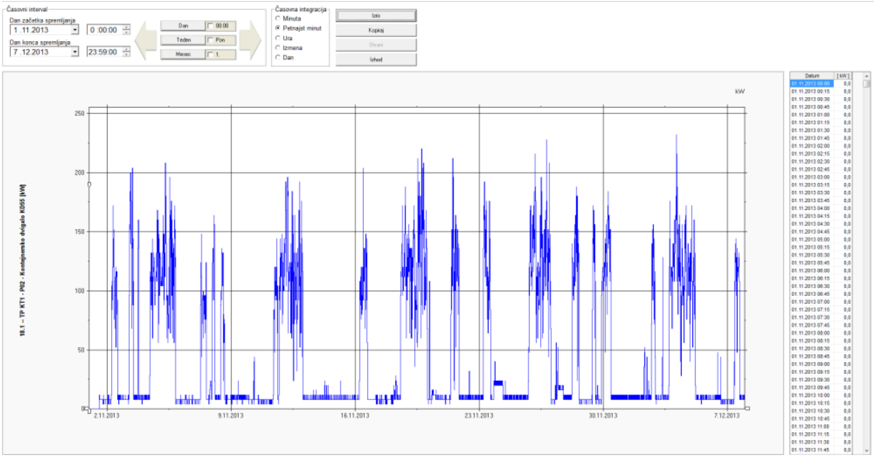




Fuel consumption (l) – minute level

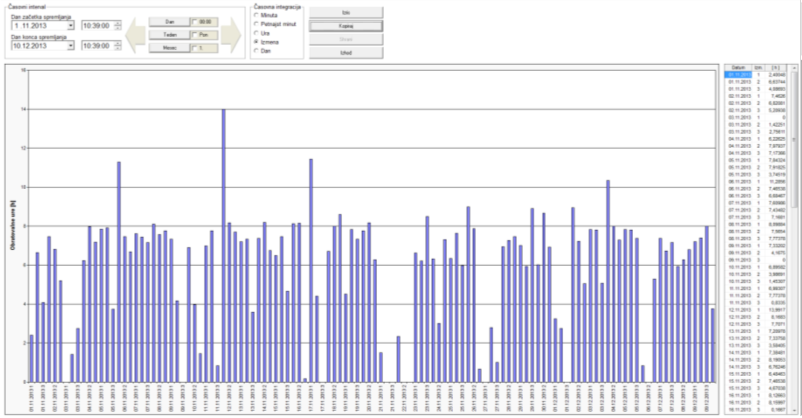
Installation the prototype - electricity



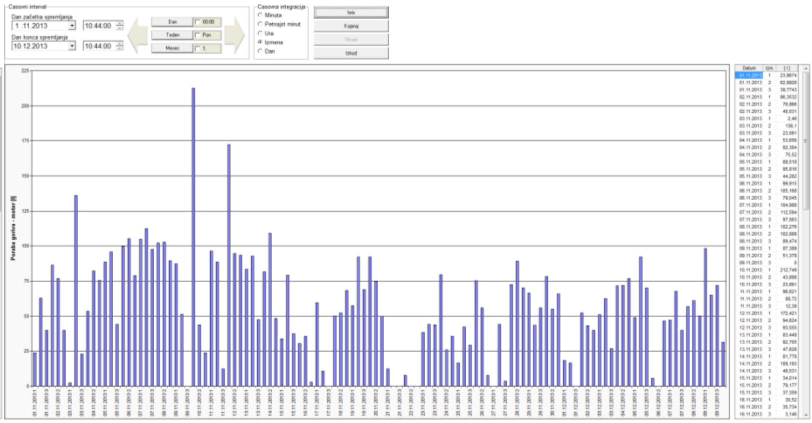


Installation the prototype – RTG data

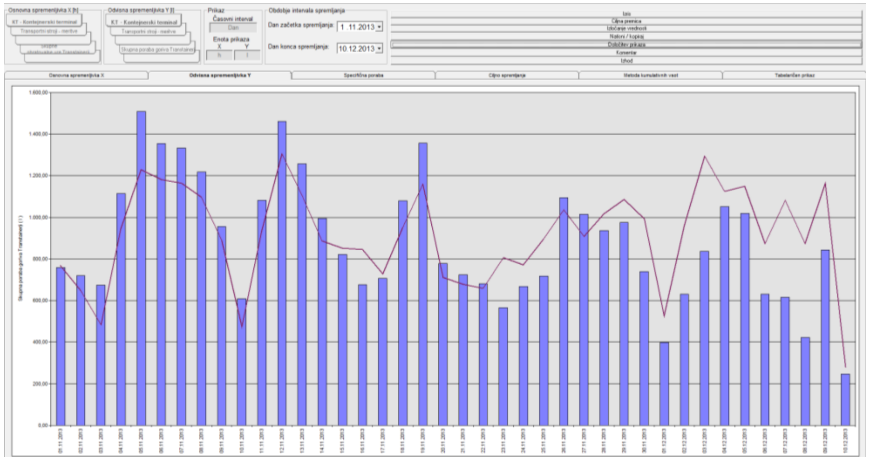
Production data on 7 RTG. Internal code RTG 33 - RTG 39



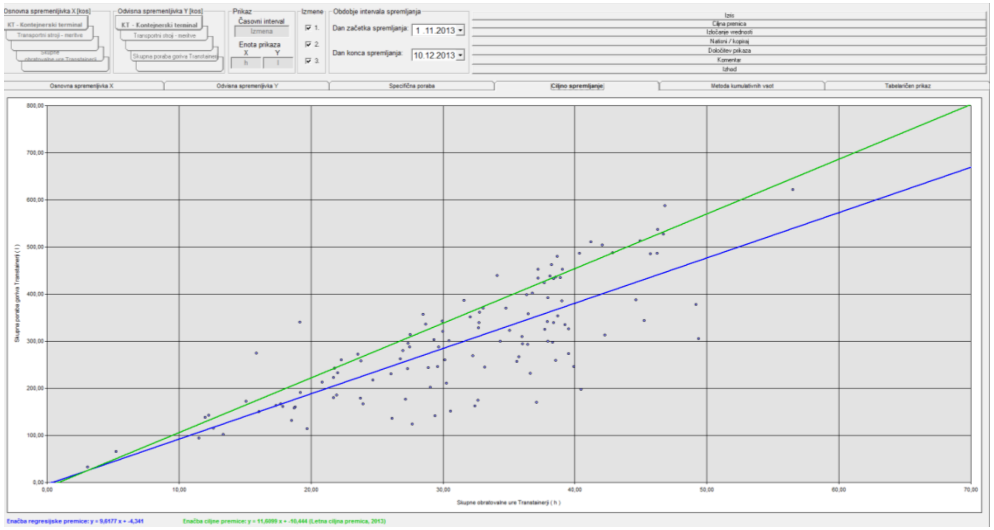
Effective operating hours (h)



Fuel consumption (l)

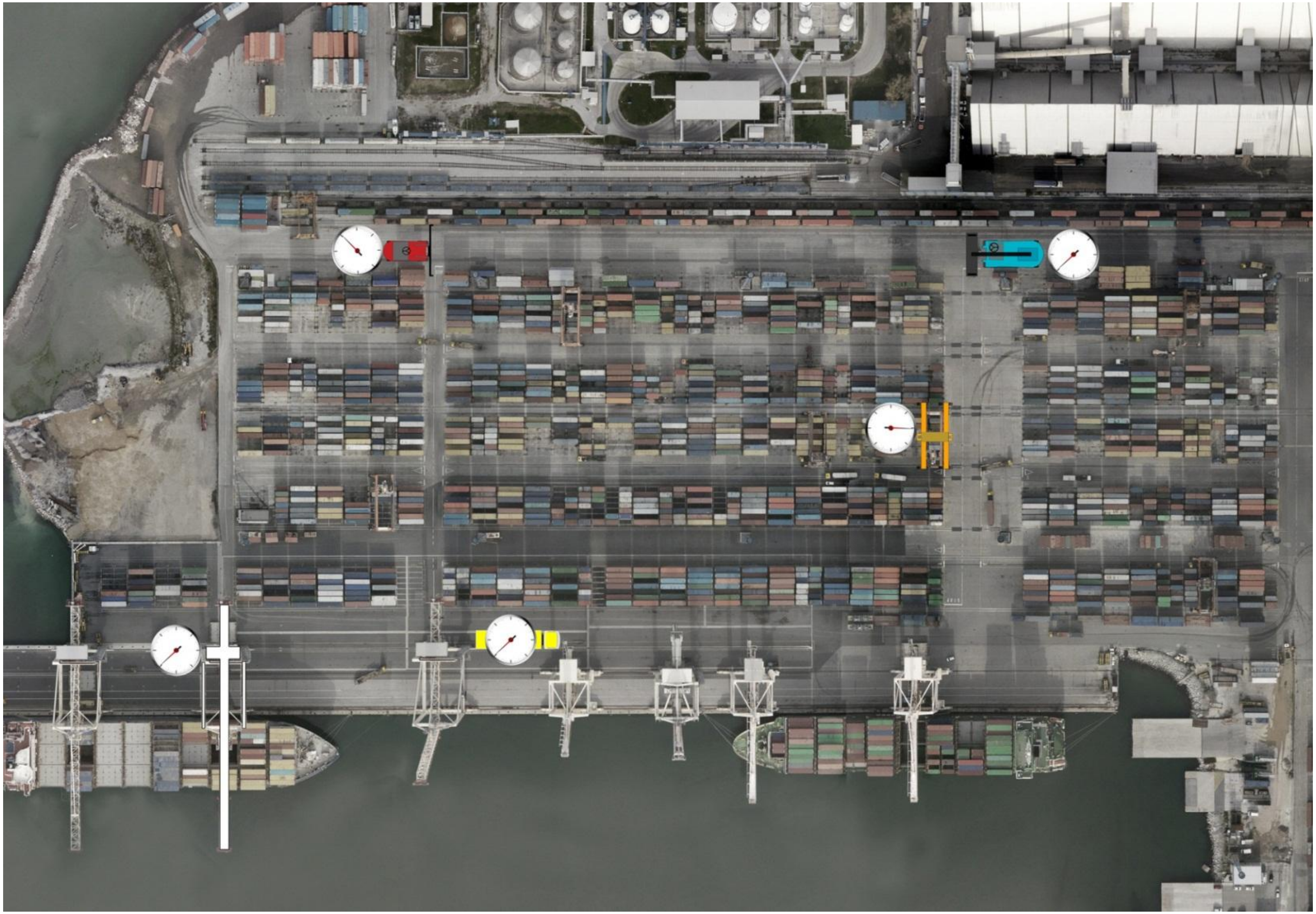


Fuel consumption deviation from the target (l)

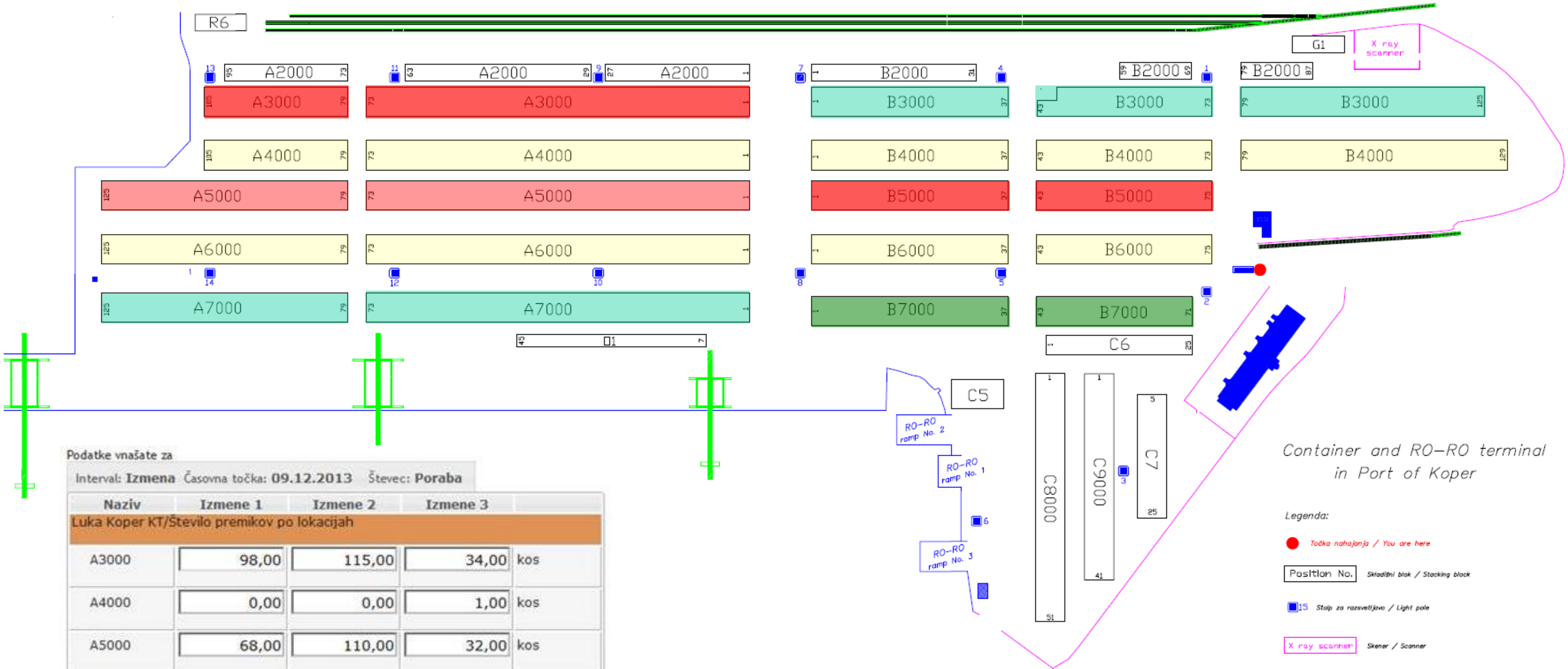


Fuel consumption on total operating hours (l / h)

Installation the prototype - scheme



Installation the prototype - results



Podatke vnašate za

Interval: **Izmena** Časovna točka: **09.12.2013** Števec: **Poraba**

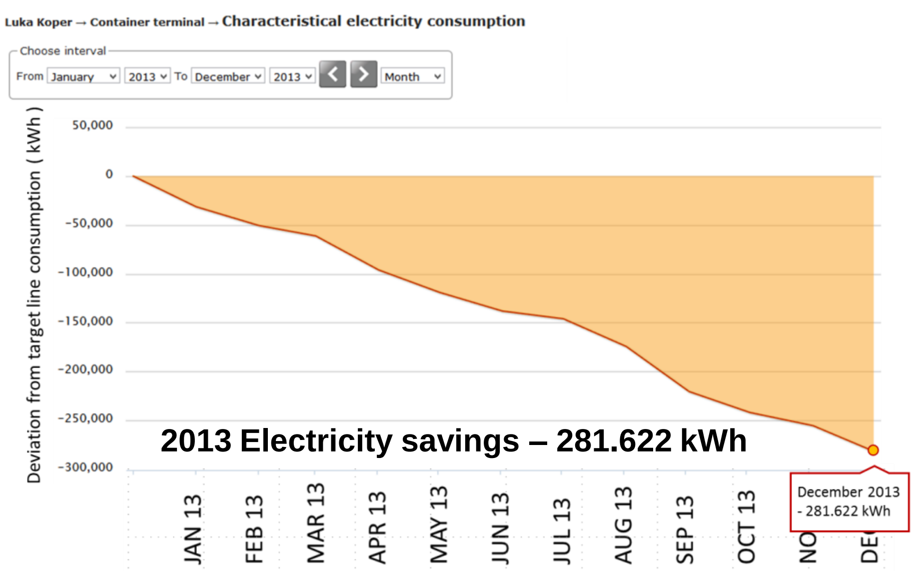
Naziv	Izmene 1	Izmene 2	Izmene 3	
Luka Koper KT/Število premikov po lokacijah				
A3000	98,00	115,00	34,00	kos
A4000	0,00	0,00	1,00	kos
A5000	68,00	110,00	32,00	kos
A6000	0,00	0,00	0,00	kos
A7000	47,00	34,00	14,00	kos
B3000	87,00	9,00	0,00	kos
B4000	0,00	2,00	0,00	kos
B5000	76,00	69,00	23,00	kos
B6000	0,00	0,00	0,00	kos
B7000	17,00	37,00	9,00	kos

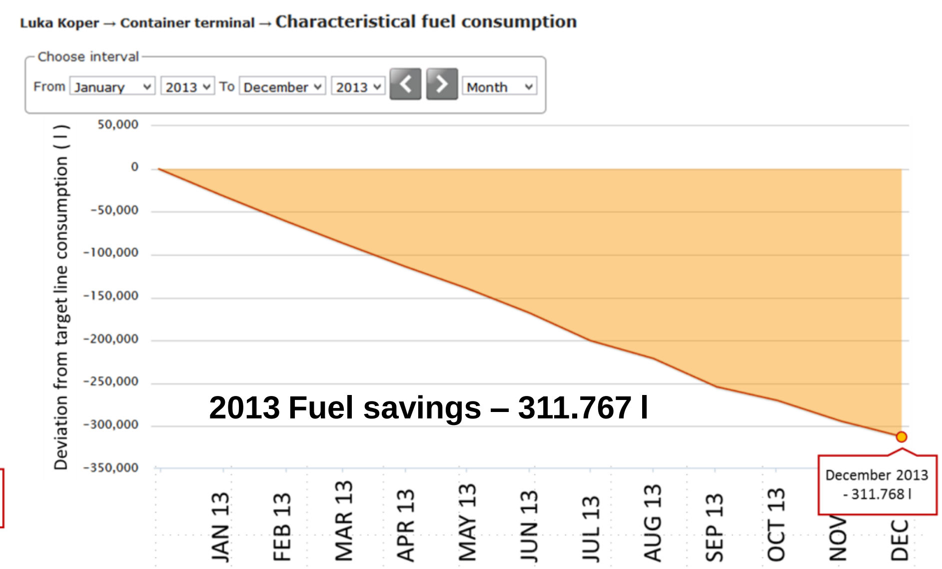
On a daily basis monitoring the movement and the energy consumption in the container blocks

Installation the prototype – results (2)

The main benefits with the implementation of the pilot Greencranes:

- A proper knowledge about fuel and electricity consumption for each type of machinery - knowledge about energy consumption and environmental impacts
- Understanding the workload of machinery and number of movements per container blocks
- The establishment of new KPIs



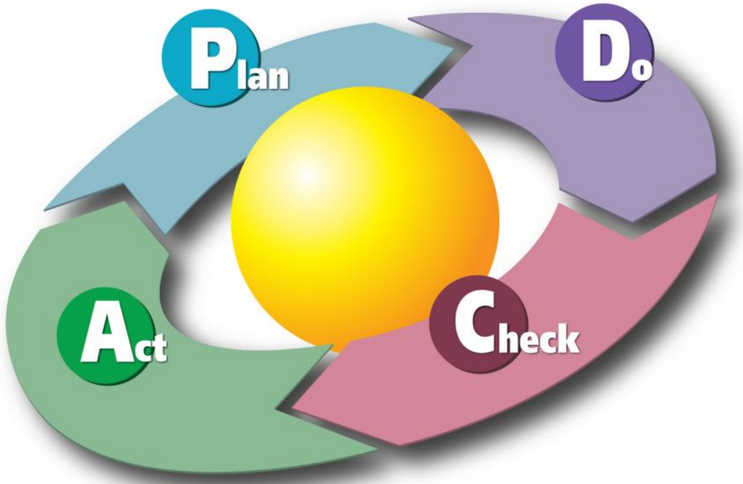


ISO 50001

An Energy Management System helps organisations to integrate energy and management into the business structures, with a purpose to save energy, save costs and improve theirs energy, environmental and business performance. **An Energy Management System (EMS) is a systematic process for continually improving energy performance.**

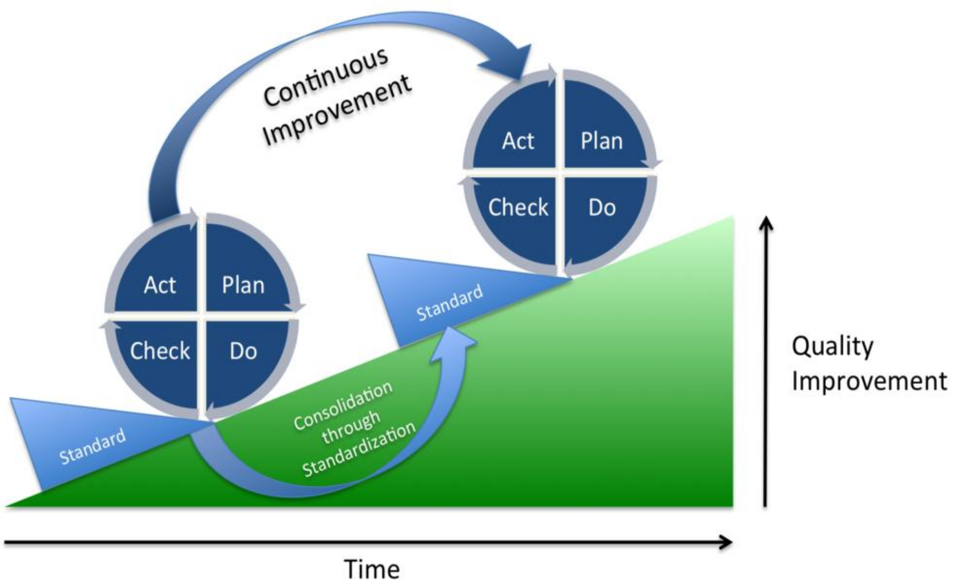
Establishing an EMS requires you to:

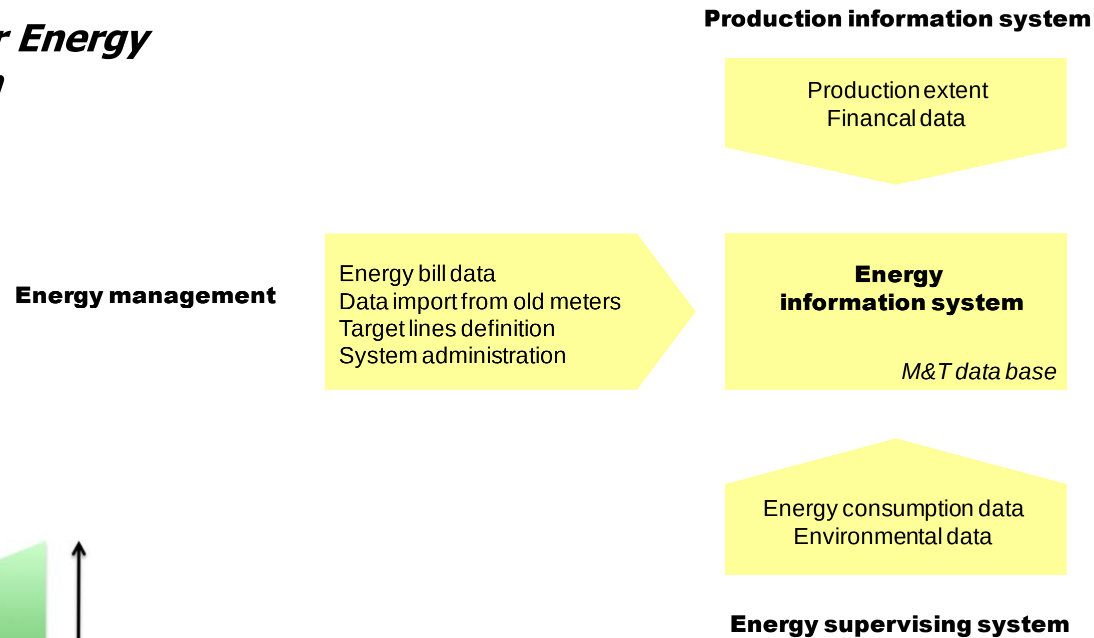
- Develop and implement an energy policy.
- Identify your significant energy use.
- Set energy objectives and measurable targets.
- Implement and operate action plan to meet these objectives and targets.
- Check and take corrective action as required.
- Review your system continually and improve where possible.



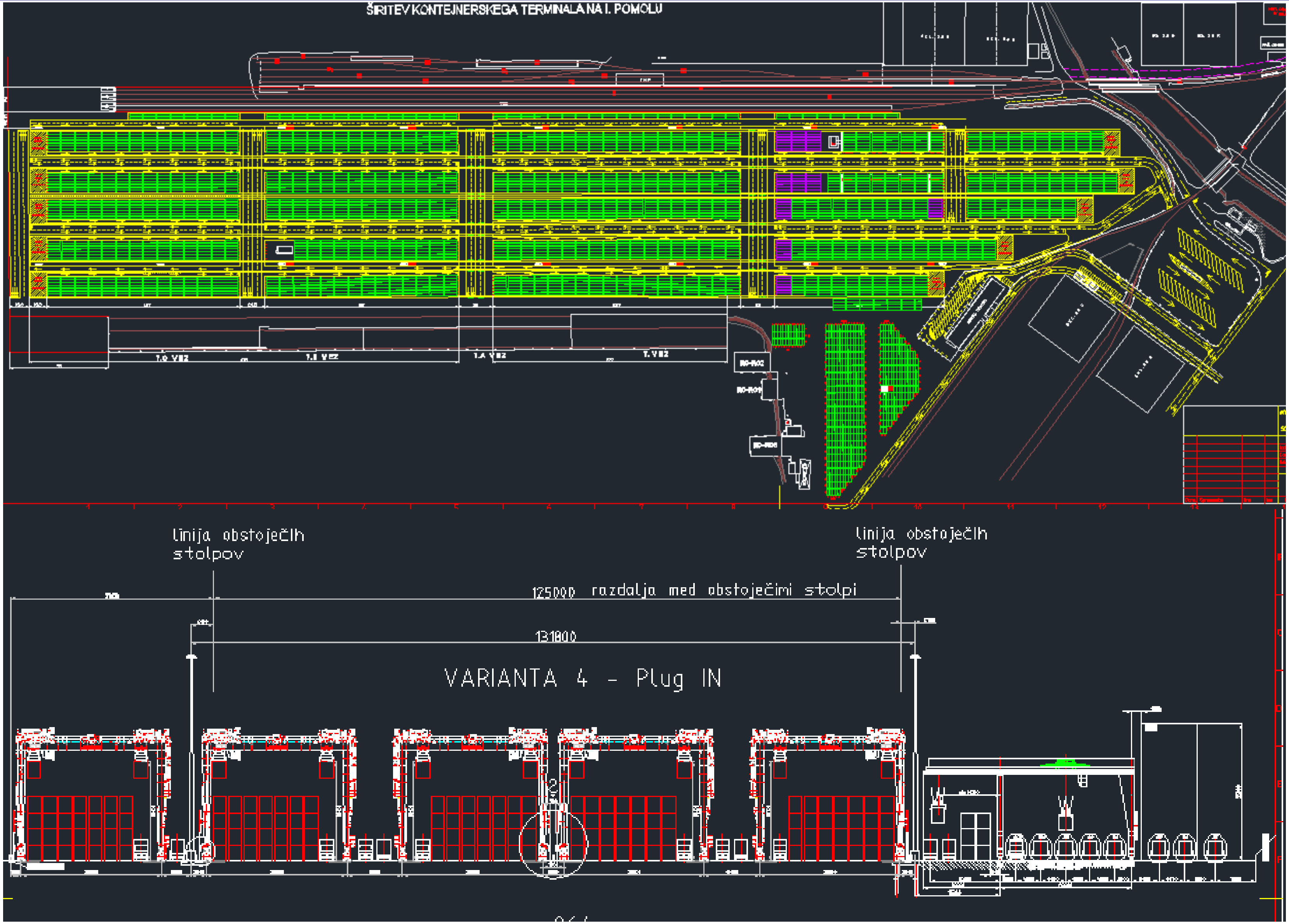
Energy and environmental management system cannot be effective without the active involvement of the top management!

Basic scheme of Luka Koper Energy Information System





Further plans



Conclusion and future challenges

- **Port of Koper** started with the transformation in **sustainable and low carbon port**!
- **EEMS** has been recognized as **the first and necessary step** in the development of **sustainable port infrastructure**
- **The next step will be the electrification of RTGs**
- EEMS will enable exploitation of the full potential of the Port of Koper, especially in the field of **competitiveness** and **economic growth** and **reduction** of **negative environmental impacts**

Questions?
Thank you for your attention

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