The new face of Haul Truck linings

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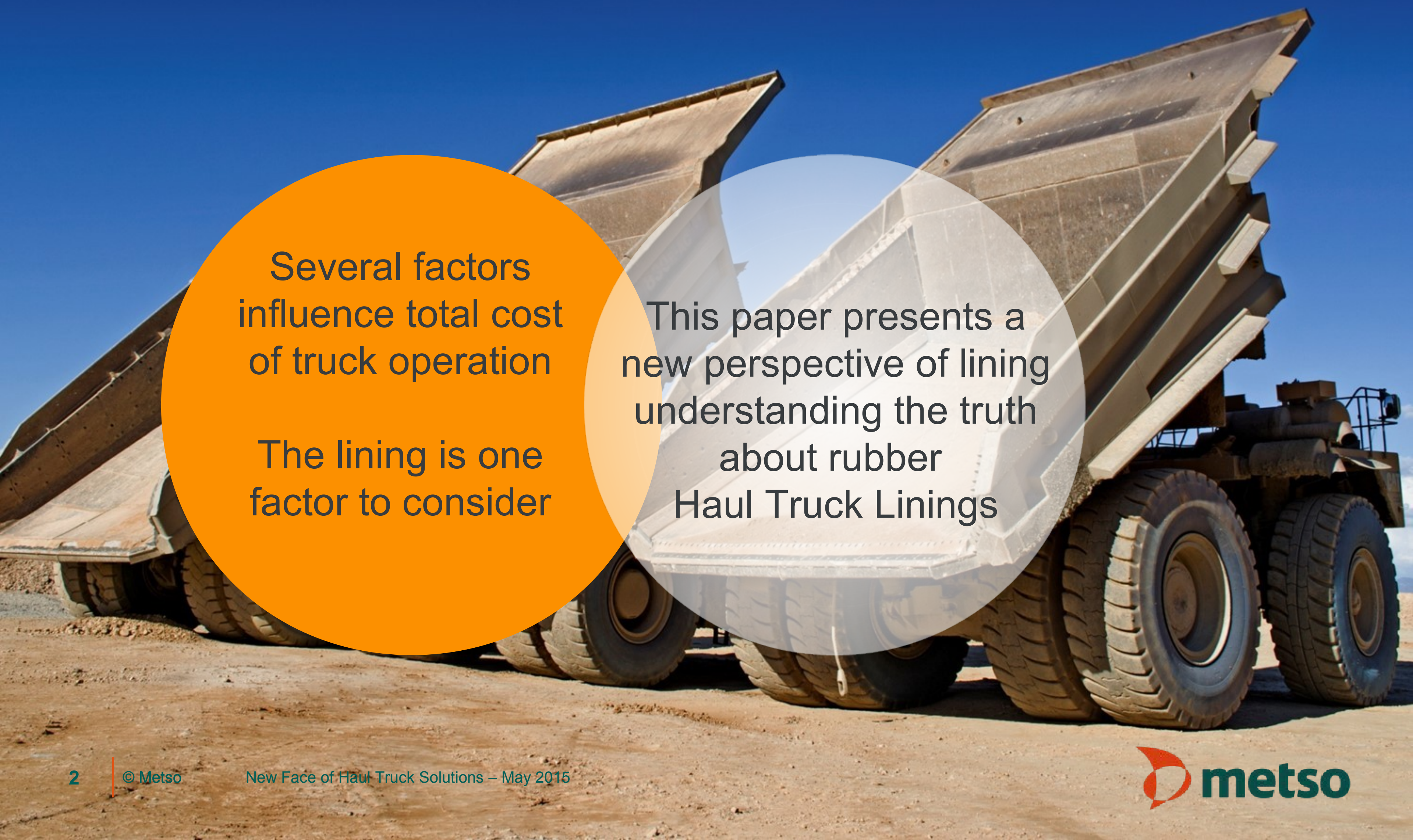
The new face of Haul truck linings



Several factors influence total cost of truck operation

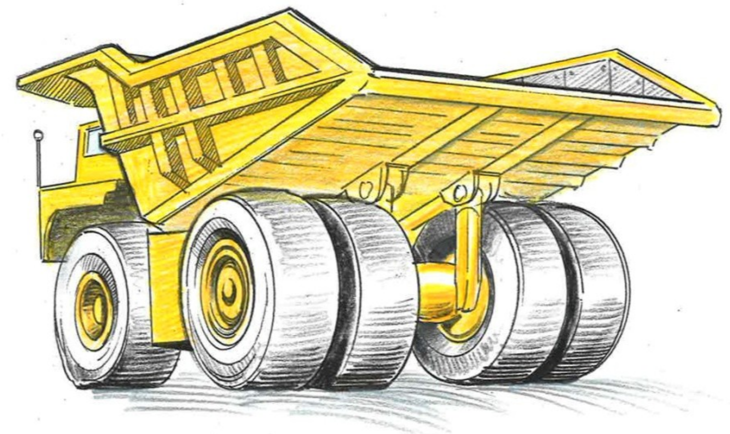
The lining is one factor to consider

This paper presents a new perspective of lining understanding the truth about rubber Haul Truck Linings

The new face of Haul Truck linings

A study have been conducted comparing classic steel lining with an adapted truck rubber wear lining

Results shows that:



- The adapted rubber absorbs stress better at every point of the truck work cycle to protect the structure
- The adapted rubber shows increased availability of trucks with less maintenance and increased wear life
- The adapted rubber shows great improvements of the working environment with reduced noise and vibration

Cost Savings

Example from study

- Operating in Copper mine
- 320 tones truck
- 10 x CAT 795 trucks in operation
- 3 spare boxes
- Service interval with steel lining: 18 month
- Material lump size up to 6.5 foot (2 meter)
- Climate: -58°F to 104°F   (-50°C to +40°C)

Savings of

3 071 600 $

during a period of 5 years

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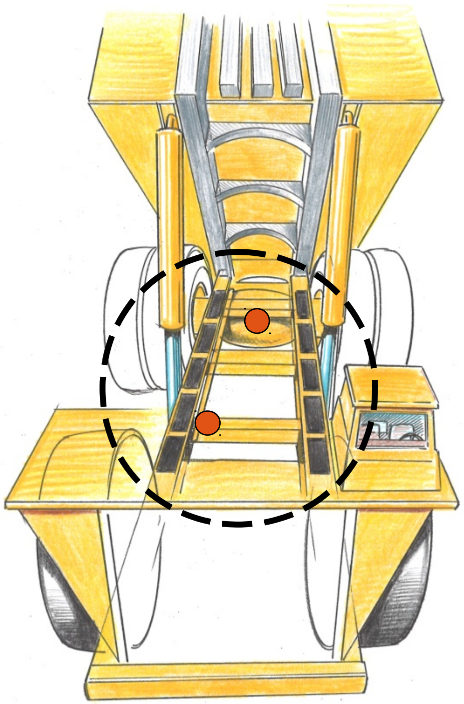
Sensor orientation

Comparison of trucks equipped with steel lining and adapted rubber lining

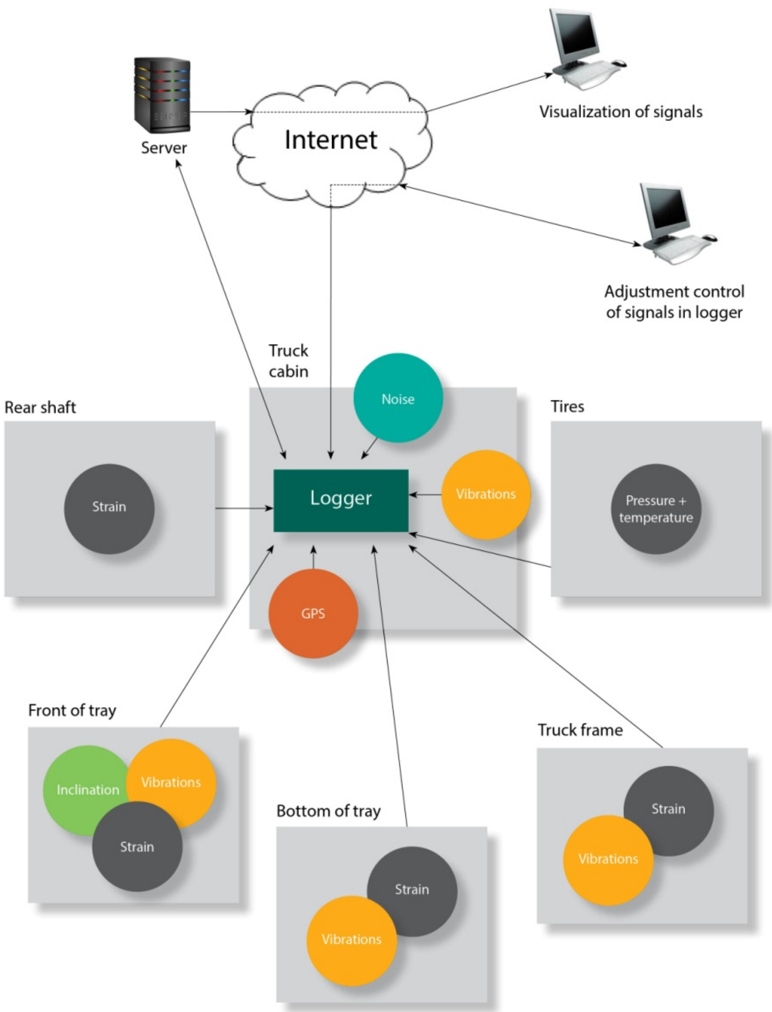
Location of sensor points carefully selected together with the customer – the most problematic areas where a lot of maintenance is required

Sensor orientation

- Vibrations in tray bottom
- Strain in tray bottom
- Strain in cross beams and rear shaft
- Noise in driver cab



Schematic explanation of measuring & software



Impact and vibrations

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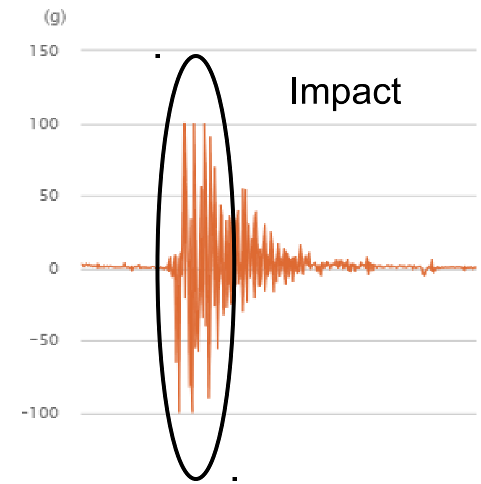
Impact and vibration

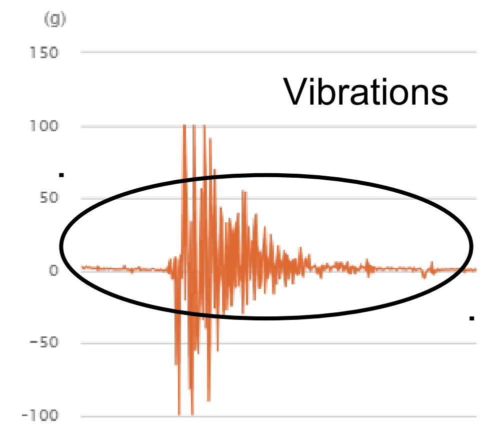
Steel lining

Adapted rubber lining

Impact and vibrations

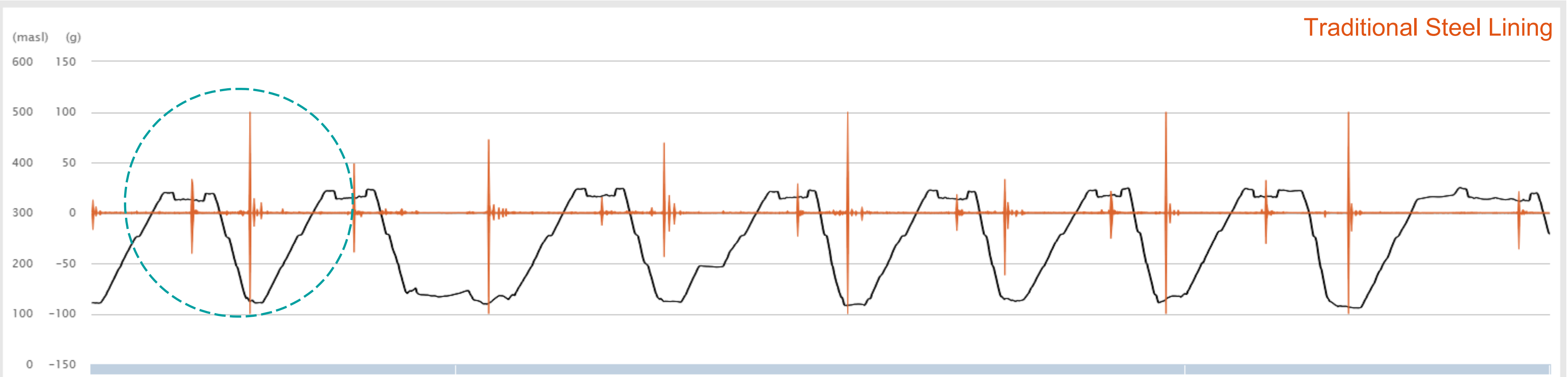
- Impact and vibrations cause strain and stress on objects
- The term impact is used to describe a high kinetic energy that acts on an object
  - Impact is often measured by its peak acceleration in g's and pulse duration
  - Example: a short pulse shock (1 ms) with high magnitude (300 g) has little damage potential, but a 20 ms 300 g shock might be critical
- Vibrations are periodic oscillations
  - Vibrations are measured in g's as well as frequency
- Large g's can be very destructive due to the strain they induce, especially if reoccurring
- Piezoelectric accelerometers were used to measure vibrations and impact (g)

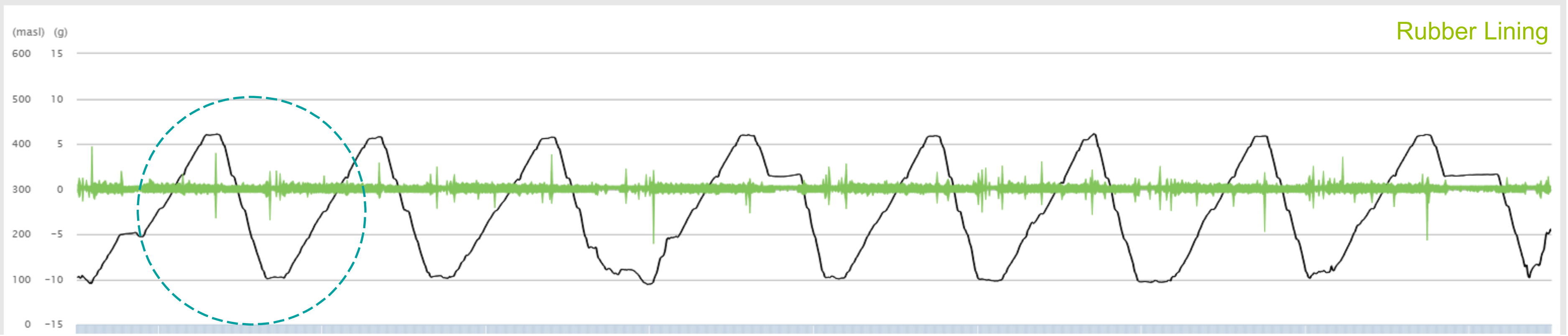




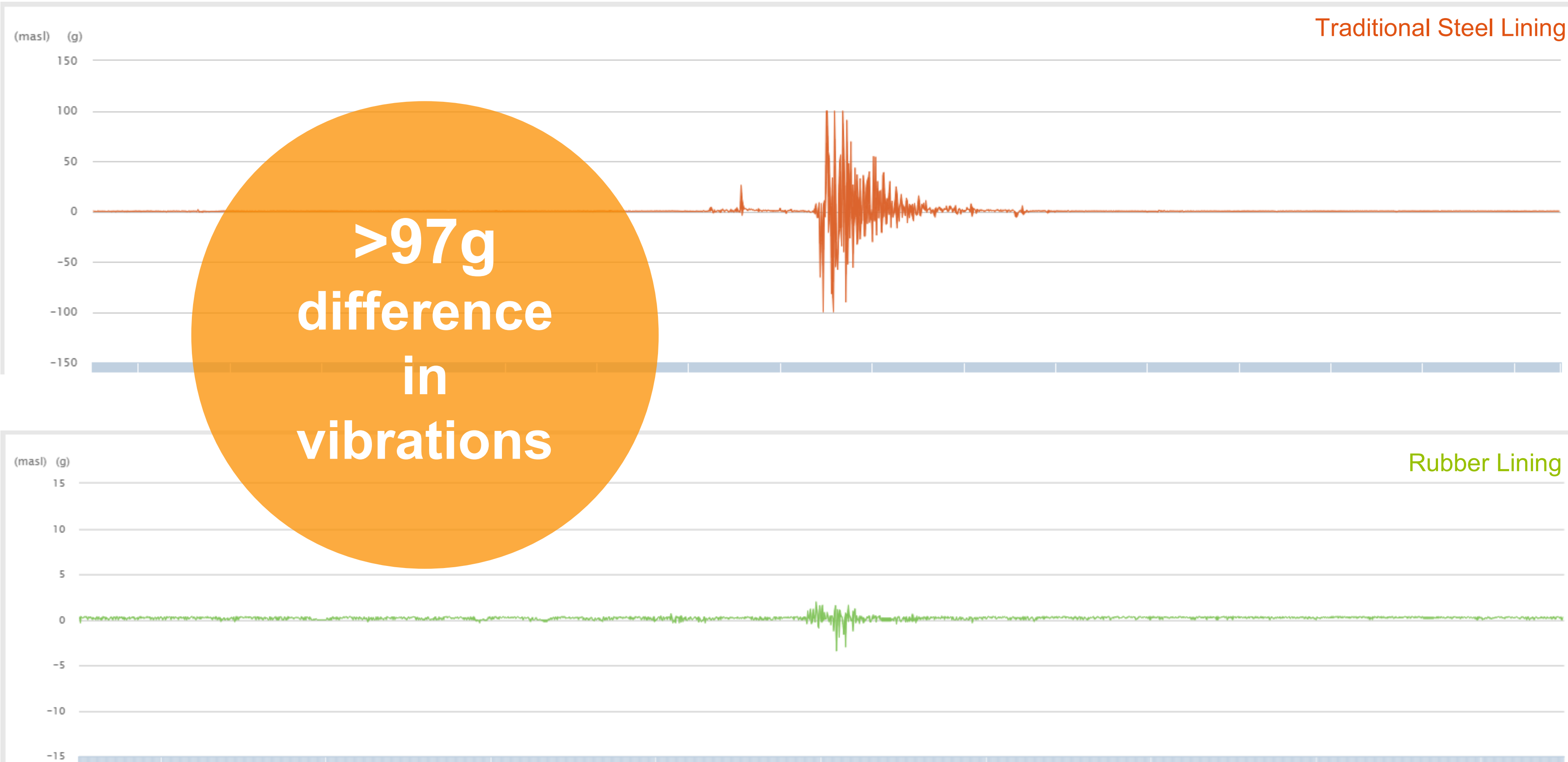
Vibrations in tray bottom during loading / dumping

Comparing traditional steel with rubber lining





Vibrations in tray bottom during loading



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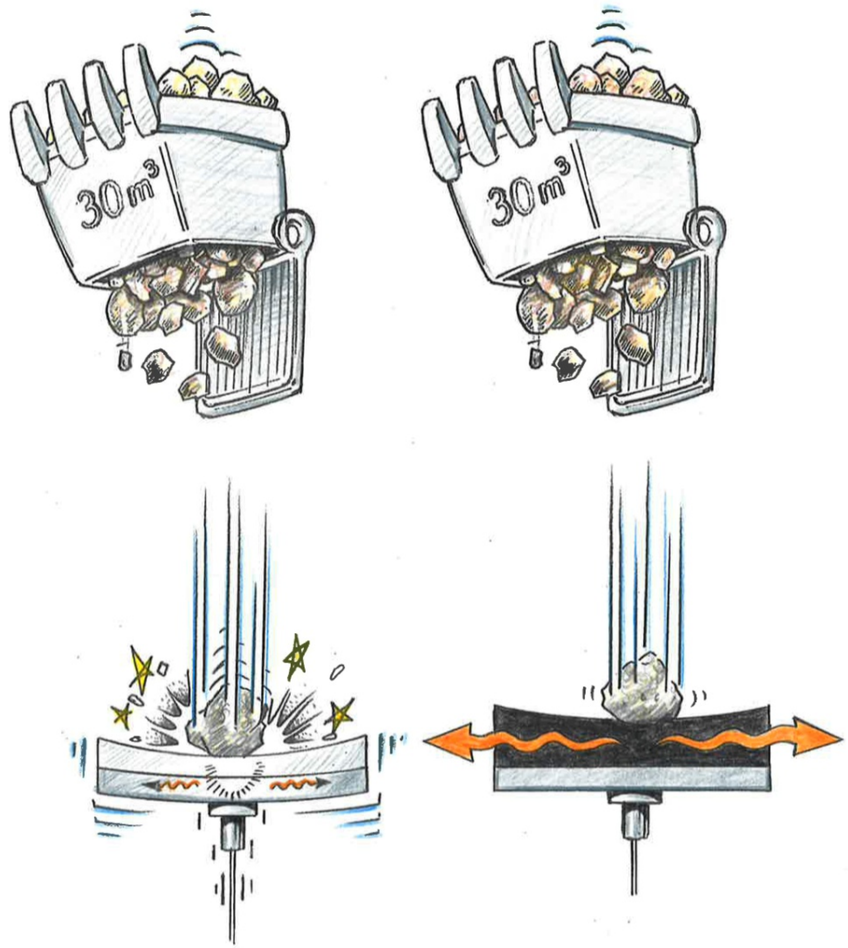
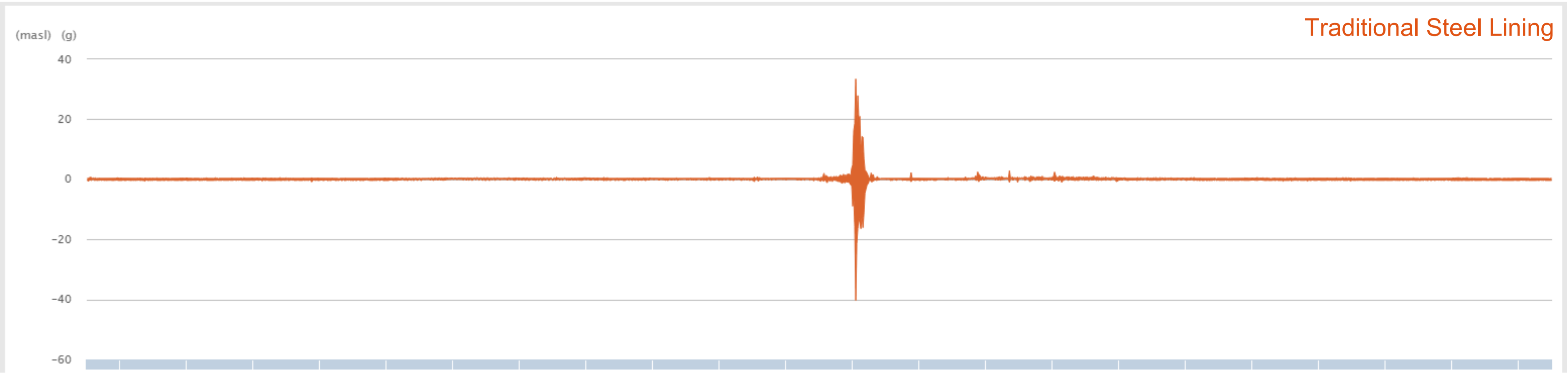
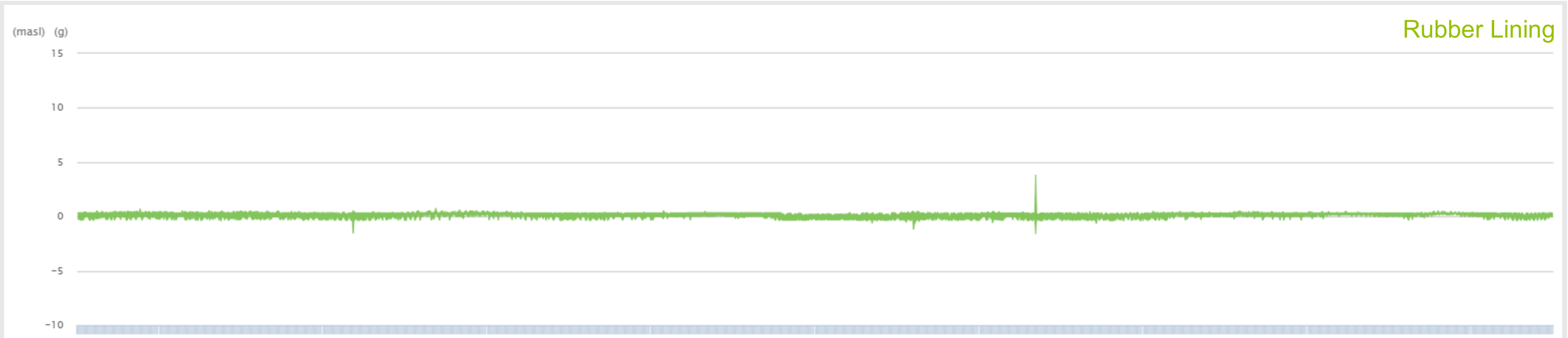
Comparison between steel and rubber

- Truck with steel lining
  - The impact on the tray was very high – reaching sensor's maximum of 100g almost every time the steel lined truck was being loaded
- Truck with adapted rubber lining
  - The impact at the same point was – 95% less!



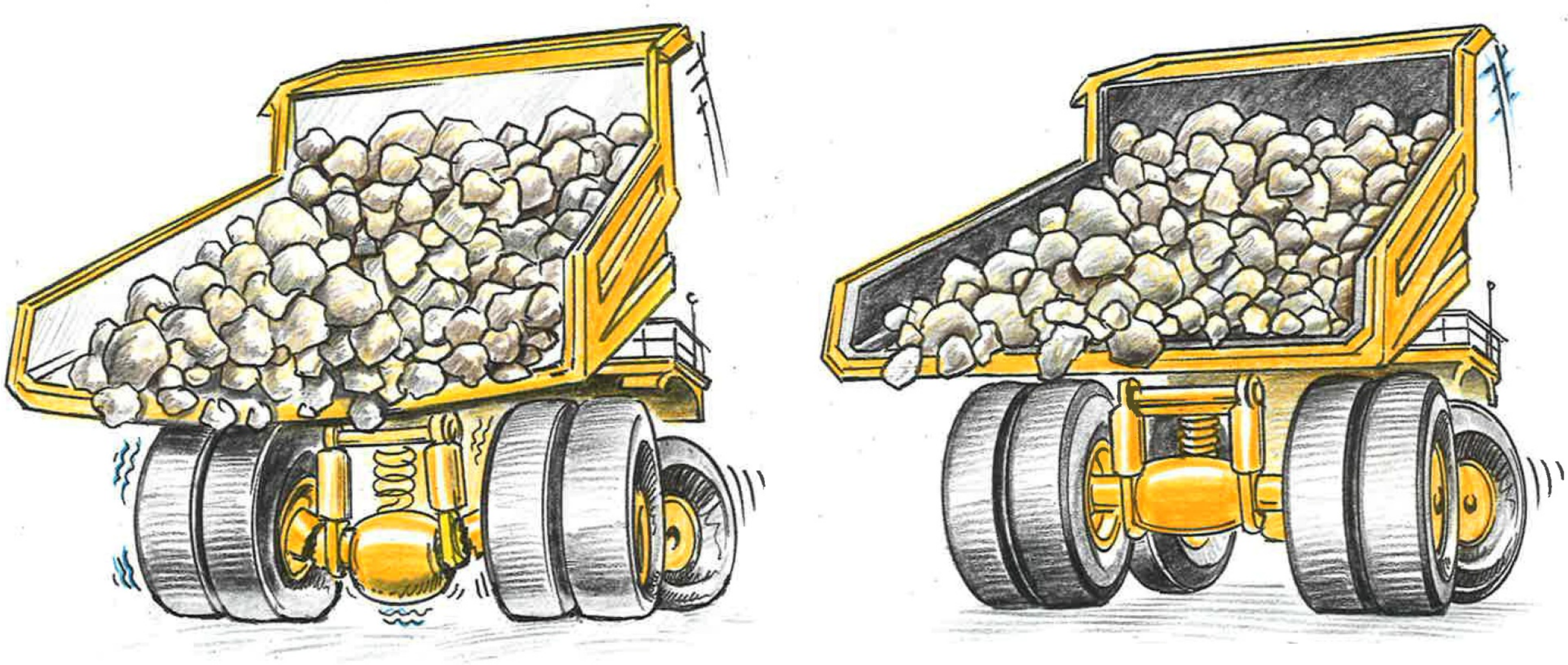
Vibrations in tray bottom during dumping





Strain

Strain rear shaft during dumping



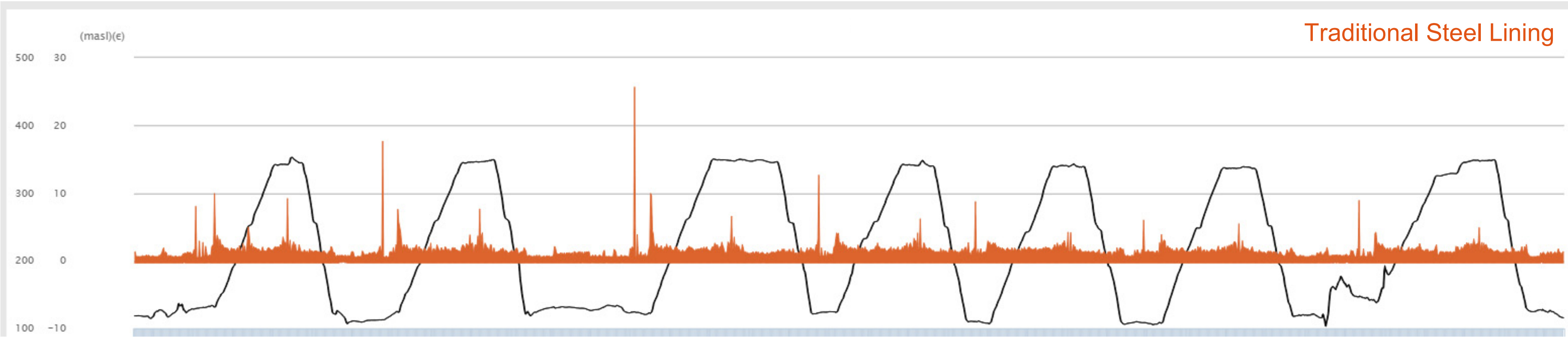
Strain

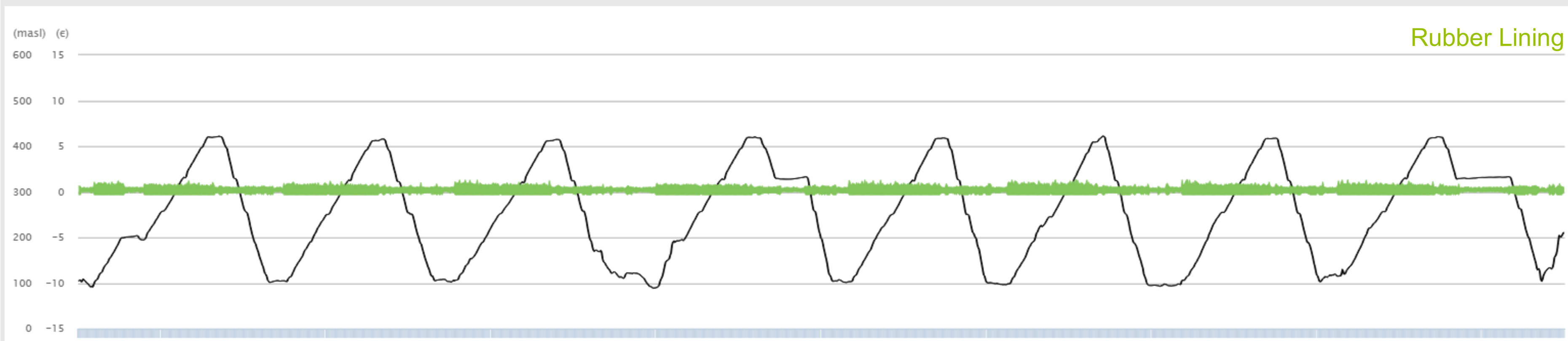
- Strain **e** is the result of stress **s** on an object
- If a material is stressed by a force it often changes shape: extended, shortened or pulled apart
- If a material is subjected to strain frequently it will eventually break from fatigue, this happens on a tray
- The strain is defined as the change in length divided by the material's original length

- If you apply no force to an object, no strain
- If you apply a certain force you'll extend the object's length by a certain amount, equal to a certain strain
- If you apply more force so you double the extension, you have produced twice as much strain

Strain in tray bottom during loading / dumping

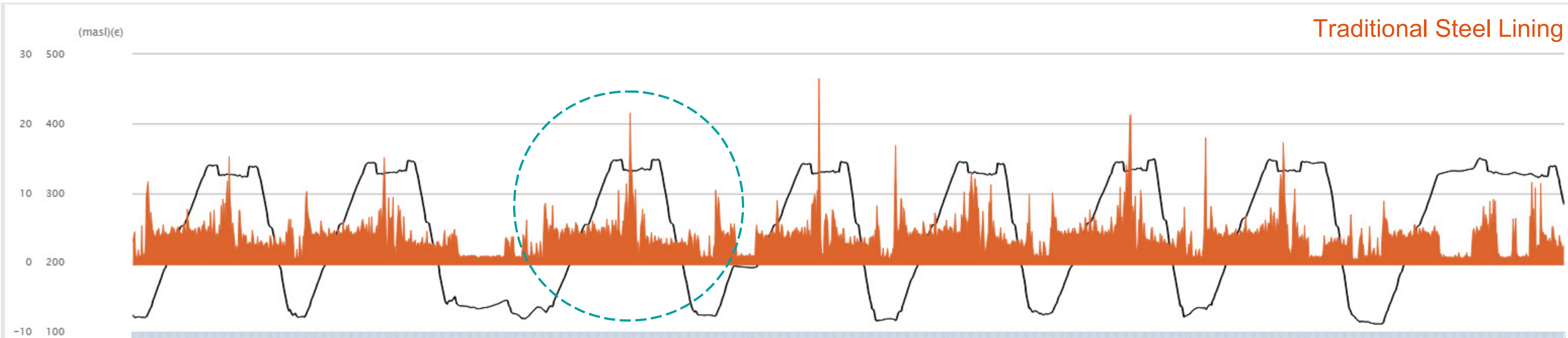
Comparing traditional steel with rubber lining

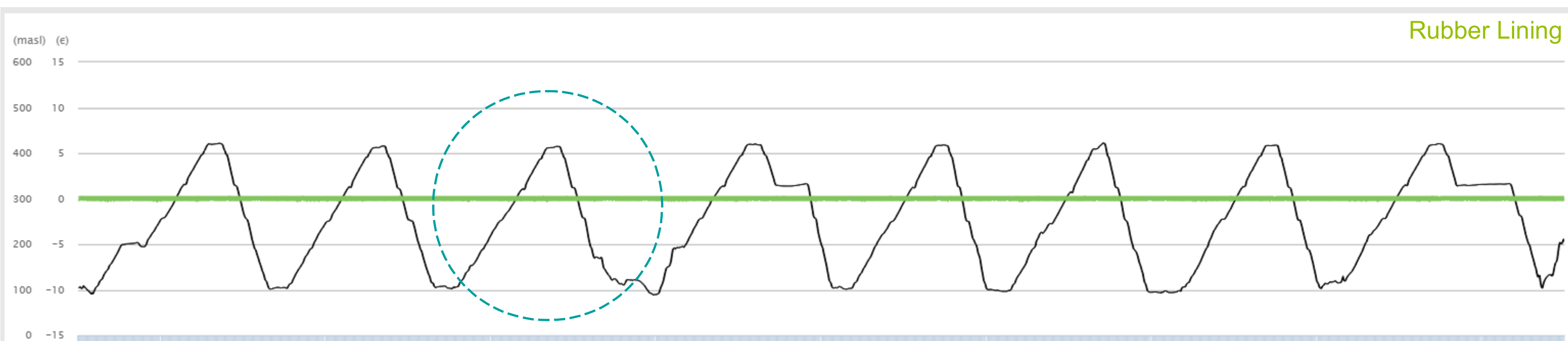




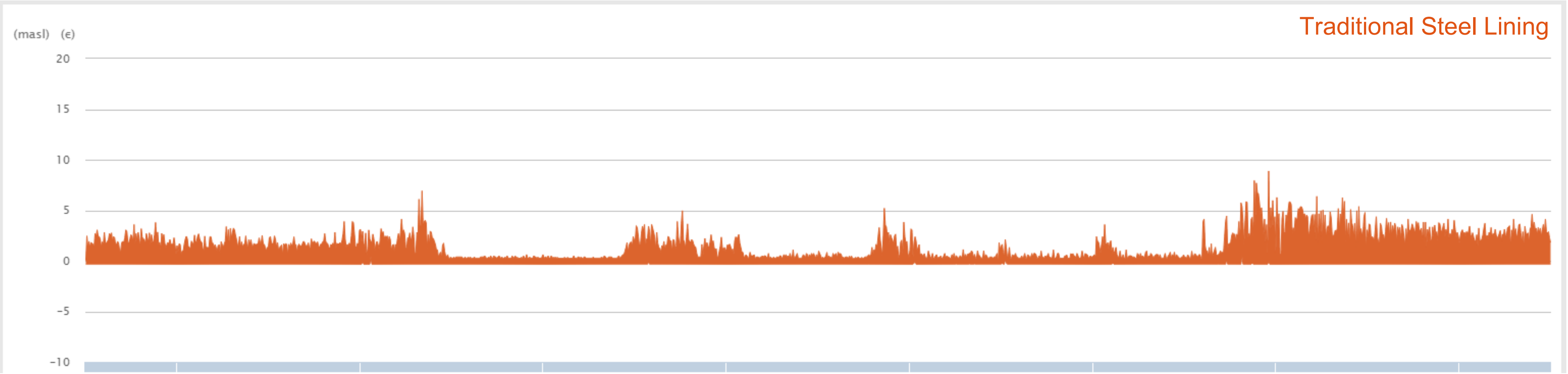
Strain in rear shaft during loading / dumping

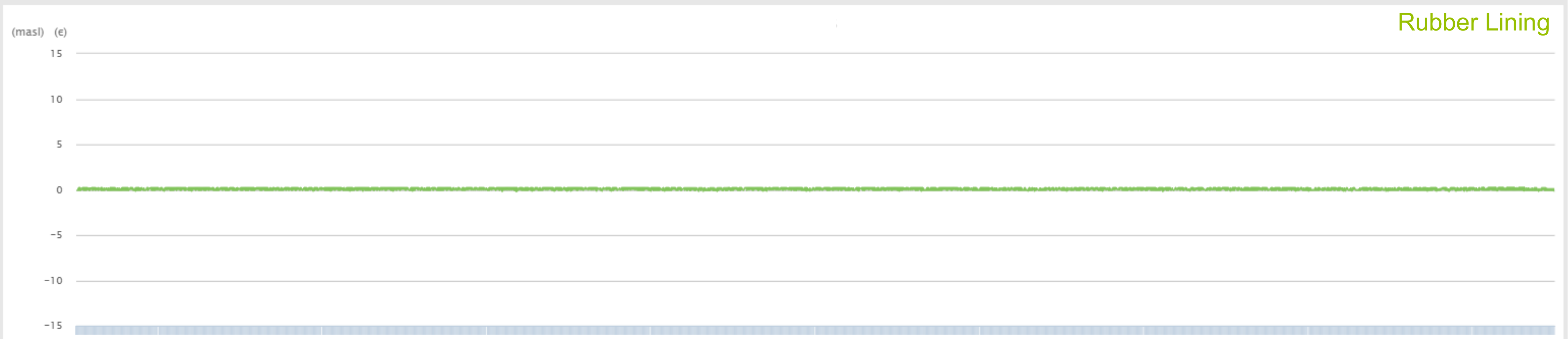
Comparing traditional steel with rubber lining



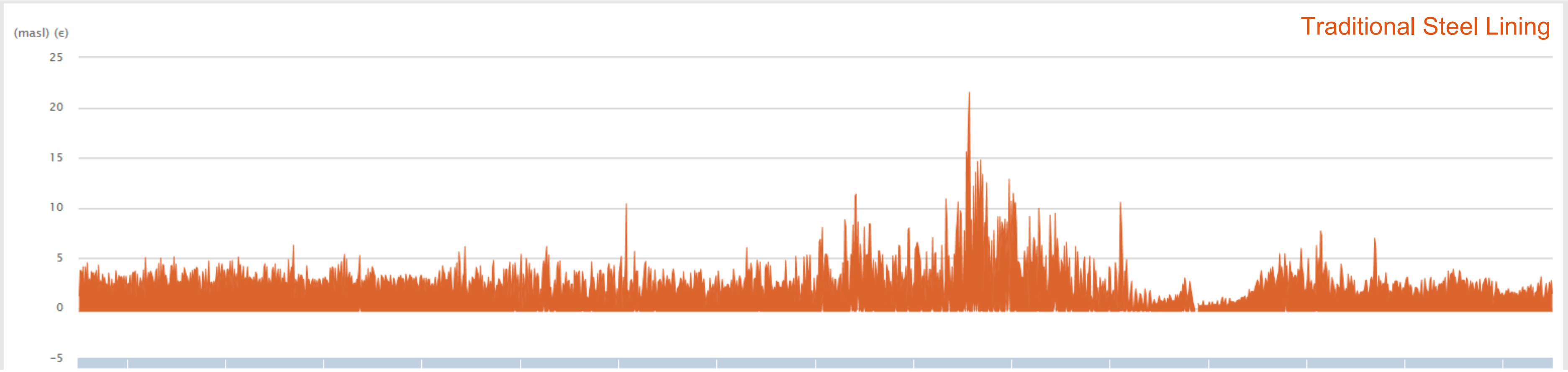


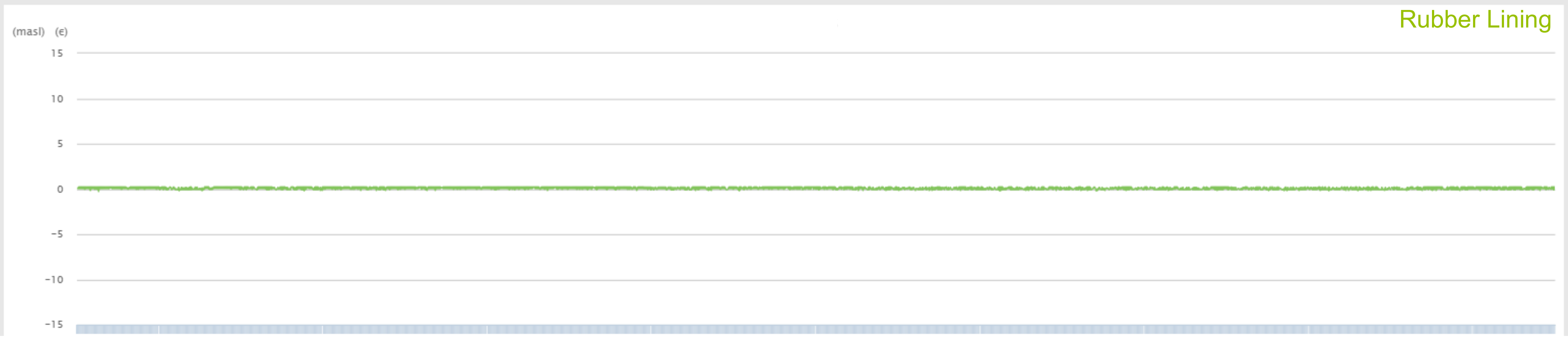
Strain in rear shaft during loading





Strain in rear shaft during dumping





Noise

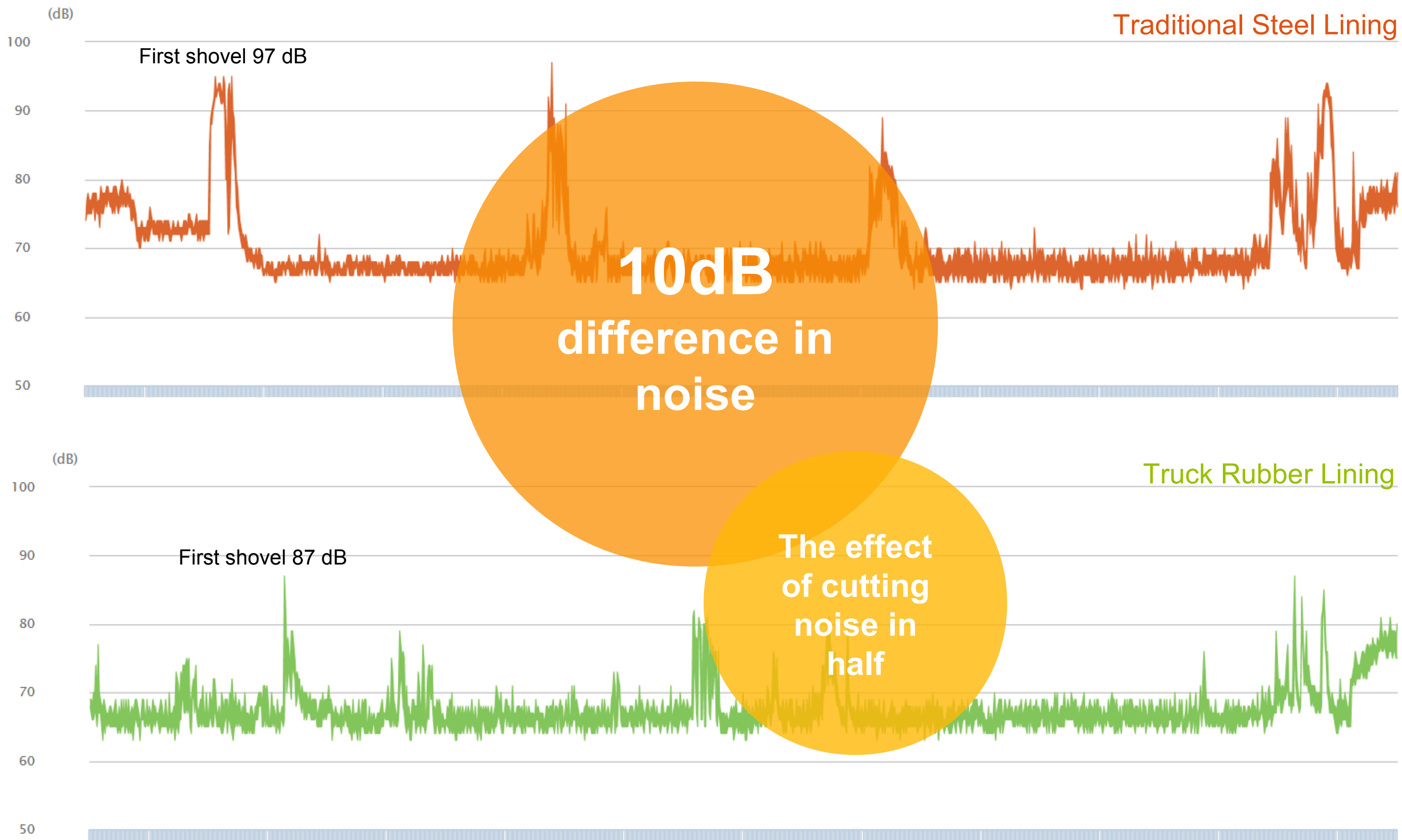
Noise

- Noise is measured in units of sound pressure levels called decibels, using A-weighted sound levels (dBA)
- Decibels are measured on a logarithmic scale which means that a small change in the number of decibels results in a huge change in the amount of noise and the potential damage to a person's hearing
- How "loud" something is perceived is highly subjective but as a rule of thumb: *an increase of 10 dB will be perceived as double the volume*

Sound sources (noise) examples with distance	Sound Pressure Level dB
Jet Aircraft, 50 m away	140
Threshold of pain	130
Threshold of discomfort	120
Chainsaw, 1m distance	110
Disco, 1 m from speaker	100
Diesel truck, 10 m away	90
Kerbside of busy road, 5 m	80
Vacuum cleaner, distance 1 m	70
Conversational speech, 1 m	60
Average home	50
Quiet library	40
Quiet bedroom at night	30
Background in TV studio	20
Rustling leaves in distance	10
Hearing threshold	0

Noise in driving cab during loading

Comparing traditional steel with rubber lining



Conclusions

How is it possible to save

3 071 600 $

during a period of 5 years

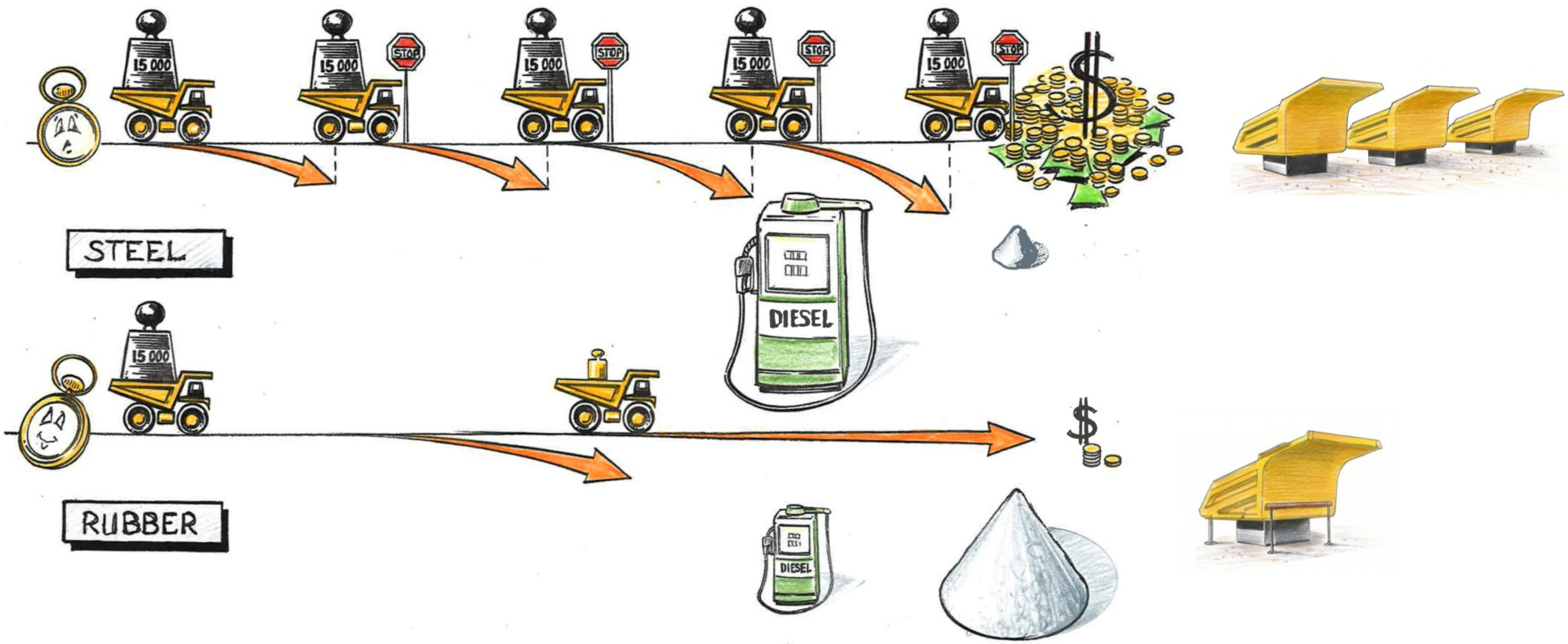
Where do the savings come from…

- Reduced vibrations and strain results in less maintenance => increased availability
- Less wear results in less maintenance => increased availability
- Rubber absorbs stress better at every point of the truck work cycle to protect the structure
- Improved health, safety and environment.
  - Less noise and vibrations means better working conditions
  - In addition, the rubber modules are easy to cut, unlike cutting steel, this process does not emit smoke (fumes)

Steel lining = protection

Adapted rubber lining = protection, wear resistance & environmental improvements

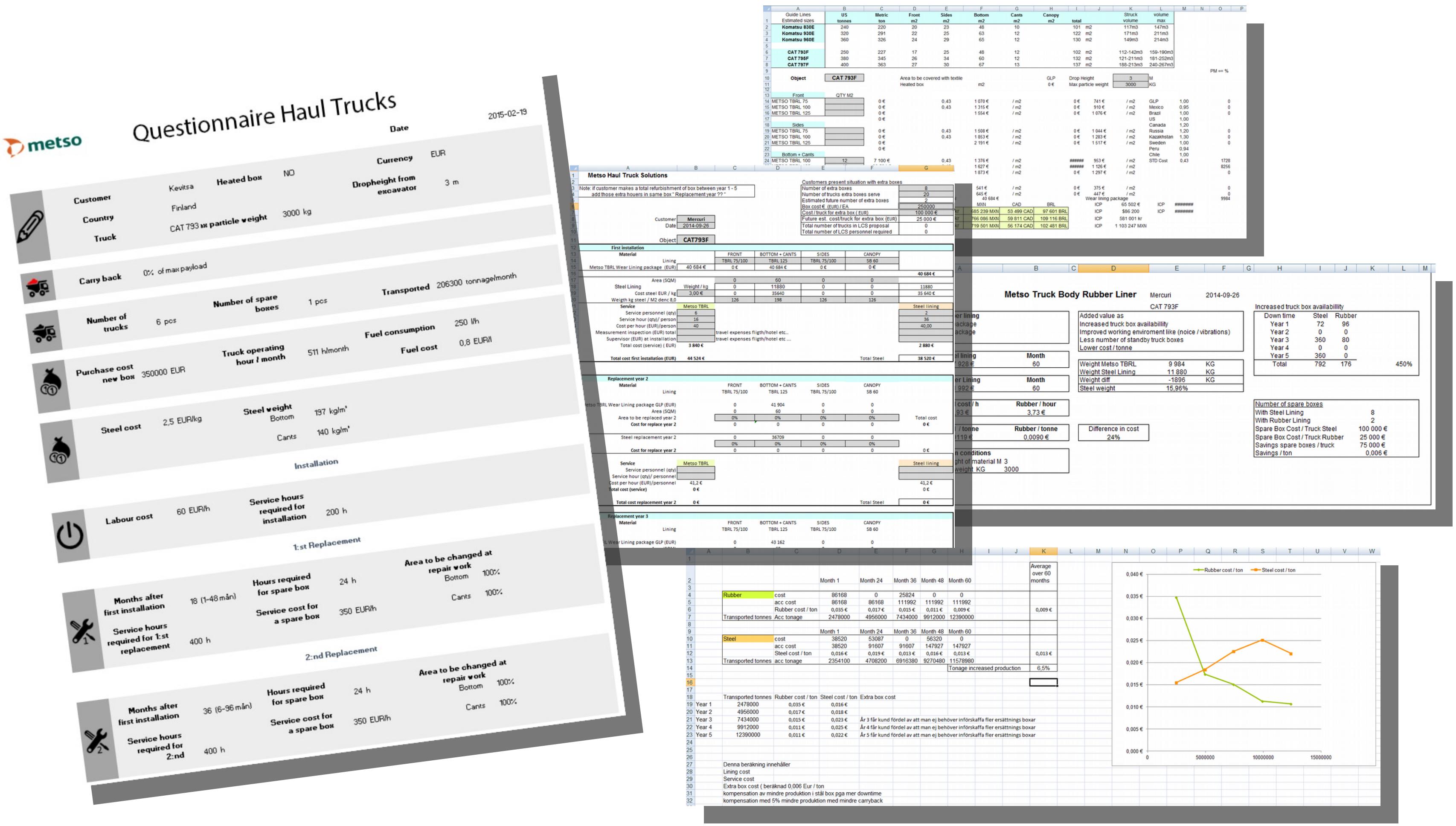
Where do the savings come from…



Steel lining
- Interval 18 months – re-lining
- Weight increase every 18 month
- Stop for maintenance every 18 month
- 3 spare boxes

Rubber lining
- Low average weight over the period
- Increased availability due to less maintenance (stop for re-lining)
- Less weight over period => less fuel consumption
- 1 spare box

Gathering data



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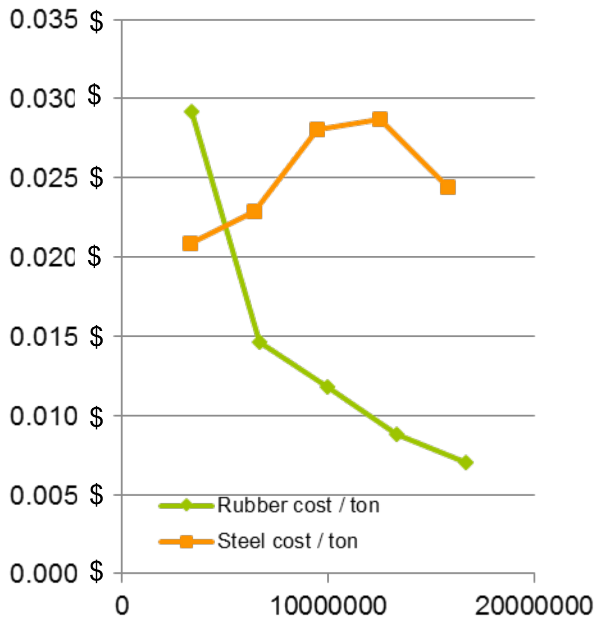
Total Net Savings over a period of 5 years

Total transported tonnes = 16 599 960

	$ per ton	Total $
Initial installation cost	-0,0028	- 46 178
Service and maintenance	0,0134	222 399
Reduced number of boxes	0,0049	81 451
Reduced carryback	0	0
Fuel consumption	0,029	49 488
Environmental	?	?
Total Net Value		**307 160**



307 160 USD per truck over a period of 5 years

*Savings of **3.071.600 USD** for the fleet of 10 trucks*

Conclusions

With the adapted rubber lining, everything is reduced:

downtime, numbers of spare boxes, maintenance costs and more.

The only increase is the earnings in dollars/ton

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Rubber vs steel

Carry back

Volume