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EVs AND MARITIME INSURANCE

ELEPHANT OR SWAN?

Rome, 20 February 2024

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EVs and Maritime Insurance - What Evs are?

HEV (Hybrid electric vehicle)

It combines a conventional internal combustion engine (ICE) with an electric propulsion system (hybrid vehicle drivetrain).

The powertrain is intended to achieve better fuel economy than a conventional vehicle.

They do not plug in to recharge.

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EVs and Maritime Insurance - What Evs are?

PHEV (Plug in Hybrid Electric Vehicle)

A plug in hybrid electric vehicle comes with both a traditional combustion engine and a battery.

Unlike hybrid electric vehicles the battery needs to be charged and can provide generally 30-60km of pure electric range.

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What Evs are?

BEV (Battery electric vehicle)

Pure electric vehicles.

They are powered by rechargeable battery packs, with no secondary source of power.

They plug into an electricity source to recharge.

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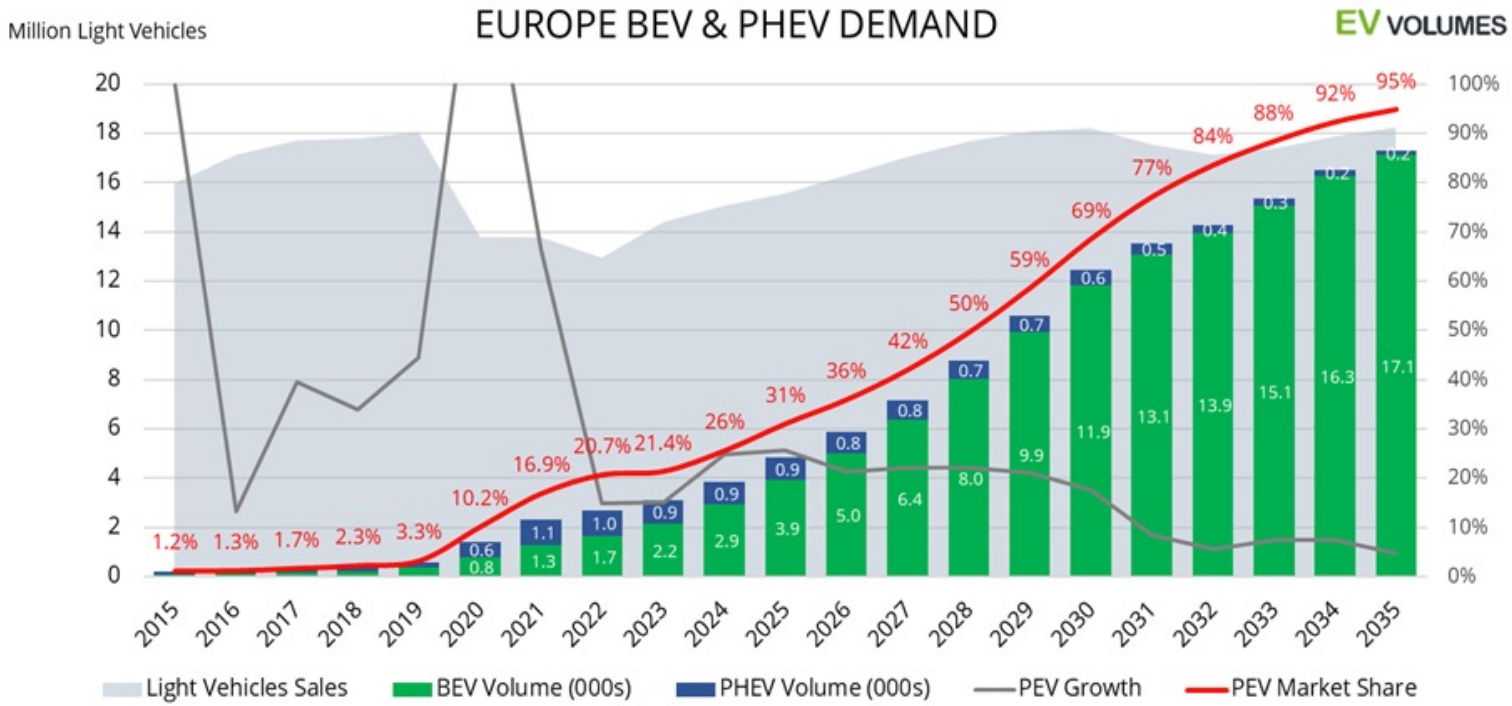
AIPAM Associazione Ingegneri Periti di Avarie Marittime

EVs and Maritime Insurance - How Many EVs?



SOURCE: EVVOLUMES.COM

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ASSOCIAZIONE INGEGNERI PERITI DI AVARIE MARITTIME AIPAM

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Just cars?

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EVs and Maritime Insurance - Just cars?

SOURCE: MARKETSANDMARKETS.COM

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EVs and Maritime Insurance - What do we know?

Rumsfeld Matrix

In 2002, during a press briefing about the Iraq War, Donald Rumsfeld, US Secretary of Defense, divided information into four categories

- known knowns
- known unknowns
- unknown knowns
- unknown unknowns

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Rumsfeld Matrix

Known knowns: These are facts or variables that we're aware of and understand. They form the basis of our knowledge and provide a solid foundation for decision making.

White Elephants are ‘known knowns’; existential risks with obvious impacts, but difficult to address due to emotional circumstance. Albino elephants deemed sacred, forbidden for labor costing high upkeep, had been gifted by Monarchs of Siam to intentionally ruin people who fell out of their favor.

Examples include a money losing venture endeared by the Chairman.

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EVs and Maritime Insurance - Rumsfeld Matrix

Known unknowns: These are factors we know exist, but don't fully understand. They represent gaps in our knowledge that we must address through research, investigation, or consultation with experts.

Gray Rhinos are ‘known unknowns’; probable, high impact trends that are clearly observable, yet often ignored. While the impact is clear, the inaction in addressing an oncoming Gray Rhino roots from the lack of awareness on the subject.

Examples can be Climate Change, Pandemic, Blockchain and Artificial Intelligence.

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EVs and Maritime Insurance - Rumsfeld Matrix

Unknown knowns: These are elements that we don't realize we know. They're typically buried in our subconscious, overlooked, or dismissed as irrelevant. Uncovering these insights can lead to surprising breakthroughs in decision making.

Black Jellyfish are ‘unknown knowns’; unforeseen risks arising from known phenomena. Things we think we know and understand, but turn out more complex and uncertain than initially expected.

In 2013, while the rapid increase in Black Jellyfish populations was clearly observed, nobody could have predicted that they’d shut down Sweden’s Oskarshamn Nuclear Powerplant by clogging its water inlets.

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EVs and Maritime Insurance - Rumsfeld Matrix

Unknown unknowns: These are factors that we're not aware of and can't predict. They represent the most significant source of uncertainty and risk, as they can catch us off guard and derail our plans.

Black Swans are the *'unknown unknowns'*; events highly improbable, difficult to predict with massive impact. Until Dutch explorers discovered black swans in Australia in 1697 A.D., the western world had been using it as an idiom for the impossible since atleast the 2nd century.

The invention of the internet and the 2008 economic crisis are good examples.

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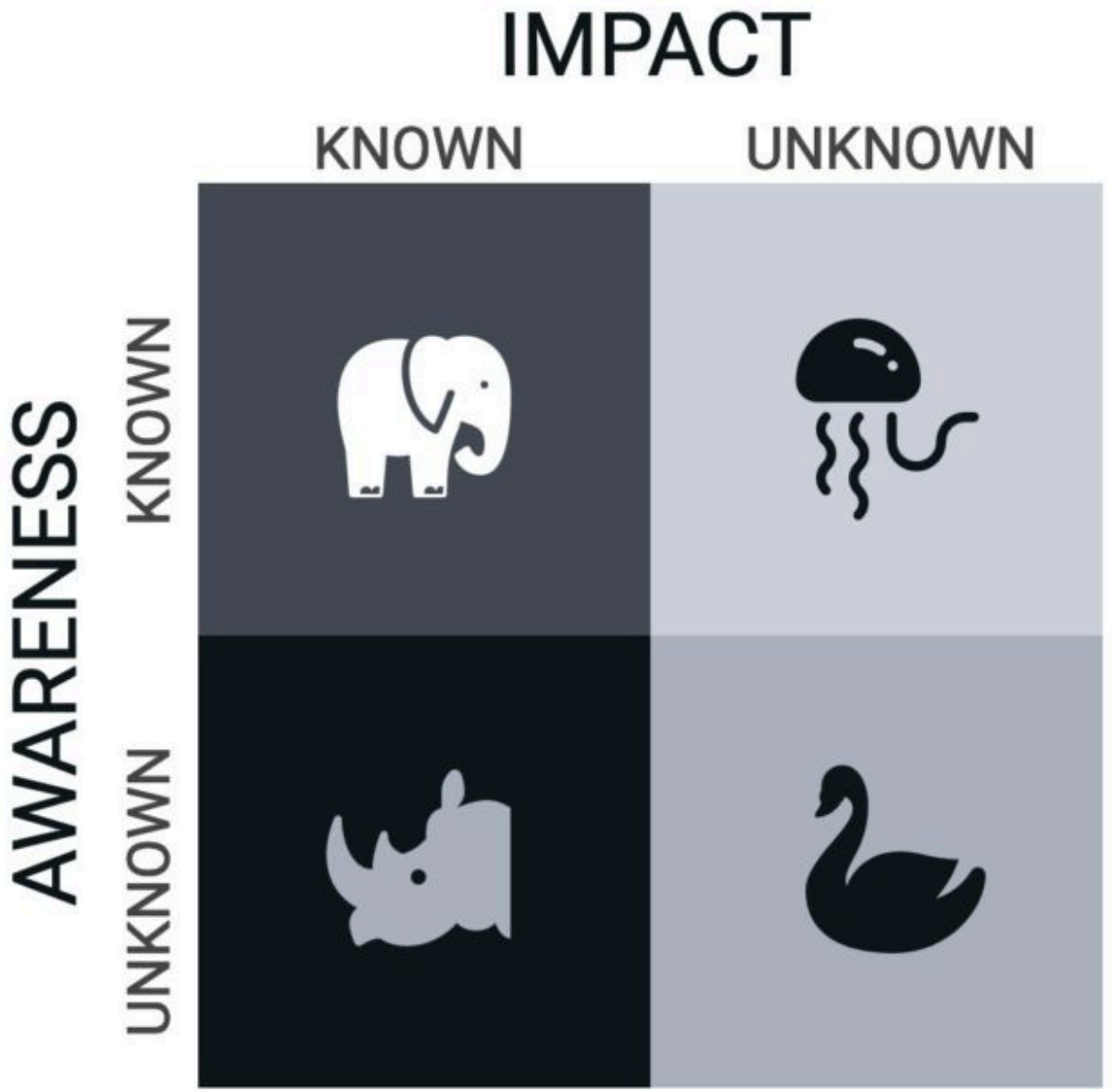
Where are we?



EVs and Maritime Insurance - What do we know (2)?

1. Soon EVs will be in great number
2. All the EVs are similar, regardless of type of battery
3. Fire from EV and ICEV pose the same risk
4. Regulatory bodies are addressing the matter
5. We are capable of identifying problematic EV
6. We can monitor the situation on board
7. We can manage to reduce the risk
8. We can address the emergency when triggered
9. The existing vessels can withstand the risk
10. The aftermath of an emergency is clear and understood

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1 - EV will be soon in great number

- Yes, it is a clear trend, pushed not only by real need, but also by strong pressure from public opinion or at least from a part of it.
- There are and there will be stepbacks, but most likely the Governments will override them.

Known Known

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2 - All the EVs are similar, regardless of type of battery

Lead Acid Battery. The lead acid battery was predominantly used in Electric Vehicles. It was used as an EV vehicle battery till the 80s. It is low in cost and has good efficiency. But this technology has vanished with the arrival of the Lithium-ion battery, because Lead acid batteries are heavier and have a low energy density. Still, Lead acid batteries are used for low-power applications and power backup applications.

EVs and Maritime Insurance
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2 - All the EVs are similar, regardless of type of battery

Nickel-Cadmium (NiCd) Battery. Though Nickel-Cadmium batteries had exceptional energy density and high efficiency, they had a low cycle life. They dominated the market till the early 90s. Despite its superior properties, it is not preferred for modern electric vehicles. They were used as EV car batteries during the 90s but were soon banned because of their toxicity. The manufacturing process was also expensive, which made researchers look into alternatives.

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2 - All the EVs are similar, regardless of type of battery

Nickel-Metal Hydride (NIMH) Battery. NIMH batteries are a modified version of Nickel Cadmium batteries. Nickel-Metal Hydride batteries are used in MHEV, which does not require an external source for charging. NIMH batteries have a high self-discharge rate, yet they are used in Hybrid vehicles as they are much safer and the probability of explosion is relatively low.

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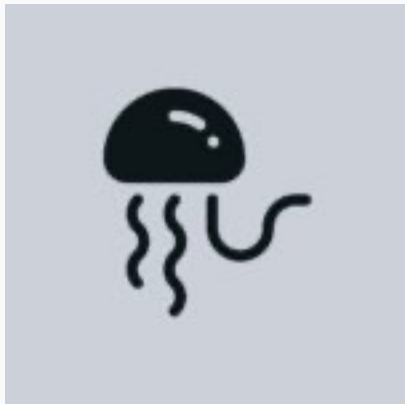
2 - All the EVs are similar, regardless of type of battery

Lithium-ion (Li-ion) Battery. Lithium-ion is the most common battery that can be found in electric vehicles. Because of its high energy-to-unit mass, it is chosen as an EV vehicle battery. They are light in weight and have a low self-discharge level, which means it does not discharges energy in idle conditions. Most of today's Electric Vehicles and Plug-in Hybrid Electric Vehicles deploy Li-ion batteries to power the motor.

- Lithium iron phosphate (LFP)
- Lithium Nickel Manganese Cobalt (NMC)
- Lithium Nickel Cobalt Aluminum Oxide (NCA)
- Lithium-Ion Manganese Oxide (LMO)
- Lithium-Ion Cobalt Oxide (LCO)
- Lithium Titanate Oxide (LTO)

Unnown Known



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3 - Fire from EV and ICEV pose the same risk

"The fire load that they [EVs] have, their energy source, is 20% and 80% is the rest of the car, the surroundings, the plastics. When you've got internal combustion engine cars, there's likely to be a pool fire because of the fuel that gets out of the tank."

Hendrike Kühl,
policy director of the International Union of Marine Insurance (IUMI)

- Amount of water necessary to extinguish the fire of a single car: 30,000 ltrs for EV, 1,400 ltrs for ICEV (Australian Firefighters Union)
- Possibility of re-ignition
- Differences in combustion gases
- Different requirements for firefighting suits

Known Unknown

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4 - Regulatory bodies are addressing the matter

There are currently no requirements from the International Maritime Organisation (IMO) specific to the carriage of electric vehicles on passenger or cargo ro-ro vessels.

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IMO Sub-Committee on Ship Systems and Equipment (SSE 9)
27 February-3 March 2023

- Ships constructed on or after 1 January 2026
- Fixed fire detection and fire alarm system for weather deck intended for the carriage of vehicles;
- Video monitoring system ro-ro spaces;
- Improvements for structural fire protection;
- Fixed water-based fire-extinguishing system based on monitors to cover weather decks for vehicles.

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4 - Regulatory bodies are addressing the matter

On vessels subject to SOLAS, the provisions of the International Maritime Dangerous Goods (IMDG) code apply to “small electric vehicles such as electric bicycles and kick bikes” and are classified as Dangerous Goods as UN 3171 BATTERY-POWERED VEHICLE or BATTERY-POWERED EQUIPMENT.

Special provision 388 specifies that battery powered vehicles are self-propelled apparatus designed to carry one or more persons or goods, for example bicycles (pedalcycles with a motor) and self-balancing vehicles.

Special provision 961 statesthat those vehicles are not subject to the provisions of the IMDG code if they are stowed in the vehicle, special category, or ro-ro space, or on the weatherdeck of a roll-on/roll-off (ro-ro) ship.

If these conditions are not met, the vehicles should be assigned to class 9, and fulfil the provisions of the IMDG code.

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4 - Regulatory bodies are addressing the matter

All batteries above 100 Wh should be provided with appropriate third-party Conformity Assessment such as UKCA or equivalent and be in compliance with IEC 62619 and/or IEC 62620 where appropriate. Batteries and associated systems, such as chargers, should be sourced from reputable manufacturersand retailers, and have appropriate certification.

Damaged batteries must not be charged, and any charging should be ceased immediately if damage occurs during charging.

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4 - Regulatory bodies are addressing the matter

In all spaces used for the storage of electric powered personal watercraft, electric tenders and/or Li-ion (or similar) batteries of over 100 Wh, any electrical equipment should either be of certified safe type (Ex T2 IIC or equivalent) or should be able to be electrically isolated from a safe location outside the space.

The spaces should be equipped with certified safe type (Ex T2 IIC or equivalent) emergency lighting & low location lighting to mark escape ways.

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4 - Regulatory bodies are addressing the matter

- Lighter materials of EV bodies tend to be more combustible than more traditional materials and the risk of being ignited needs to be condidered in addition to the risks of combustible gas generated by the EV being ignited.
- The chemical reactions occurring during thermal runaway generate combustible gases, toxic gases and oxygen. Hydrogen fluoride, in particular, is extremely toxic and poses immediate danger to human life.
- The risk of electric shock due to possibly spraying water on healthy battery cerlls needs to be considered.

Class NK – Guidelines for the Safe Transportation of Electric Vehicles

EVs and Maritime Insurance

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4 - Regulatory bodies are addressing the matter

There are no shared rules.

In practice, each society establishes different rules, fueling uncertainty.

Corsica Linea has established a rule for anyone who wants to board one of its ferries with an electric vehicle: drivers, in fact, are invited to show up with a battery charge of no more than 30%.

Some companies such as the Norwegian Uecc have set a range between 20% and 50% for the transport of electric vehicles.

Another Norwegian company, Havila Kystruten, has instead banned the loading of any rechargeable vehicle, while Irish Ferries even provides a charging service on board.

This is proof of how precise and common rules do not exist.

Quattroruote

Known Unknown

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5 - We are capable of identifying problematic EV

- Likeliness of thermal runaway depending from age of batteries and their maintenance
- Mechanical damage increases risk of thermal runaway
- Level charge suggested to be within a range
- Doubts on re-charging
- Reliability of second hand or refurbished batteries

Unknown Known or Unknown Unknown?

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6 - We can monitor the situation on board

Identification of electric vehicles during the booking process to aid the understanding of numbers of electric vehicles carried onboard and to separate pure electric vehicles from hybrid vehicles

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6 - We can monitor the situation on board

Use of wing mirror cards or other identifying markers would aid in the quick identification of electric vehicles by deck patrols and during loading.

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6 - We can monitor the situation on board

Operators may wish to position electric vehicles under drenchers, on weather decks or away from dangerous goods.

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6 - We can monitor the situation on board

The crew involved in car deck inspections may be supplied with and trained in the use of thermal imaging cameras.

Furthermore, operators should also consider the addition of closed-circuit television (CCTV) which can incorporate a flame recognition system.

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6 - We can monitor the situation on board

Fire patrols should pay special attention to look for evidence of smoke or heat from the areas of vehicles where a battery is normally located, for example the underside. They should also listen for “popping sounds” which may be indicative of a potential thermal-runaway event.

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6 - We can monitor the situation on board

Any specialised response to electric vehicle fires should be incorporated into the vessels established fire drills.

A response plan for electric vehicle fires should be included in the vessels Safety Management System (SMS) and be regularly reviewed be the operator. The response plan should be risk assessed by the operator.

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Known Unknown

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7 - We can manage to reduce the risk

- China was holding a 76 percent share of the global lithium-ion batteries production capacity in 2022.
- As of 2023, the country's lithium-ion batteries capacity was over 10 times larger than in the United States, the second-largest producer of this energy storage technology.

www.statista.com

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7 - We can manage to reduce the risk

- In 2021, China was the powerhouse of electric vehicles lithium-ion battery manufacturing, producing around 80 percent of batteries that entered the global market.
- It is expected that, by 2030, China will be manufacturing some 68 percent of the world's lithium-ion batteries, while European production is estimated to account for around 11 percent.

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7 - We can manage to reduce the risk

- No assessment is possible on installed batteries
- No tool exist to monitor the status and condition of batteries.

Unknown Unknown

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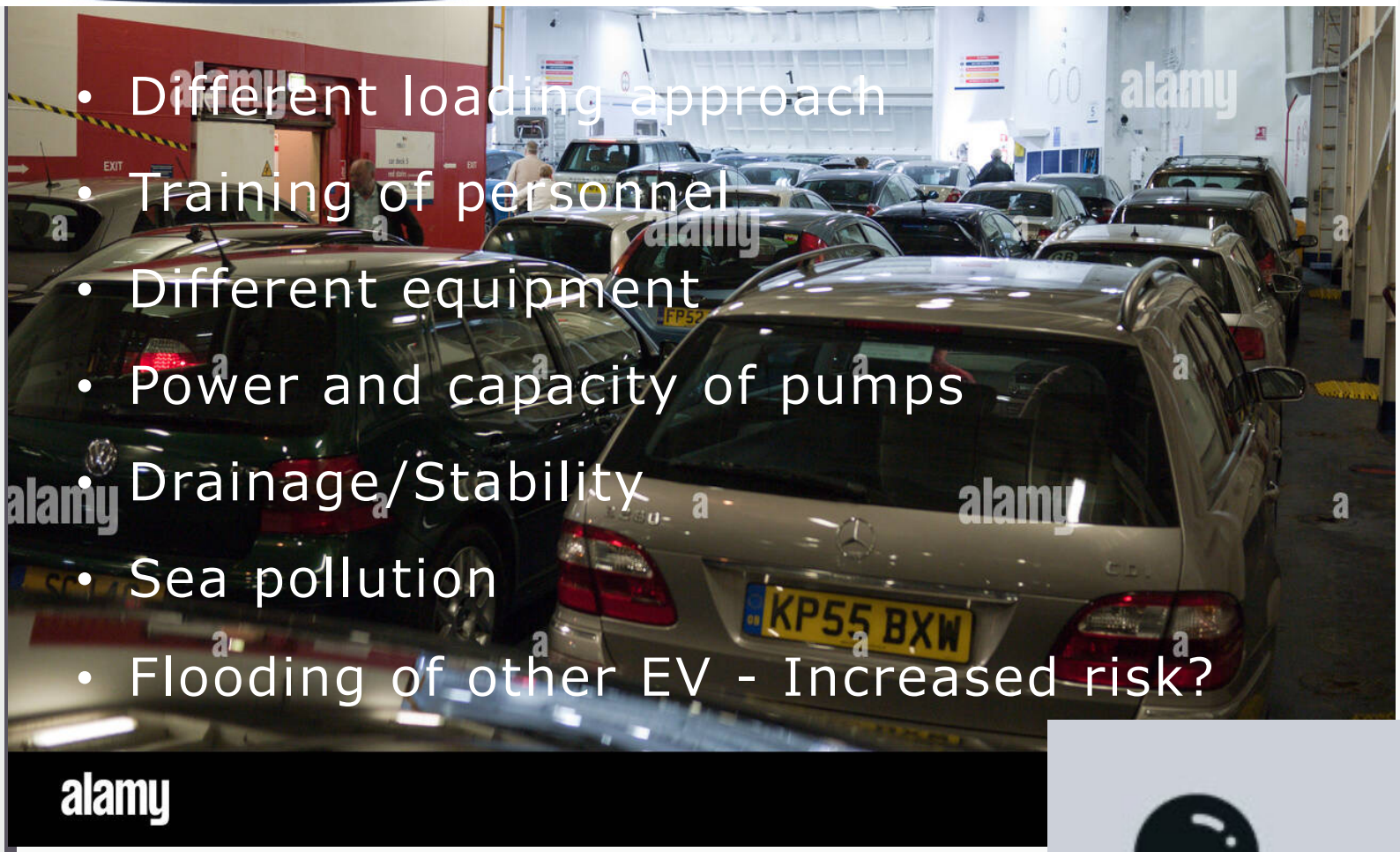
8 - We can address the emergency when triggered



- Different loading approach
- Training of personnel
- Different equipment
- Power and capacity of pumps
- Drainage/Stability
- Sea pollution
- Flooding of other EV - Increased risk?

Unnown Known

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9 – The existing vessels can withstand the risk

- To leave gaps between EVs - Lashing plans to be reconsidered

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9 – The existing vessels can withstand the risk

- EVs are 25% heavier than equivalent ICEVs – Loading plans and calculations to be revised

EVs and Maritime Insurance

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9 – The existing vessels can withstand the risk

- Early detection – Smoke detectors insufficient, new type of heat detectors, off-gas detectors, low location

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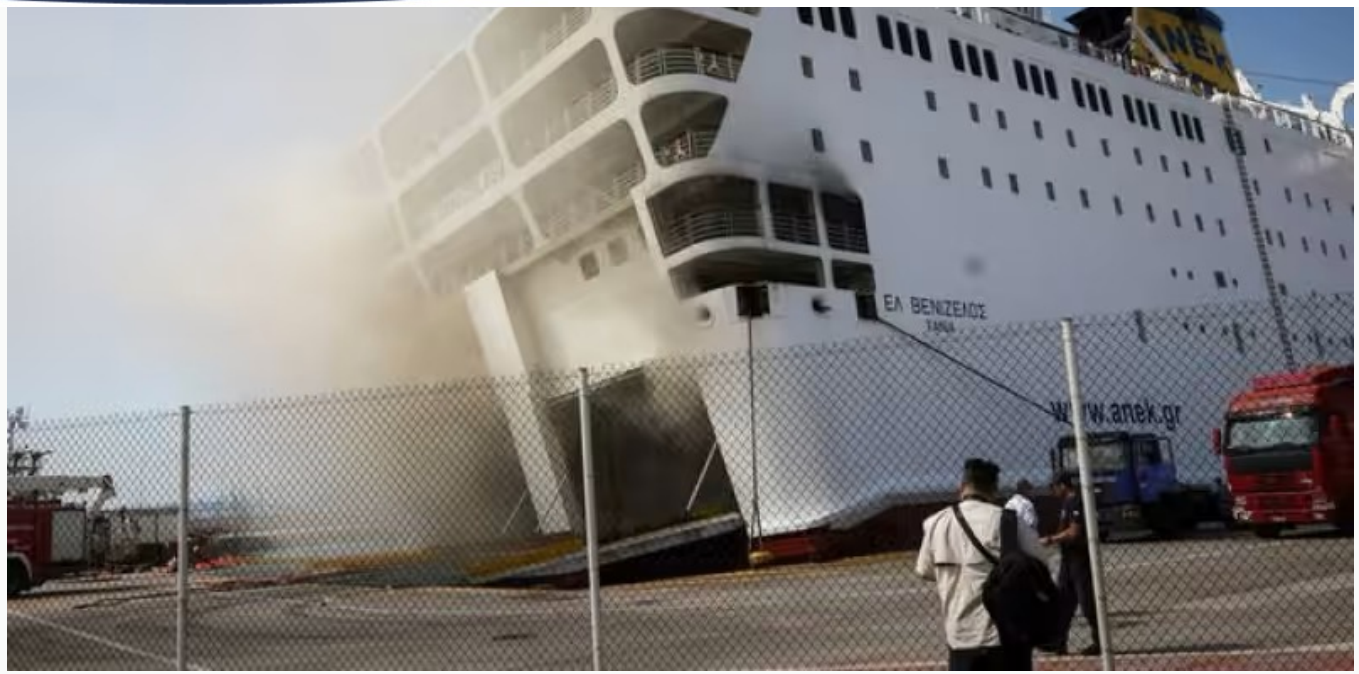
9 – The existing vessels can withstand the risk



- Huge amount of water needed at early stage – Drainage systems to be reliable

Unnown Known

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10 – The aftermath of an emergency is clear and understood

- Unloading damaged cars
- Necessity of quarantine
- Decontamination of equipment
- Disposal of damaged batteries

Unnown Known

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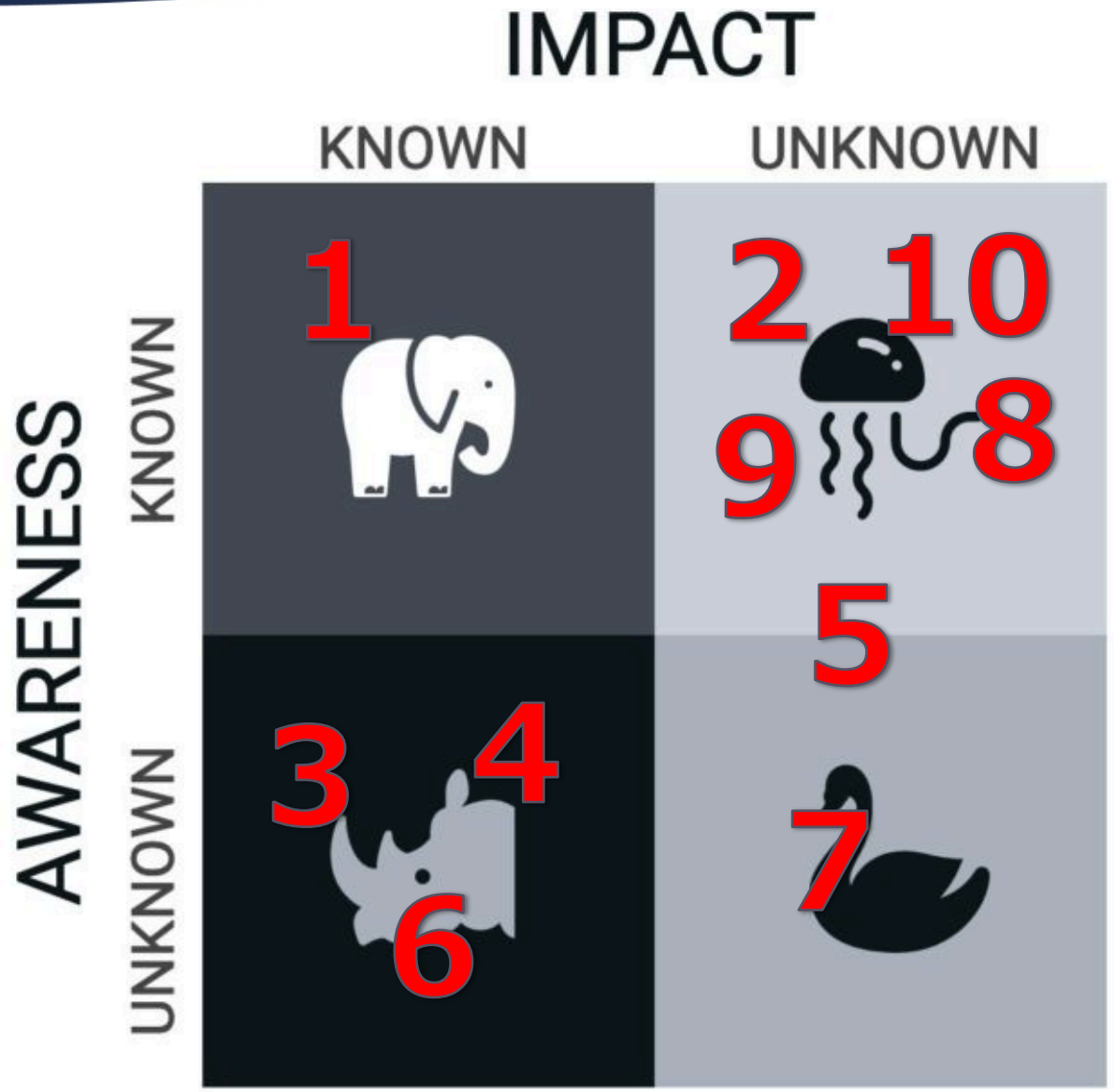
EVs and Maritime Insurance - Where are we? (2)



EVs and Maritime Insurance - Actions

First: Prioritize and address Known unknowns

Allocate resources to address these uncertainties through research, consultation, or experimentation

3. Fire from EV and ICEV pose the same risk

4. Regulatory bodies are addressing the matter

6. We can monitor the situation on board

EVs and Maritime Insurance - Actions

Second: Leverage Unknown Knowns

Incorporate the insights from the unknown knowns quadrant into your decision making process.

These previously hidden perspectives can lead to breakthroughs, challenge existing assumptions, or offer alternative solutions

2. **All the EV are similar, regardless of type of battery**
8. **We can address the emergency when triggered**
9. **The existing vessels can withstand the risk**
10. **The aftermath of an emergency is clear and understood**
5. **Are we capable of identifying problematic EVs?**

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EVs and Maritime Insurance - Actions

Third: Monitor and Respond to Unknown Unknowns

Despite your best efforts, unknown unknowns will always exist. Establish a process for continuously monitoring the decision environment and adapting to unforeseen events. Implement feedback loops, risk management practices, and contingency plans to stay agile and responsive to emerging uncertainties.

7. We can manage to reduce the risk

5. Are we capable of identifying problematic Evs?

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Elephant or Swan?

Rome, 20 February 2024

Thank you