



Vale's journey to Green Energy Vehicle

Vale Energy Transition Metals

North Atlantic Operates 7 Mines, 3 Mills, 1 Smelter and 5 Refineries in Canada, UK and Japan



2030 Vision for Green Energy Vehicles underground

2030 VISION

“ To successfully implement *low carbon mining vehicles* that **reduce GHG emissions** and **improve health and safety in the workplace**, driven by **challenging mine conditions at depth** and corporate sustainability goals which **prioritize environmental stewardship and zero harm operations**. ”



SUSTAINABLE

Initiatives are in-line with Vale's targets of a 33% reduction in GHG emissions by 2030, and net-zero by 2050



HEALTH-FOCUSED

Air quality and ventilation is improved in underground operations to better working conditions



RESULTS-DRIVEN

With innovative technologies, GEVs meet or exceed diesel equivalents in performance. Enabling mining at Depth

Vehicles Purchase History and Timeline



That's the new 2-yard **electric scooptram**, now in operation at Creighton mine. A new concept in load-haul-dump operation, the unit is operating in a cut-and-fill stoping complex on the 6600 level.

1976

Tethered 2-yard electric LHD at Creighton Mine (6600 Level)

Vehicles Purchase History and Timeline

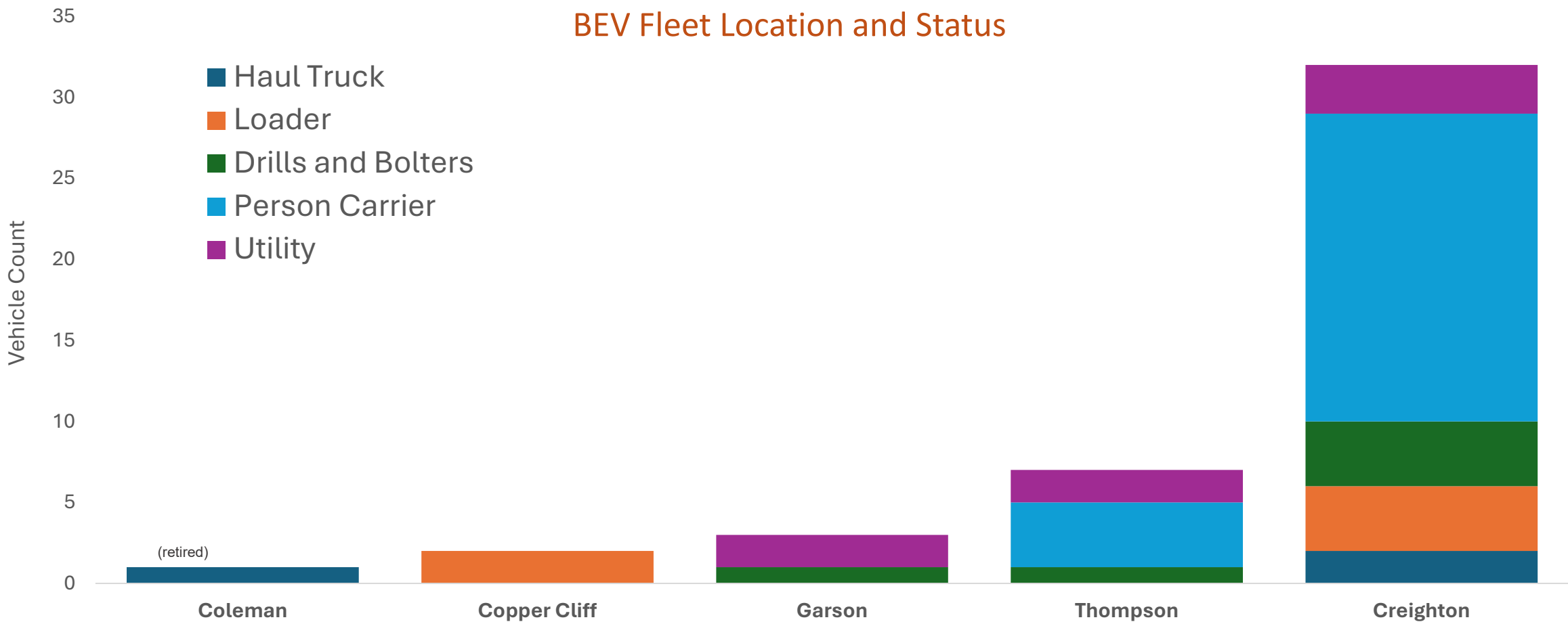


2026

Vale is currently trialing ~50 BEV's within North Atlantic Base Metal mines

Leveraging the investment made is top of mind. Operational feedback, vehicle data and telemetry, environmental monitoring and vehicle performance are key indicators that are determining the future viability of these technologies.

North Atlantic U/G BEV Portfolio



Few Lesson Learned along the way ...



Lesson Learned (1/2)



Economics

Increased Capex per unit and infrastructure cost

Increased Opex with BaaS vs fuel

Savings can be made on Ventilation requirement (40% to 60% in greenfield) or allowing access to constrained OBs



Wholistic business case is required



Look at both saving ventilation cost or increasing mining intensity



Not one solution works for all



Consider Electrification as part of your transformation journey



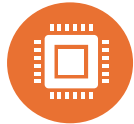
Performance

Higher Performance is observed with higher torque in muck pile and speed for trucking

Improved working conditions & morale

(Cooler air temperatures, Less noise, Cleaner air, Improved vehicle performance, Effective working hours per shift)

Lesson Learned (2/2)



Technology

Technology is rapidly evolving with new generation of equipment and chemistry



Work closely with OEMs as partners, build platform for ease of transformation

Knowledge is limited inside and outside the company



Build flexibility into design



Operational Readiness

Training operational and maintenance personal is critical for success



Advance strategical planning

Safety is a key concern for many

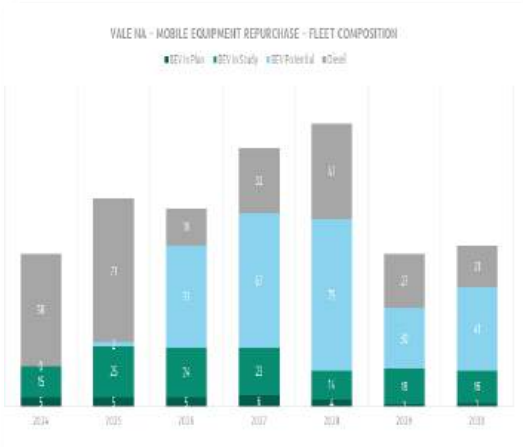


Build your own internal specifications, education, safety protocols, training, mock-up

There is still tremendous work to embed BEV equipment within our mines

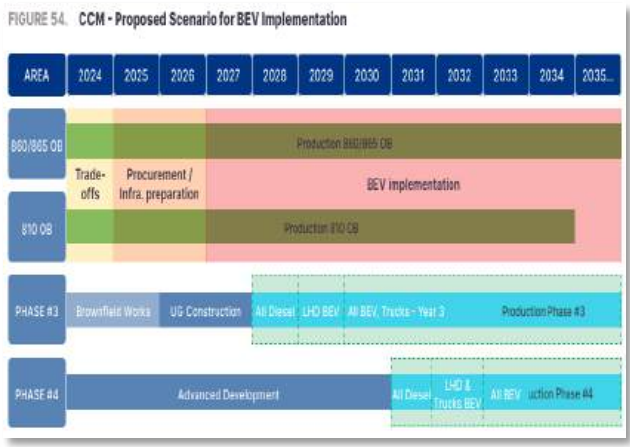
Execute current plan

Implement where we know there is Value



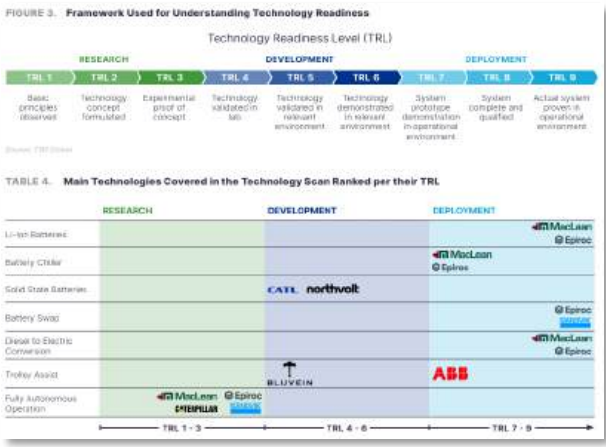
Assess the remaining uncertainty

Trade-offs Perform remaining Trade-off studies where path is unclear



Develop Technology

Continue to work on Technology development to offset current shortcomings (Dynamic charging, range anxiety e.g)



Many questions are still to be answered...

Technology Risk

- **Technology development**
Wait for the next generation or implement now?
- **Charging Strategy**
- **Adjacent Technologies**
How do EV's align with automation?

Implementation risk

- **Power Grid:**
Can we handle the draw for a full fleet? How to manage charging sequence as a new constraints for operations?
- **Change Management:**
How do we ensure success at the operation? Slow or fast implementation?
- **Operational Benefit**
Will we realize the savings we expect?

Market and supply

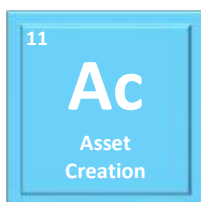
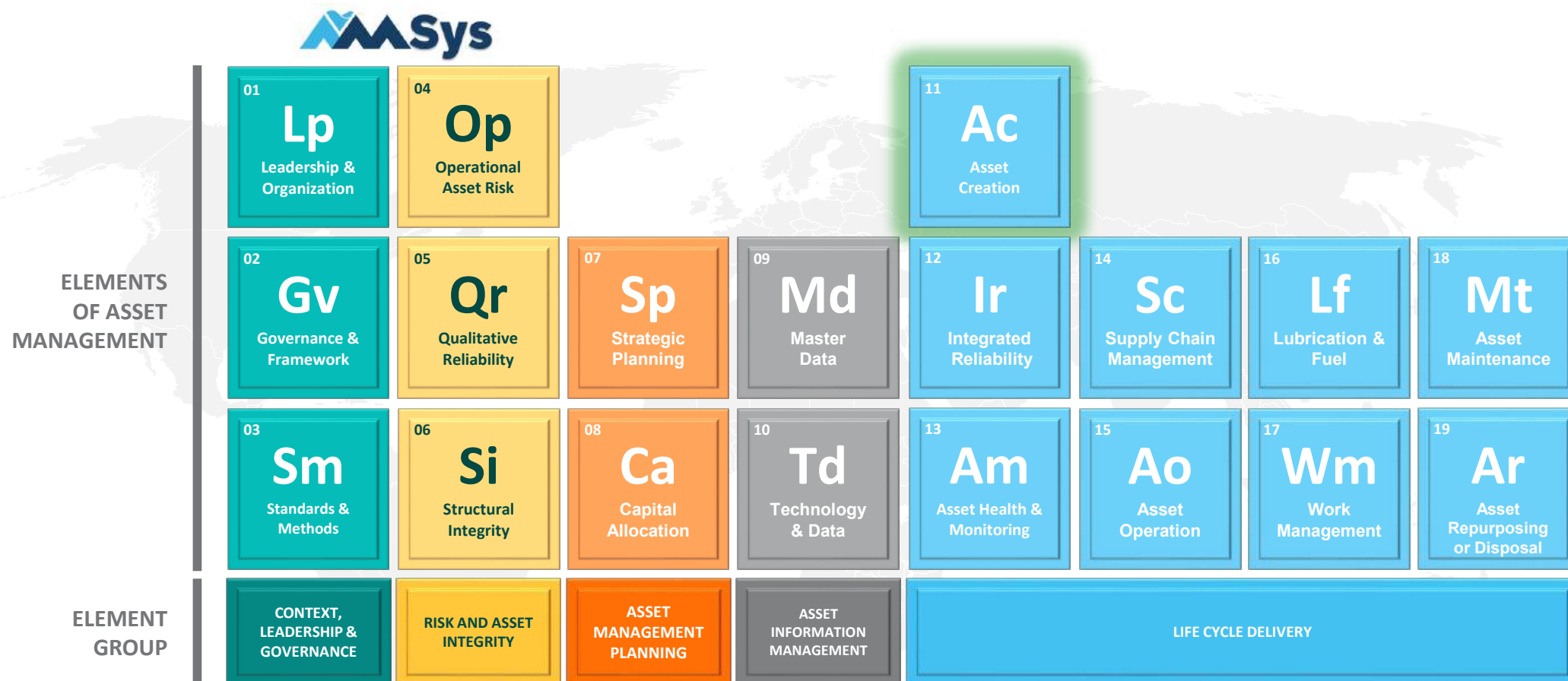
- **Market Supply**
Does it align with our needs ?
- **Sustainability**
Manufacturing location and its carbon footprint?

And Many others...

Asset acquisition process



AMSys – Asset Management System Model (elements)

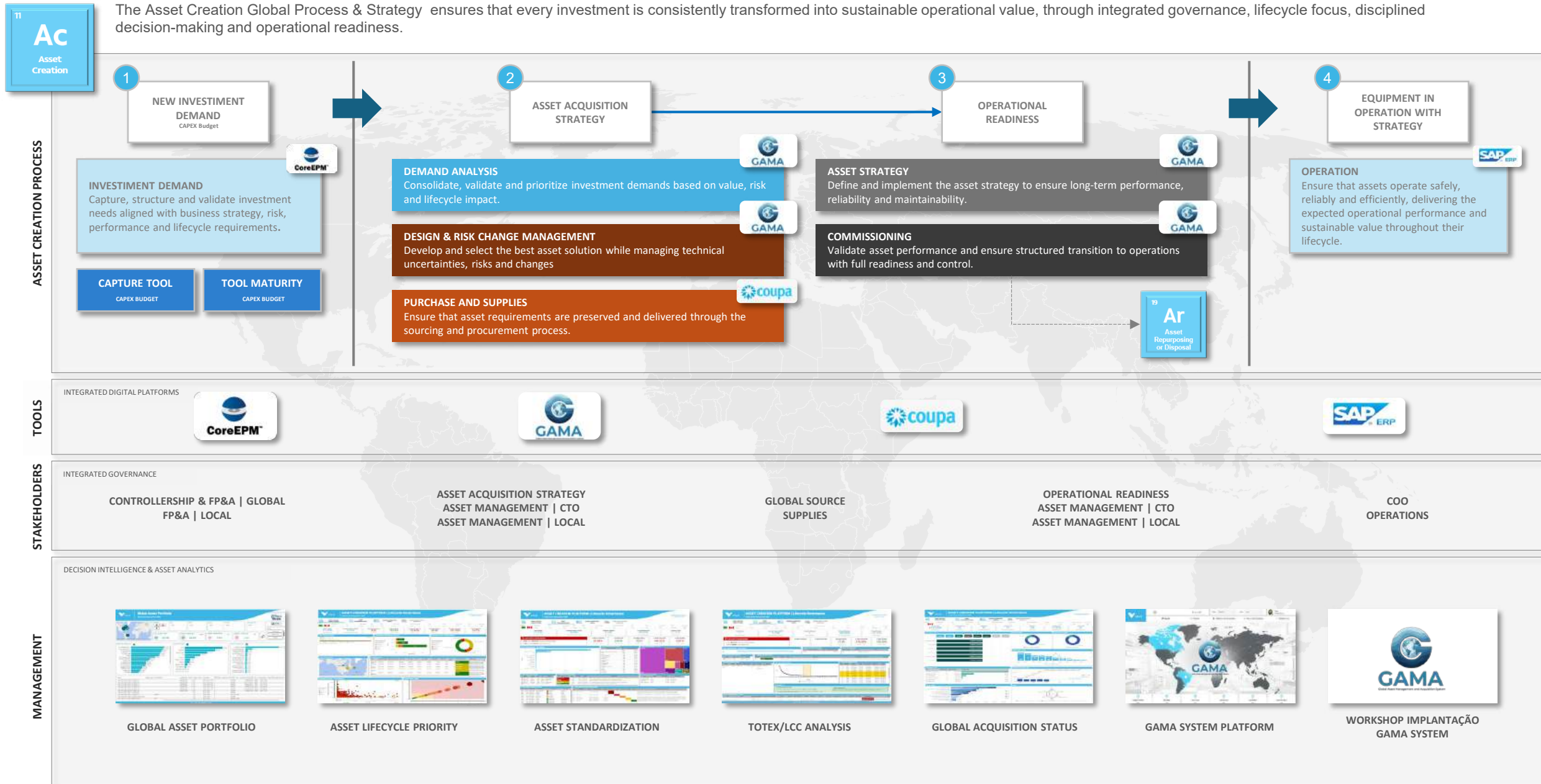


11. ASSET CREATION

Este elemento tem como propósito estabelecer, governar e assegurar o processo de criação de ativos, desde a definição da necessidade até concepção, projeto, aquisição, construção, instalação, comissionamento, prontidão operacional, handover e estabilização inicial, garantindo que novos ativos, substituições ou modificações atendam aos requisitos operacionais, de confiabilidade, manutenibilidade, integridade, segurança, riscos, requisitos regulatórios, tecnologia, padronização, benchmarking, inovação e eletrificação, sempre conectadas ao LoBP, ao SAMP e à geração de valor para o negócio.

O elemento é subdividido em duas especialidades: **Asset Acquisition Strategy** e **Operationa Readiness**.

VBM | ASSET CREATION GLOBAL PROCESS & STRATEGY | TURNING INVESTMENT DEMAND INTO SUSTAINABLE OPERATIONAL VALUE



ASSET CREATION FRAMEWORK | GAMA SYSTEM BASE

