U.S.-AFRICA CLEAN ENERGY STANDARDS PROGRAM

Energy Storage Opportunities and Lessons Learnt for Energy Storage Technologies

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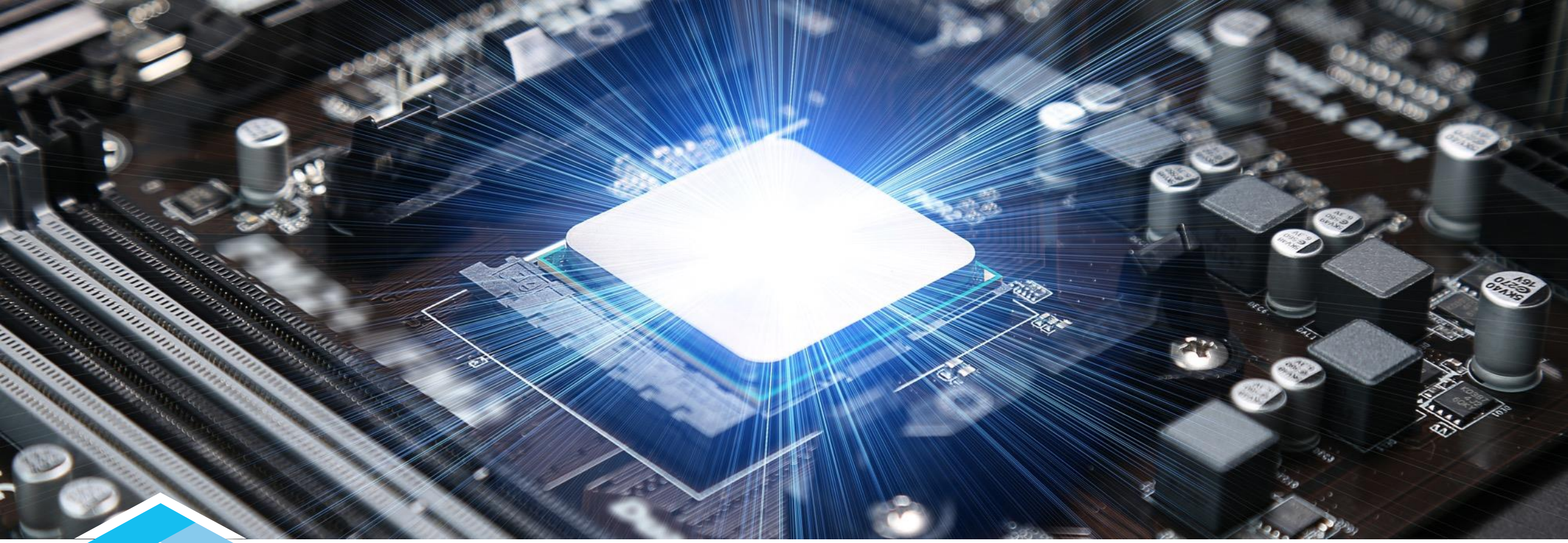
JABIL

Glossary - Acronyms

AC	Alternating Current
BESS	Battery Energy Storage System
DC	Direct Current
DSO	Distributed System Operator
IPP	Independent Power Producer
PPA	Power Purchase Agreement
PV	Photovoltaic
QoS	Quality of Service
RE	Renewable Energy
SR	Standards and Regulations
TOU	Time Of Use
UPS	Uninterruptible Power Supply

References:

EPRI (Electric Power Research institute) ESIC Commissioning Guide 2018 (November) – Draft for Review – 3002013972
SAESA (South African Energy Storage Association) Technology and Applications Sub-Committee Draft Document 2018



ENERGY STORAGE APPLICATIONS & BENEFITS

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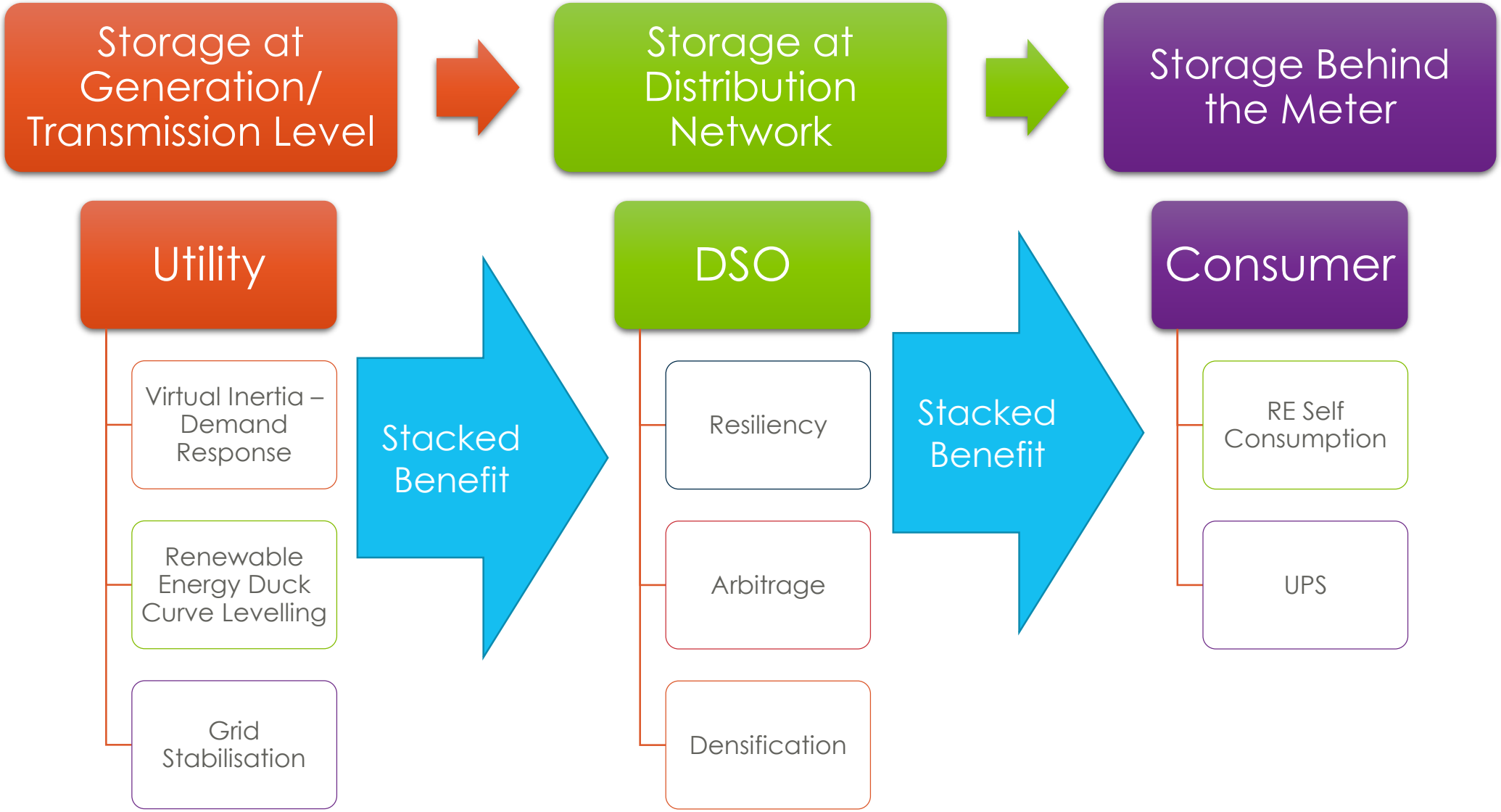
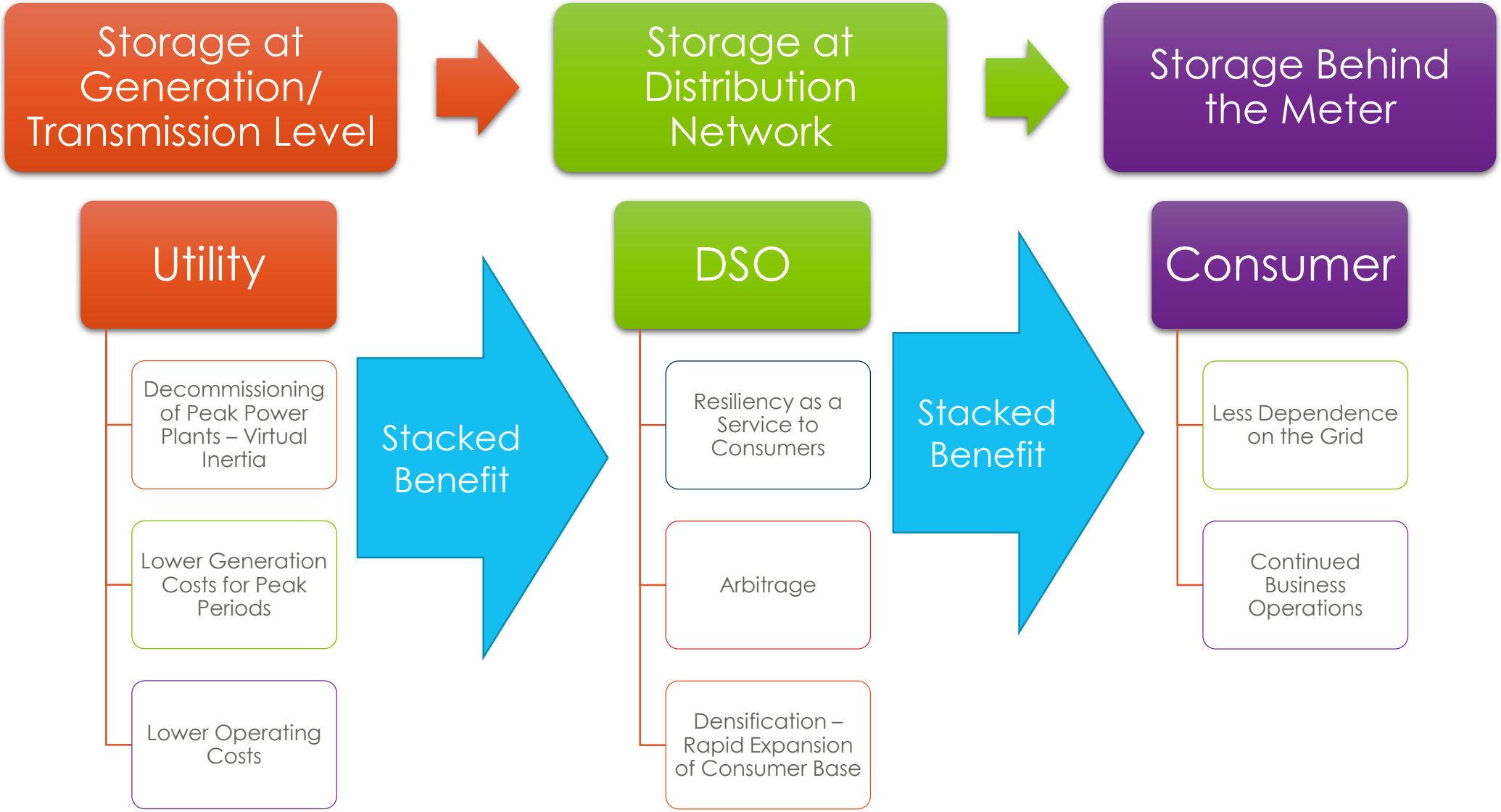
BENEFIT STACKING
STACKED TECHNICAL BENEFITS OF STORAGE ON GRID NETWORKS



BENEFIT STACKING
STACKED FINANCIAL BENEFITS OF STORAGE ON GRID NETWORKS



ENABLING THE ECONOMY
STORAGE FOR COMMERCIAL PREMISES

Customer Managed

Definition

- A grid-tied energy storage system that has an on-line UPS/ islanding mode to provide power during outages.
- Used daily for arbitrage and peak power management.

Owner/Location

- Electricity consumer or building owner/ landlord.
- Located behind the consumer billing meter.
- May be located behind any sub-metering/ pay as you go meter in a complex

Financial Benefits

- Business continuity in the event of interruptions.
- Daily TOU energy arbitrage and demand charge management.

DSO/ Utility Managed

Definition

- As above, but could also be expanded to the scale of a city block or a number of adjacent key customers in an industrial precinct that are on a common feeder.

Owner/Location

- The Distribution System Operator (DSO).
- Located behind the Utility Bulk Supply meter, but in front of the Customer meter.

Financial Benefits

- Business continuity for key customers
- New revenue potential for DSO's providing an improved Quality of Service (QoS.)
- Arbitrage benefit for the DSO at a bulk supply level
- Demand Response Programs with Utility .

MAXIMISING INVESTMENTS IN RENEWABLE ENERGY SYSTEMS
RE UTILISATION ENHANCEMENT

Business Single site / sites

Definition

- Store excess RE production, consume when the RE source is not available or during peak TOU.

Owner/Location

- A single site (RE and storage on same site} is simplest.
- A dual site scenario requires a wheeling agreement.
- The IPP/ property owner and any related business sites.
- Both RE source and BESS system are behind the end customer meter(s).

Financial Benefits

- Allows for full self-consumption of RE produced.
- The DSO benefits from a reduction in peak energy purchased from Utility.

DSO/ Utility Partnered

Definition

- Include BESS with RE power plants and the 'surplus' can be dispatched, at a time that benefits the DSO.
- The RE power plant and the BESS can be financially linked through common Utility/ DSO accounts, but exist at different locations where the storage can be strategically located elsewhere on the grid.

Owner/Location

- The IPP/ property owner owns both the RE power plant and the BESS
- The RE power plant on IPP/ property owner's premises
- BESS either on IPP/ property owner's premises or hosted by DSO where it is most beneficial to the grid.

Financial Benefits

- Allows for full self-consumption of RE produced.
- The DSO benefits from a reduction in peak energy purchased from Utility.
- Duck Bill Curve Levelling.

MAXIMISING INVESTMENTS IN RENEWABLE ENERGY SYSTEMS
RESIDENTIAL PROSUMERS

Residential Prosumers

Definition

- Residential PV typically has a surplus that can either be put to the grid or stored for later use.
- The surplus has value to the DSO in that the energy can be bought and sold to neighbouring loads at potentially better rates than Utility coal-fired power generation. Power Pools.
- RE stored and released during the residential evening peak, is a financial and technical benefit to the DSO.

Owner/Location

- The residential consumer, located behind the customer meter.

Financial Benefits

- Consumer – Self Consumption/ Resiliency
- DSO – Decrease TOU peak power tariff purchases.
- DSO – Demand Response Savings
- DSO – Grid support, overload protection etc.

PRESERVING GRID INFRASTRUCTURE
TRANSMISSION/ DISTRIBUTION NETWORK SUPPORT

Utility

Definition

- An energy storage system can be placed anywhere from the mid-point to the end of the feeder, or the mid-point of a ring feeder to avoid overload on a DSO network during peaks.
- Residential overloading is usually during the evening peak, this benefits both the Utility and the DSO.
- Virtual Inertia – Replacing peaking power plants

Owner/Location

- Utility/ IPP
- Transmission Network

Financial Benefits

- Utility/ IPP receives peak TOU energy revenue.
- Utility/ IPP can increase energy sales into constrained DSO networks

DSO

Definition

- Same as above at DSO network level.

Owner/Location

- DSO/ IPP
- Distribution Network

Financial Benefits

- Reduction in peak TOU energy charges.
- Reduction in reactive energy charges.

TARIFF ARBITRAGE & MAXIMUM DEMAND AVOIDANCE

DSO

Definition

- If a DSO intake point is operating above Utility maximum demand allowance, an energy storage system can alleviate this quickly if no additional capacity can be supplied by the Utility.
- Energy storage system would need to be at DSO network level to increase stacked technical benefits.

Owner/Location

- The DSO
- Located at primary transmission/ distribution grid feeders, but behind the Utility meter.

Financial Benefits

- Maximum demand penalty reduction.
- Network demand charge reduction
- Reactive energy charge reduction.
- Increasing capacity through storage is increasingly becoming cheaper than new bulk generation plants

IPP/ PPA based

Definition

- Overcome backlog in capacity enhancement and refurbishment through private investment into storage by IPP's

Owner/Location

- IPP's
- Located anywhere on the network, at the discretion of the DSO

Financial Benefits

- Maximum demand penalty reduction.
- Network demand charge reduction
- Reactive energy charge reduction.
- No capital outlay for constrained DSO's

SUPPORT FOR DENSIFICATION
AREA DENSIFICATION/ NEW DEVELOPMENTS

DSO

Definition

- Increase in population density due to availability of power in lower income areas. Typically informal dwellings.
- Characterized by short, high morning and evening peaks.
- An energy storage system located on the neighbourhood grid network, will service the load and avoid an overload.

Owner/Location

- DSO/ IPP/ Consumer
- DSO grid network
- Consumer – behind the meter

Financial Benefits

- Reduced cost of cross-subsidy energy for low income areas
- All stacked financial benefits

IPP/ PPA based

Definition

- Increased density in higher income areas.
- Community based PPA/ Power Pool.
- Municipalities will approve plans with lower electrical capacity requirements provided they are supported with conditions of restraint included in the title deeds.
- This provides a way to unlock otherwise constrained densification.

Owner/Location

- IPP
- Residential Body Corporate
- Property owner.
- Located behind the estate bulk supply/ consumer meter meter.

Financial Benefits

- For a municipality, these developments bring in additional rates revenues

PROVISION OF BASIC ENERGY SERVICES
ENERGY ACCESS - MICROGRIDS

Mini and Micro-grid

Definition

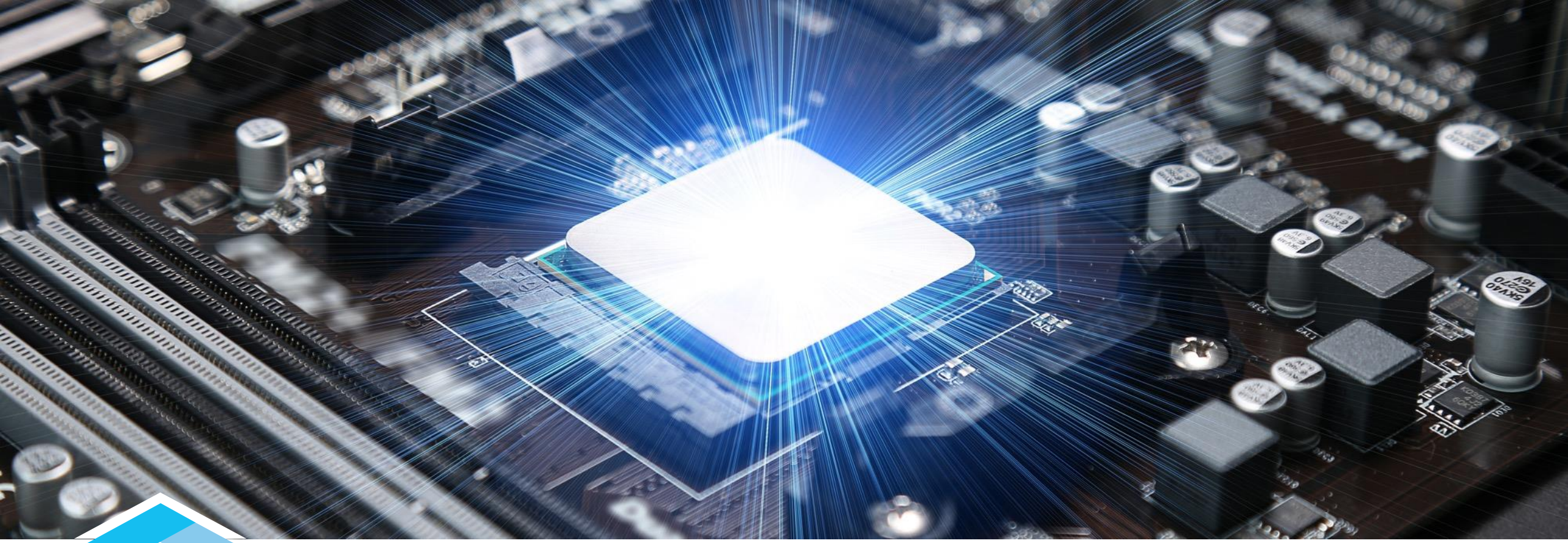
- Can be on or off-grid.
- Numerous sources of RE integrated.
- Expandable as the area densifies due to energy access.

Owner/Location

- Specialist IPP's
- DSO

Financial Benefits

- Ability to provide high value electrical services with minimal grid infrastructure



DEVELOPING SAFETY STANDARDS

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IDENTIFYING KNOWLEDGE GAPS

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General Gaps

Science Based Validation Techniques

- Methods of Testing, Inspection, Analysis to decide if an ESS deployment is safe.
- Validation could encompass the whole project life cycle, including:
- R&D, Manufacturing, Design, Installation, Construction, Commissioning, O&M, Decommissioning

Incident Preparedness Development Requirements

- Hazard/ risk analysis to determine emergency action plans for first responders.
- Training of Firefighters, Paramedics, First Responders

Utility/ DSO Gaps

New and Unique Challenges to Integration

- Complex Design Process

IDENTIFYING KNOWLEDGE GAPS

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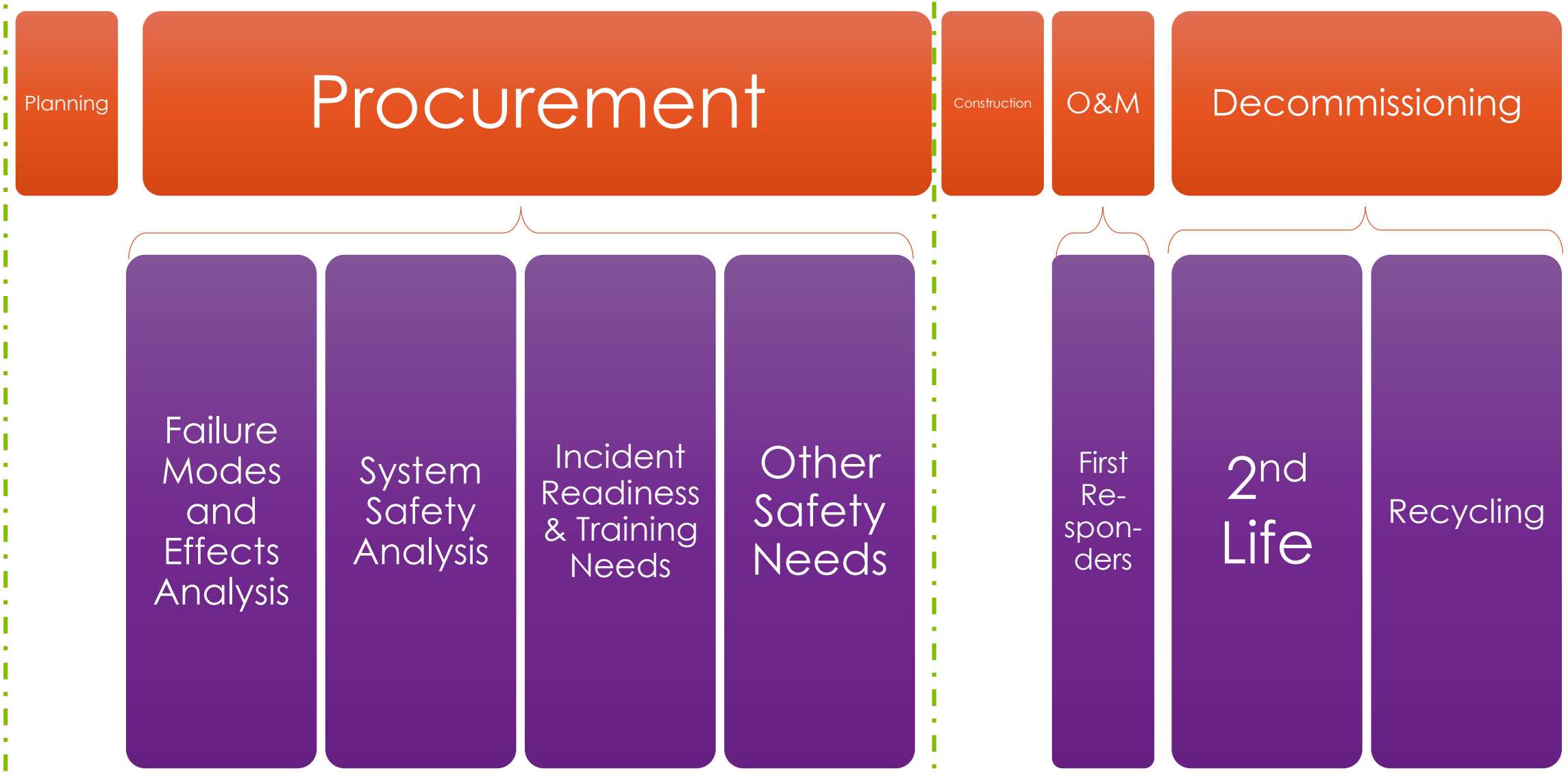
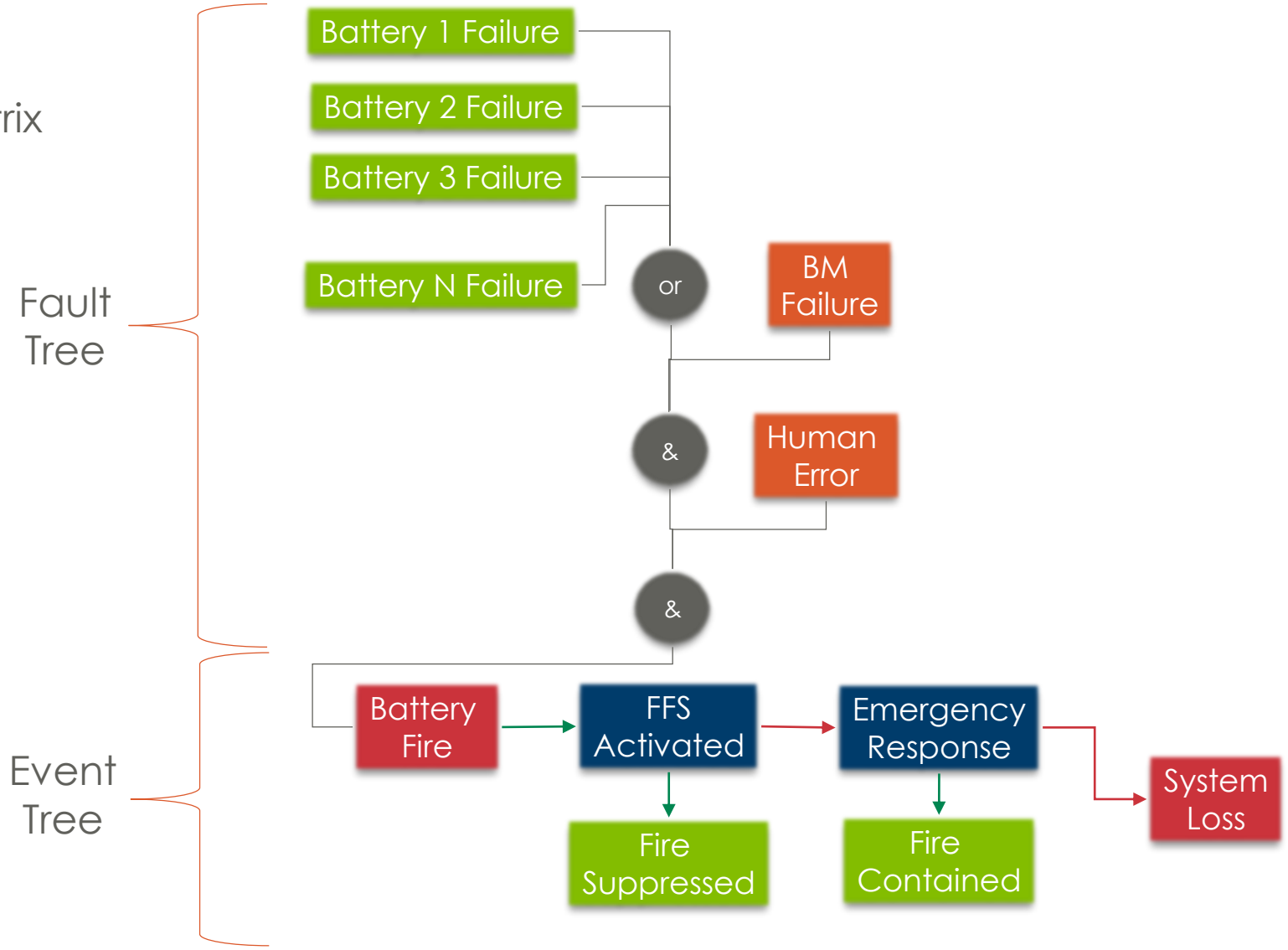
Plans to Address Gaps

ADDRESSING SAFETY IN:



ADDRESSING SAFETY

Risk Analysis Methods
An Example of a Probability Risk Matrix



STANDARDS AND REGULATIONS

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