

Accelerating Innovation for Cost Effective Energy Storage

Presented by
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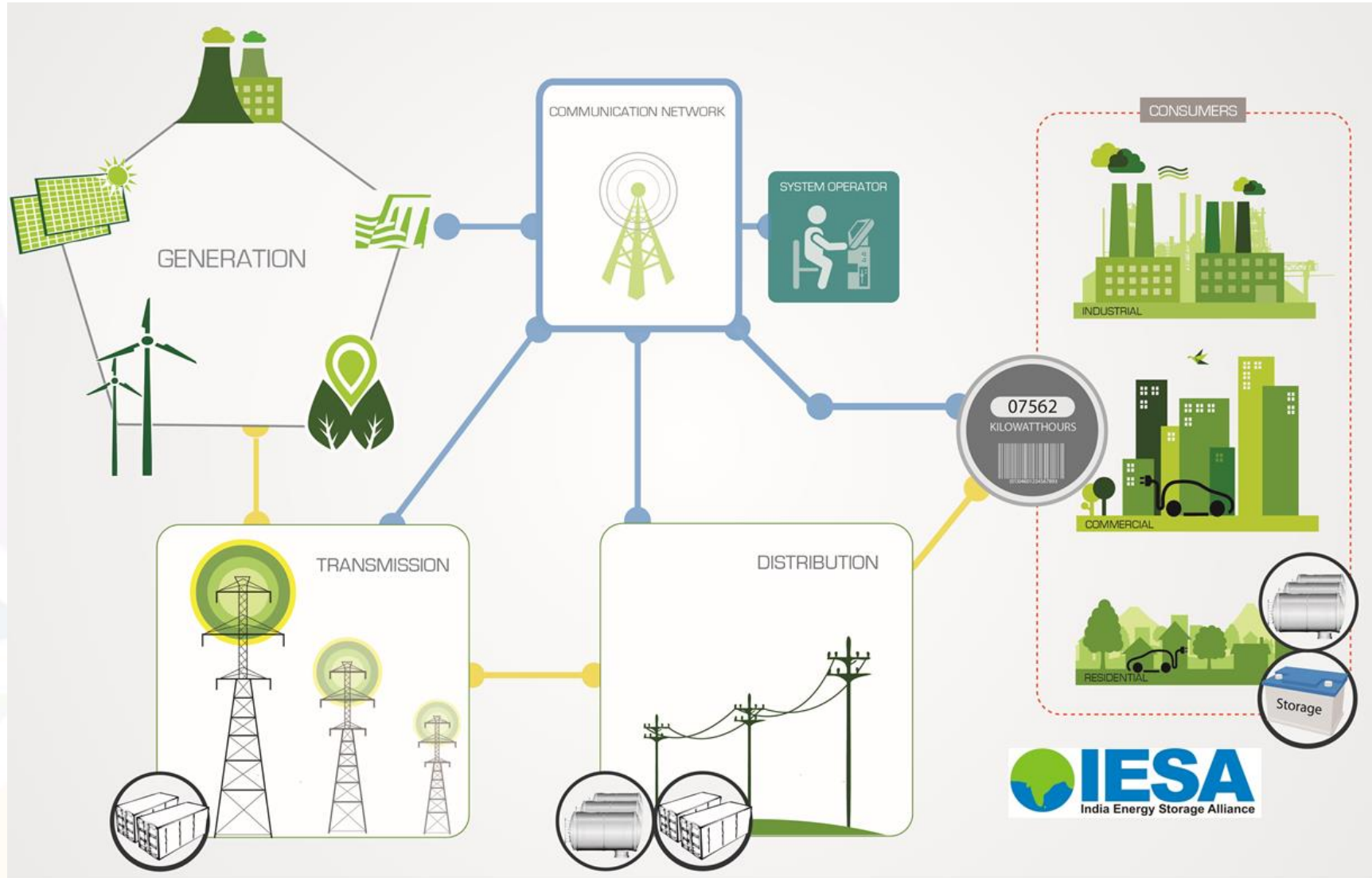


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ASIA CLEAN ENERGY FORUM 2015

Role of Energy Storage in Modern Indian Grid



Energy Storage Landscape 2015

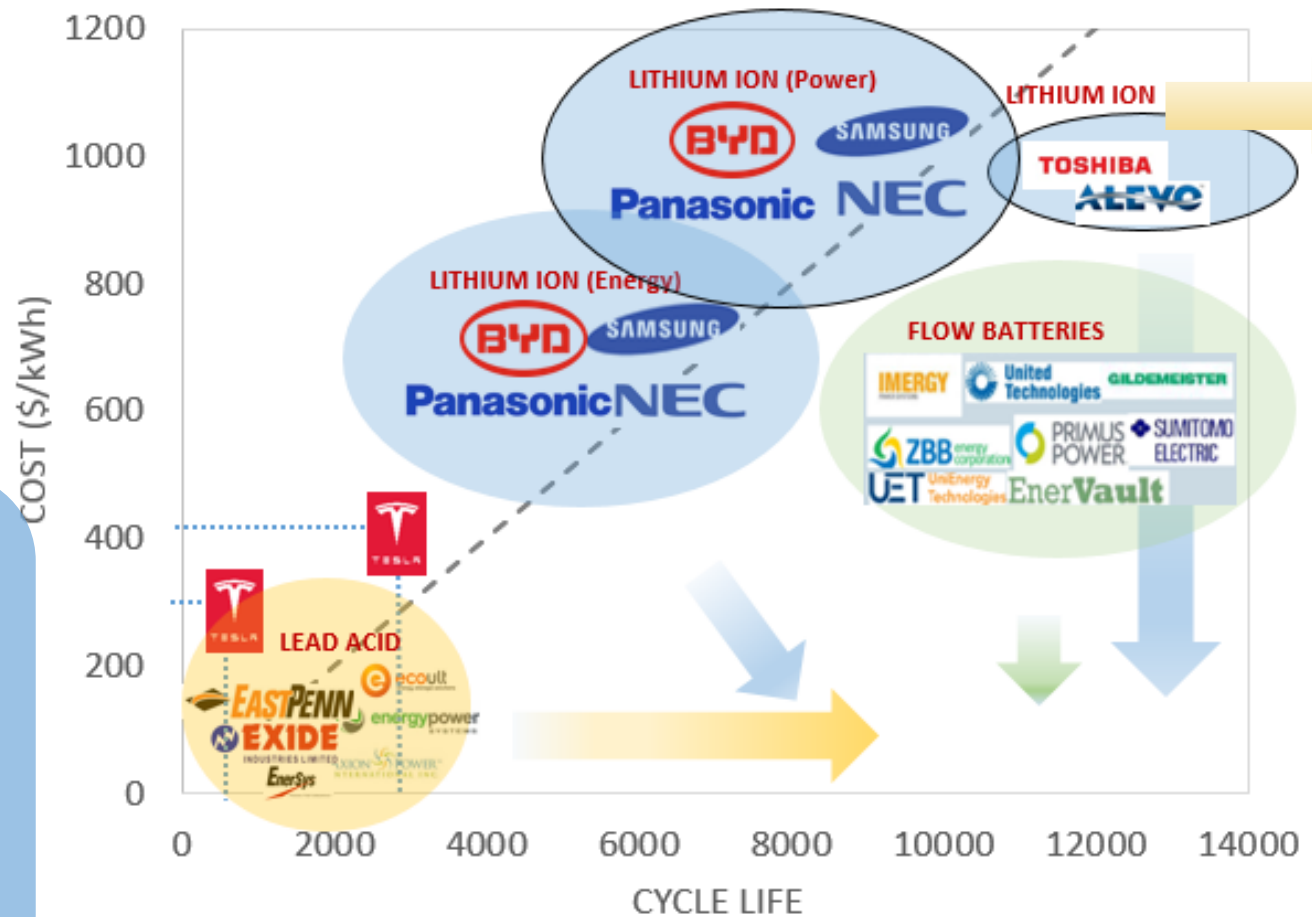
IPPs / Project Developers     			
      			
PCS / Inverter Supplier         			
Sodium Based   		Compressed Air  	
 		 	
Flywheel  			
Lead Acid      			
Li-Ion Batteries    		Flow Batteries   	
   		  	
    		 	

Energy Storage Performance Matrix

ENERGY STORAGE performance metrics:

- Capital cost (\$/kWh)
- Cycle life
- Roundtrip Energy Efficiency
- Space footprint
- C-rate (duration)
- Usable SOC range

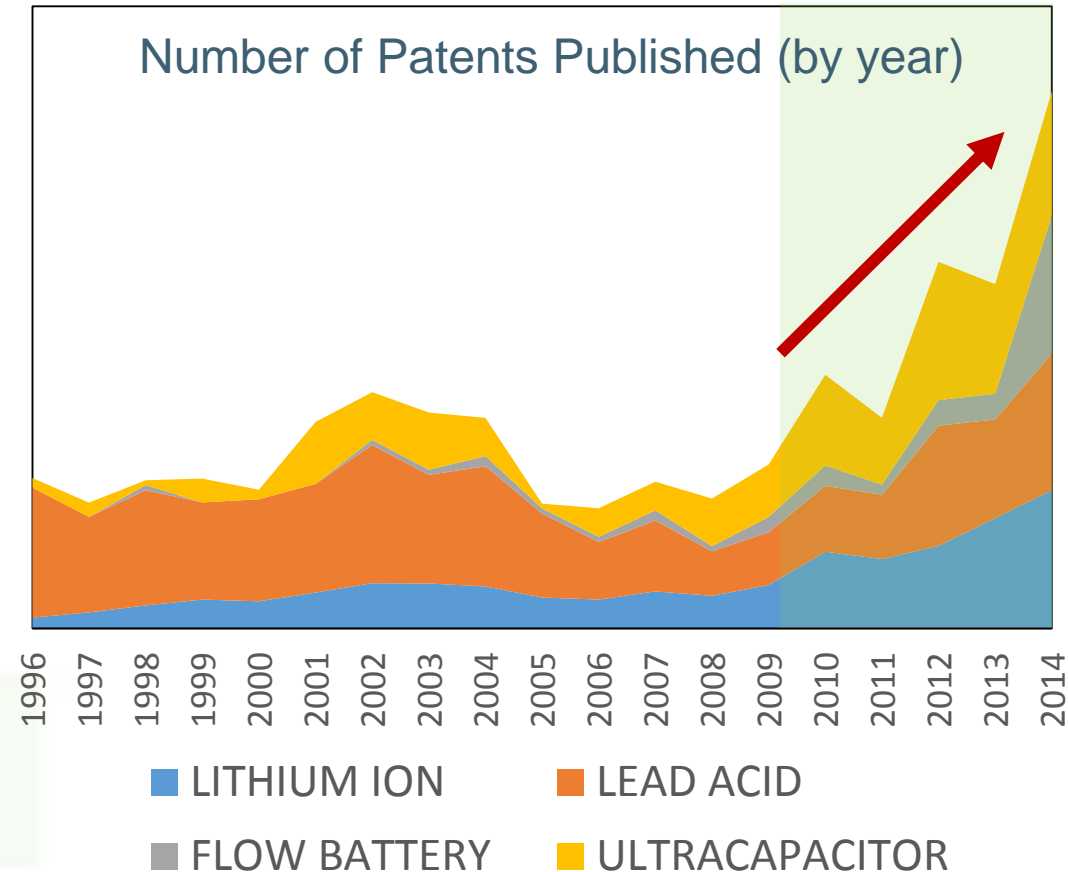
Lead Acid batteries are work horse for the industrial and residential backup and provide lower capital cost solutions. Li-Ion has emerged as the technology of choice for short duration applications & Flow batteries are vying for a position for longer duration applications.



Patent History of Energy Storage Technology

PUBLICATION STATISTICS

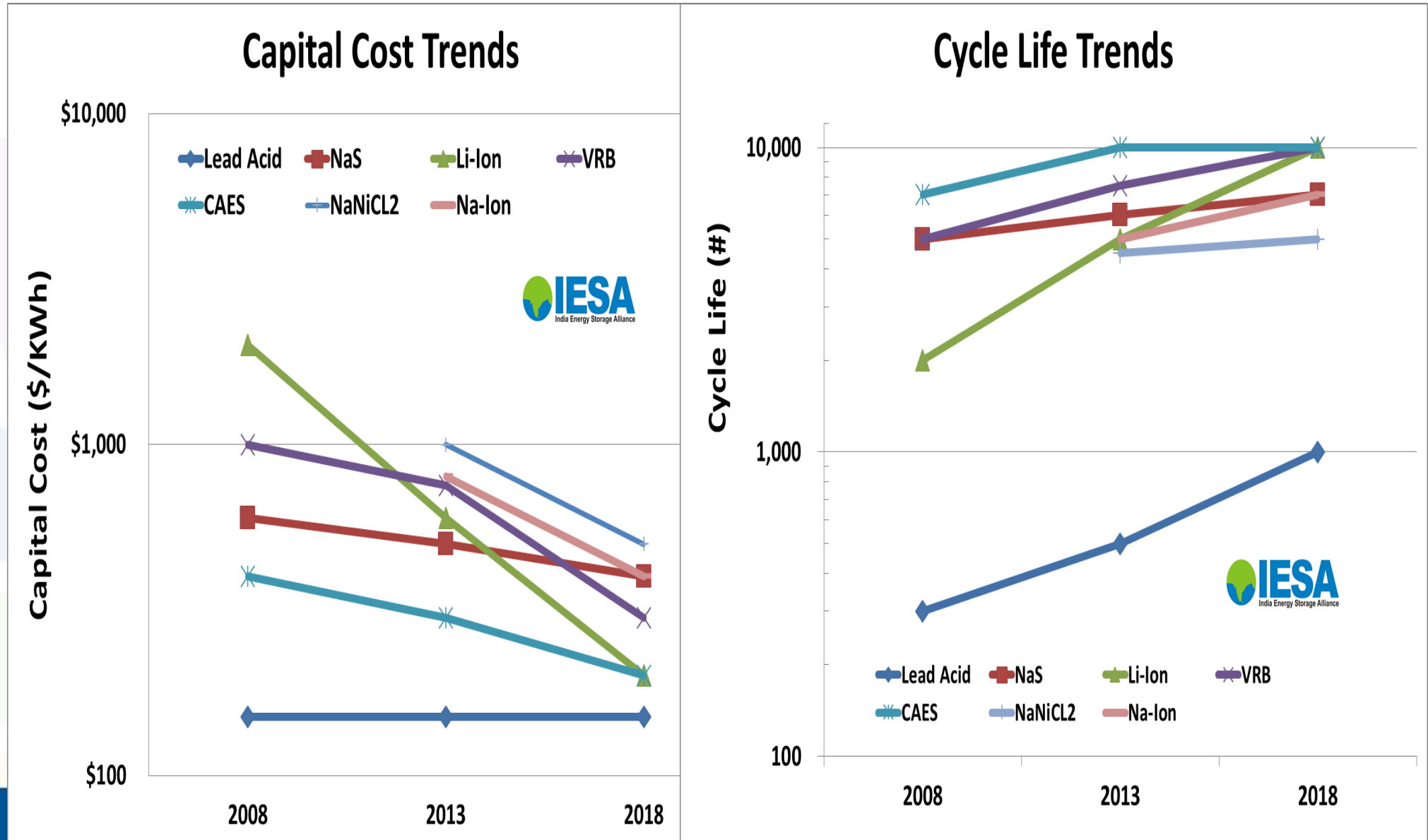
- 614 patents were granted in the year 2014 alone in US on various energy storage technologies
- 2009 onwards there is a significant increase in patents granted each year
- Current trends indicate that the development activity in energy storage is on an exponentially increasing trend
- It is expected that the next 5-6 years energy storage will witness enormous rate of innovation and many new technologies will reach a high level of maturity



As a result of the widespread applications of batteries such as renewable integration, electric vehicles, energy management, frequency regulation, the technology is progressing at a tremendous rate.

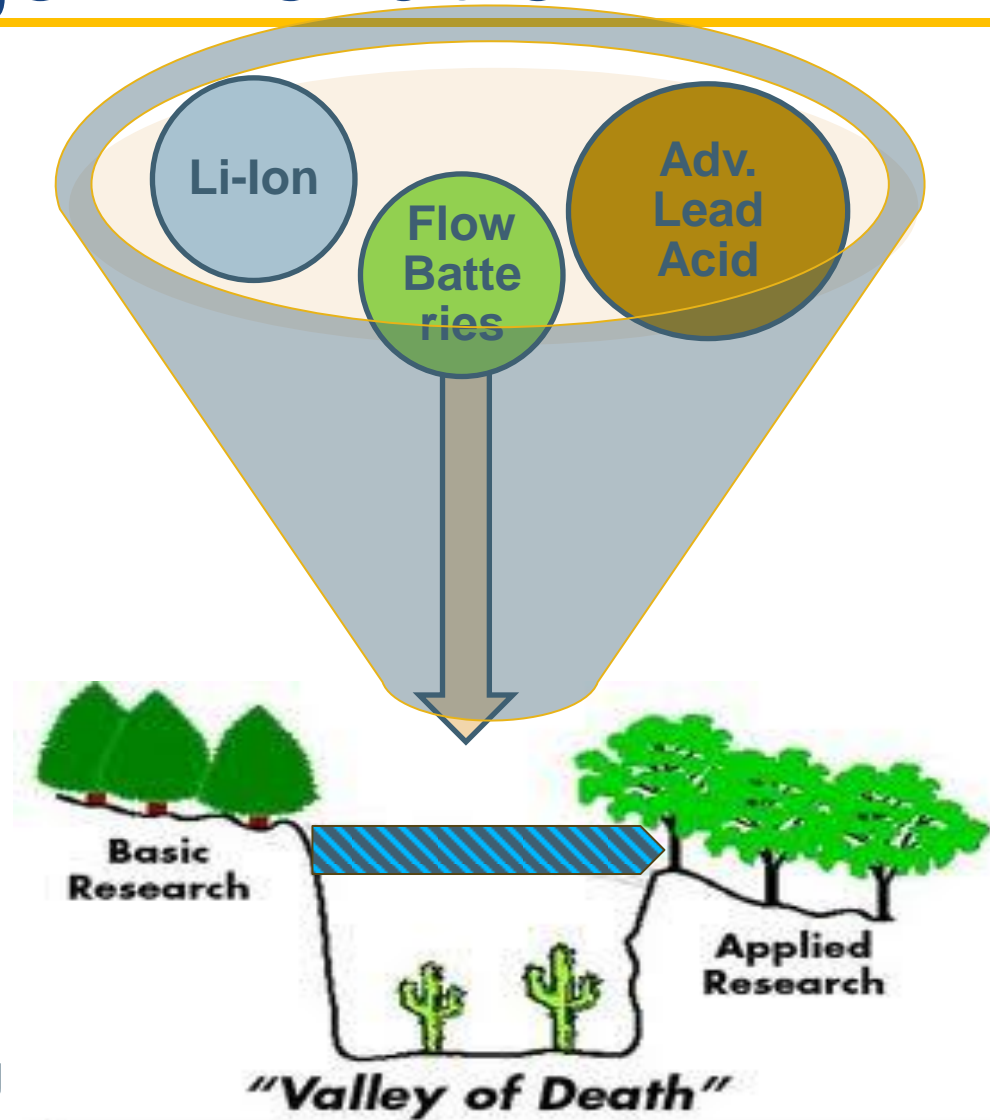
Source: Patents online search tool.

Key Trends in Energy Storage



Challenges in Energy Storage Innovation

- Materials & chemistries
 - ✓ Improving energy density
 - ✓ Improving power density
 - ✓ Improving safety
- Cell / Module / System design
 - ✓ Finalization on cell configuration;
 - ✓ Cell packaging & Proto-typing
 - ✓ PCS / Inverter design
 - ✓ BMS / EMS (IT applications)
- Go-to-market / Application Mapping
 - ✓ application & performance match
- Large-scale manufacturing
 - ✓ Developing supply chain & recycling



Vision for the India Energy Storage Accelerator

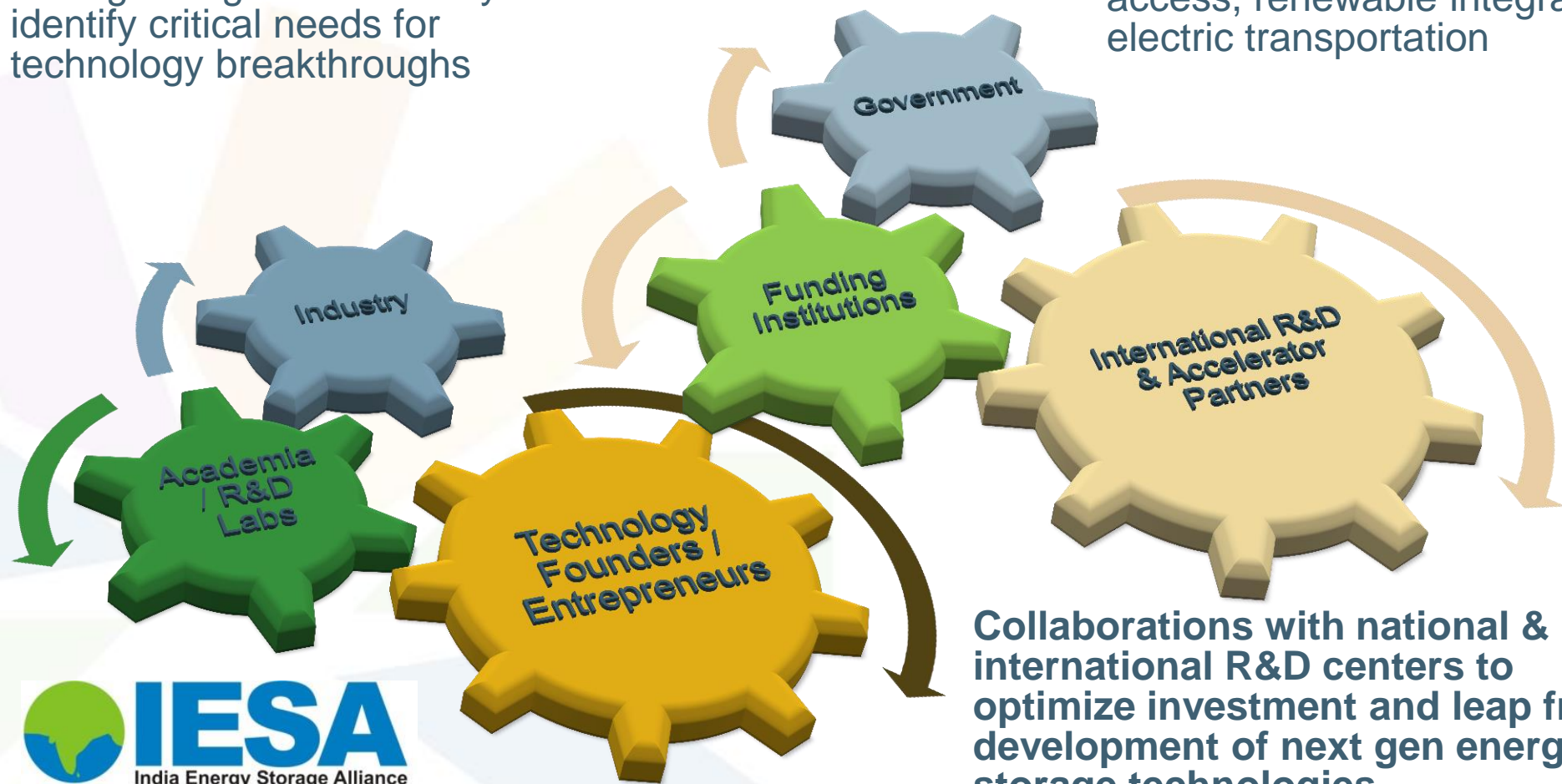
India is a wonderful lab. You innovate for India and the world will buy from you. – Late Prof C K Prahalad.

- India market could grow to 20GW + for advanced storage technologies by 2020
- India not only presents a large market but opportunity for Domestic Value Add & Reduced External Dependence
- Need to Foster Entrepreneurship in India & encourage collaborative IP creation
- India can offer Rapid Application Development
- India has the potential to become global hub for advanced energy storage systems, particularly for South East Asia & Africa.

Stakeholders for the India Energy Storage Accelerator

Strong linkage with industry to identify critical needs for technology breakthroughs

Aligning focus with national priorities such as energy access, renewable integration, electric transportation



Collaborations with national & international R&D centers to optimize investment and leap frog development of next gen energy storage technologies.

India Energy Storage Accelerator Process & Timeline



Conclusion

- Energy storage technologies are rapidly gaining adoption for variety of grid applications in recent years.
- India present huge market driven by need for diesel replacement, need for power reliability, renewable integration and energy access.
- India also present excellent opportunity for collaborations for R&D, manufacturing and exports
- We aim to make India Global Hub for next gen storage technologies
- India Energy Storage Accelerator is seeking partnerships with global R&D institutions and investors with goal of identifying 4-5 promising technologies that can transform industry by 2020.

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