



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

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UNIT IV: ENERGY STORAGE

TOPIC: **SUPER CAPACITOR BASED ENERGY STORAGE
AND ITS ANALYSIS**

PRESENTED BY

MANIKANDAN.S

19ME035

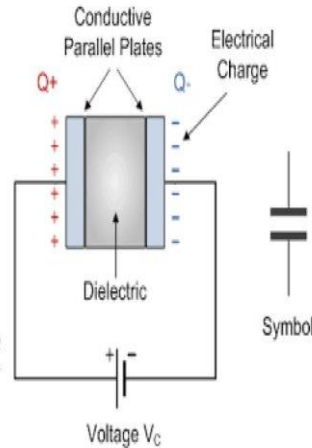
MECH A



CAPACITOR

CAPACITOR

- A Capacitor (originally known as condenser) is a passive two terminal electrical component to store energy in an Electric field.
- When a Capacitor is attached across a battery, an electric field develops across a dielectric, causing positive charge $+Q$ to develop on one plate and negative charge $-Q$ to develop on the other plate.



Capacitor have many important application

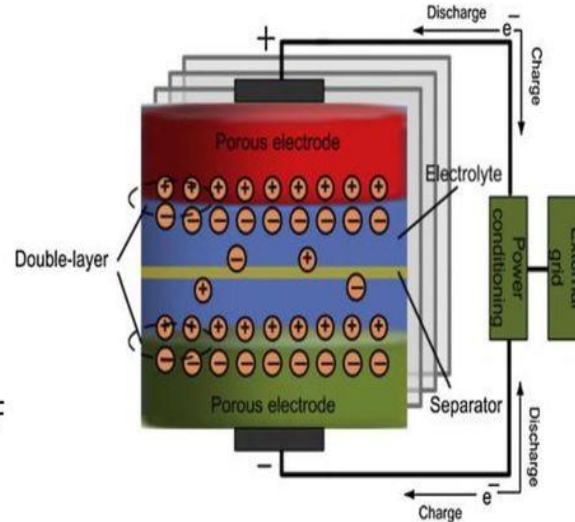
**Information stored in large computer memories
Is not lost during a momentary electric power
failure**

**The electric energy stored in such capacitors
maintains the information during the temporary
loss of power**



SUPERCAPACITOR

- A Supercapacitor is an electrochemical capacitor that has a very high energy density as compared to common capacitors, about 100 times greater.
- Supercapacitor is also known as an Electric Double layer Capacitor (EDLC) or an ultracapacitor.
- The Capacitance range is from 100F to 5kF.



4



HISTORY OF SUPERCAPACITORS

- In 1950s General Electric Engineers started experimenting components using porous carbon electrodes for fuel cells and rechargeable batteries.
- In 1957 H Becker developed a “low voltage electrolytic capacitor with porous carbon electrodes”.
- That Capacitor came to known as Supercapacitor as it stored very high amount of Energy.

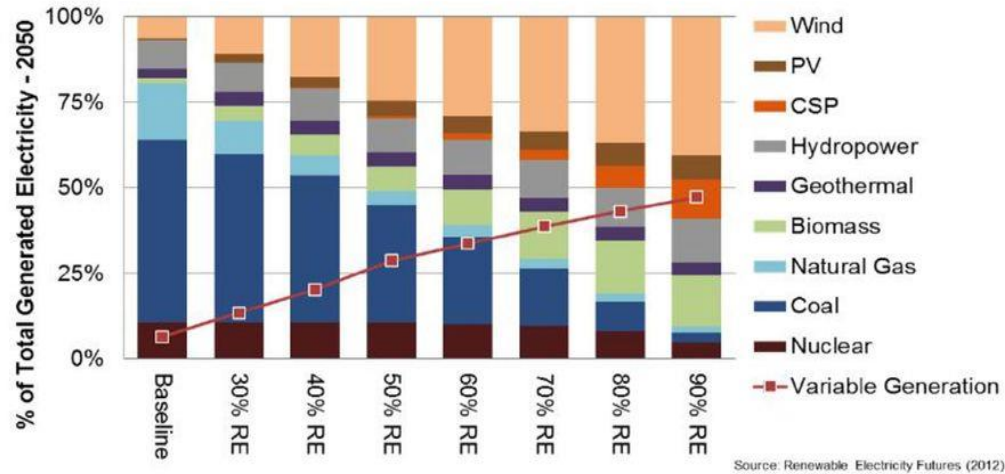


FEATURES OF SUPERCAPACITOR

- Stores high amount of Energy as compared to capacitors.
- Have high Capacitance.
- High rates of Charge and Discharge (i.e. High Power Density).
- Little Degradation over Thousands of Cycle.
- Low Toxicity.
- High Cycle Efficiency (95%).



RENEWABLE FUTURE STUDY SCENARIOS - 2050



7



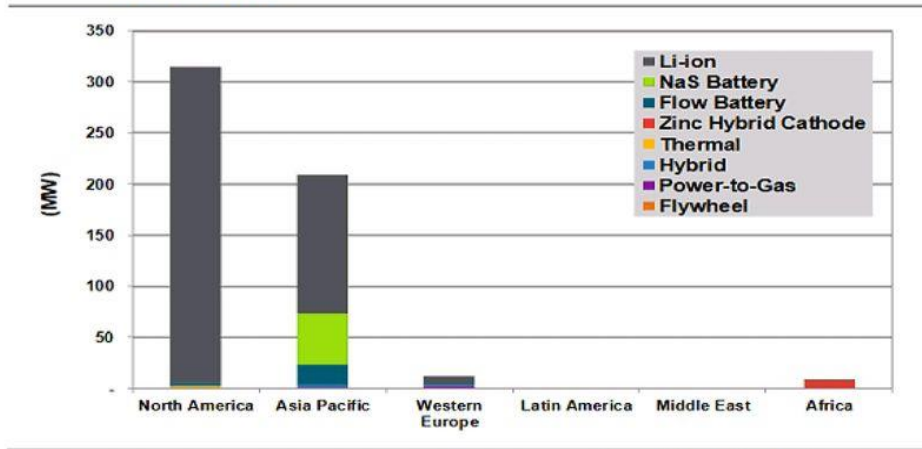
NEED OF STORAGE SYSTEM WITH RENEWABLES

- Offsets negative effects on Grid from renewable Generation variability
- Addresses power Quality Effects from Renewable Generation
- Reduced need for Ramping
- Grid Security
- Reduces Carbon Footprint
- Economic Growth
- Job Growth



ENERGY STORAGE POWER CAPACITY BY TECHNOLOGY

Chart 1.1 New Announced Energy Storage Power Capacity by Technology and Region, World Markets: 3Q 2016



(Source: Navigant Research)



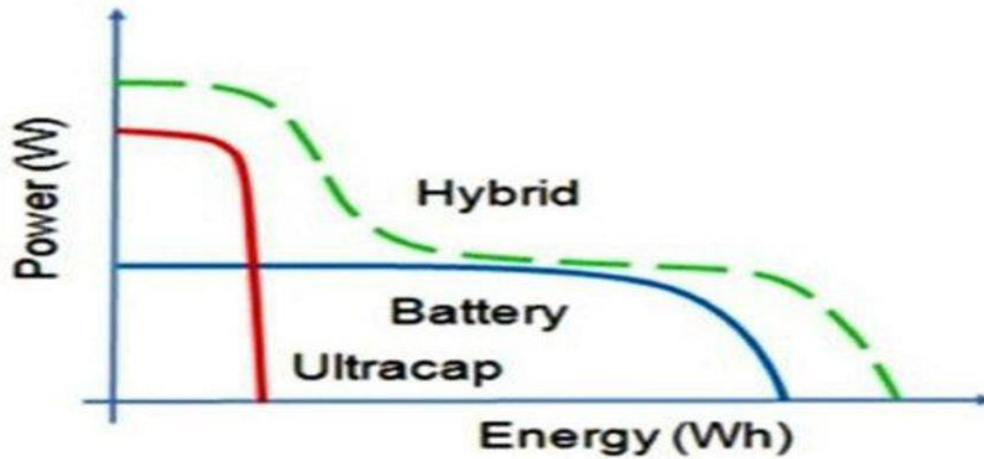
PERFORMANCE COMPARISON BETWEEN BATTERIES AND SUPERCAPACITOR

PERFORMANCE COMPARISON	BETWEEN SUPERCAPACITOR AND LI-ION	
	Supercapacitor	Lithium-ion (general)
Function		
Charge time	1–10 seconds	10–60 minutes
Cycle life	1 million or 30,000h	500 and higher
Cell voltage	2.3 to 2.75V	3.6 to 3.7V
Specific energy (Wh/kg)	5 (typical)	100–200
Specific power (W/kg)	Up to 10,000	1,000 to 3,000
Cost per Wh	\$20 (typical)	\$0.50-\$1.00 (large system)
Service life (in vehicle)	10 to 15 years	5 to 10 years
Charge temperature	-40 to 65°C (-40 to 149°F)	0 to 45°C (32° to 113°F)
Discharge temperature	-40 to 65°C (-40 to 149°F)	-20 to 60°C (-4 to 140°F)

Source: Battery University



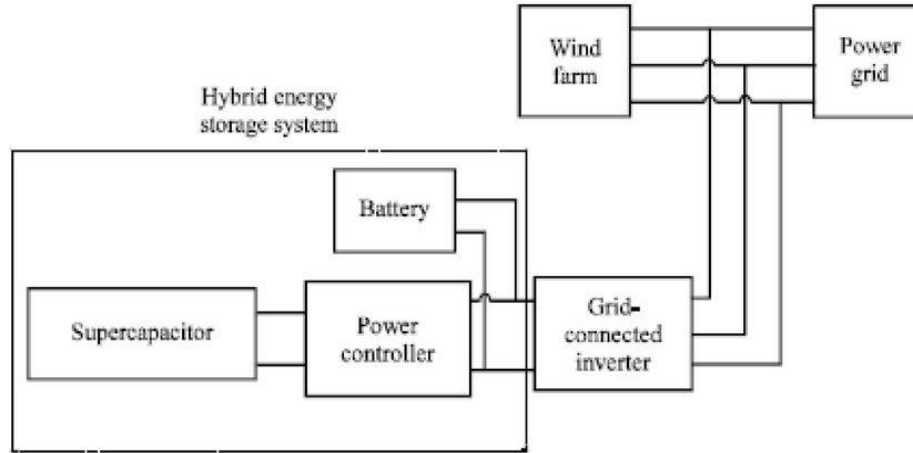
COMBINING BATTERY WITH SUPERCAPACITOR



11



HYBRID ENERGY STORAGE SYSTEM – SUPERCAPACITORS AND BATTERIES



12



BENEFITS OF HYBRID SYSTEM



13



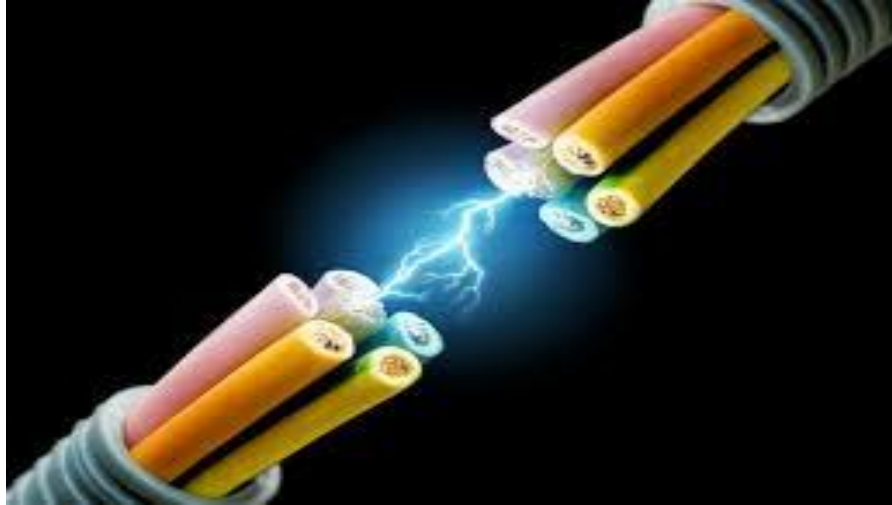
OTHER APPLICATIONS

- Voltage Stabilizers
- Power source for laptops, mobile devices etc.
- Backup power system in missiles
- Diesel Engine start up in submarines and tanks
- Back up for uninterruptable power supplies (UPS)
- Elevators and cranes



CONCLUSIONS

- Supercapacitor-battery hybrid energy storage system has numerous advantages over stand alone battery storage system.
- Apart from supercapacitor's applications in Grid, they also have various applications in transportation systems and other industries.
- However, further research is needed in the enhancement of energy density and lowering the cost of supercapacitors in order for them to compete with other storage technologies.



...THANK YOU