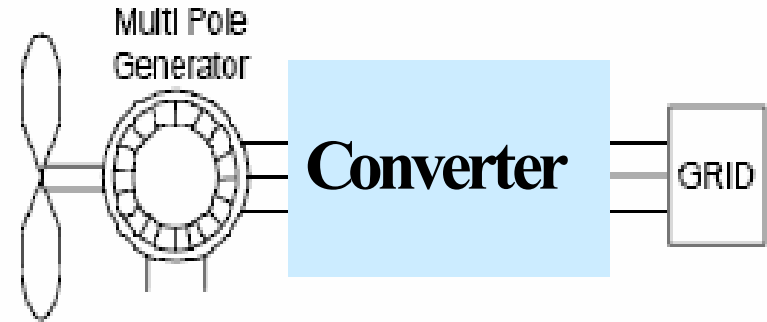
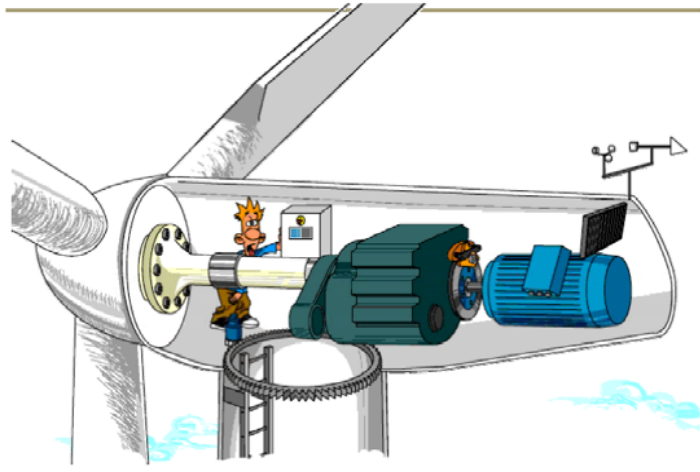


Generator Control that is Ideal for Windmills



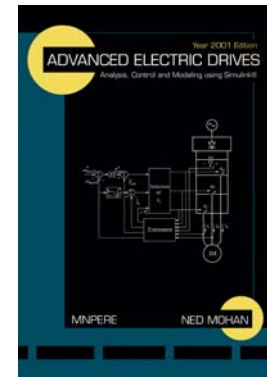
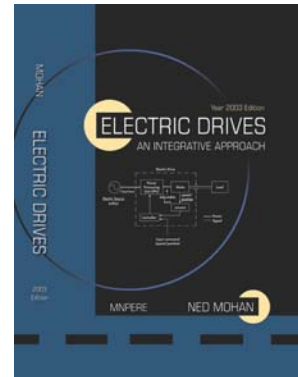
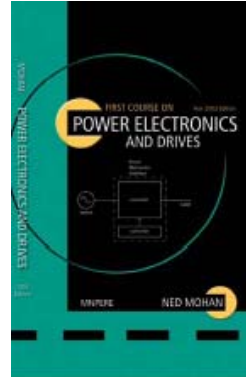
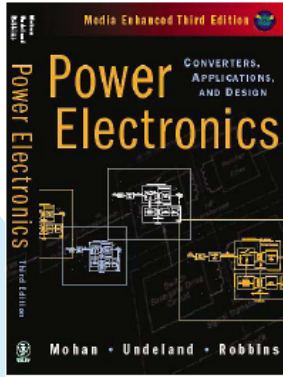
- Increases available voltage and Power to 150%
 - Generator could be $1/3^{\text{rd}}$ smaller
- Bearing currents are eliminated
- Slot insulation reduced by a factor 1.73
- Higher efficiency (?)
- Power Factor on the Utility-side is controllable
- Increased Reliability due to Capacitor Elimination
- SiC Ready

Research Activities (PhDs in the last 2 years)

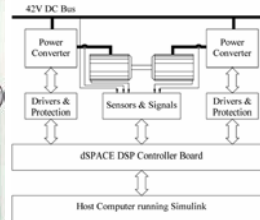
1. 14/42-Volt Novel Bi-directional dc-dc Converters (Philip Jose, Nov 2004)
2. Doubly-Fed Induction Wind-Electric Generators (Ted Brekken, July 2005)
3. Robust Control and Fault Ride-Through of Wind-Electric Generators (Manoj Rathi, August 2005)
4. Hybrid Soft-Switching DC-DC Converters (Rinkle Jain, January 2006)
5. Synchronous-Reluctance Drives for Flywheel Storage (Todd Begalke, February 2006)
6. Switched-Reluctance Motor Drives (Nitin Bhiwapurkar, June 2006)
7. Digitally-Controlled Current-Source Multi-Output Converters (Som Chakroborty Sept 18, 2006)

Educational Activities

Textbooks

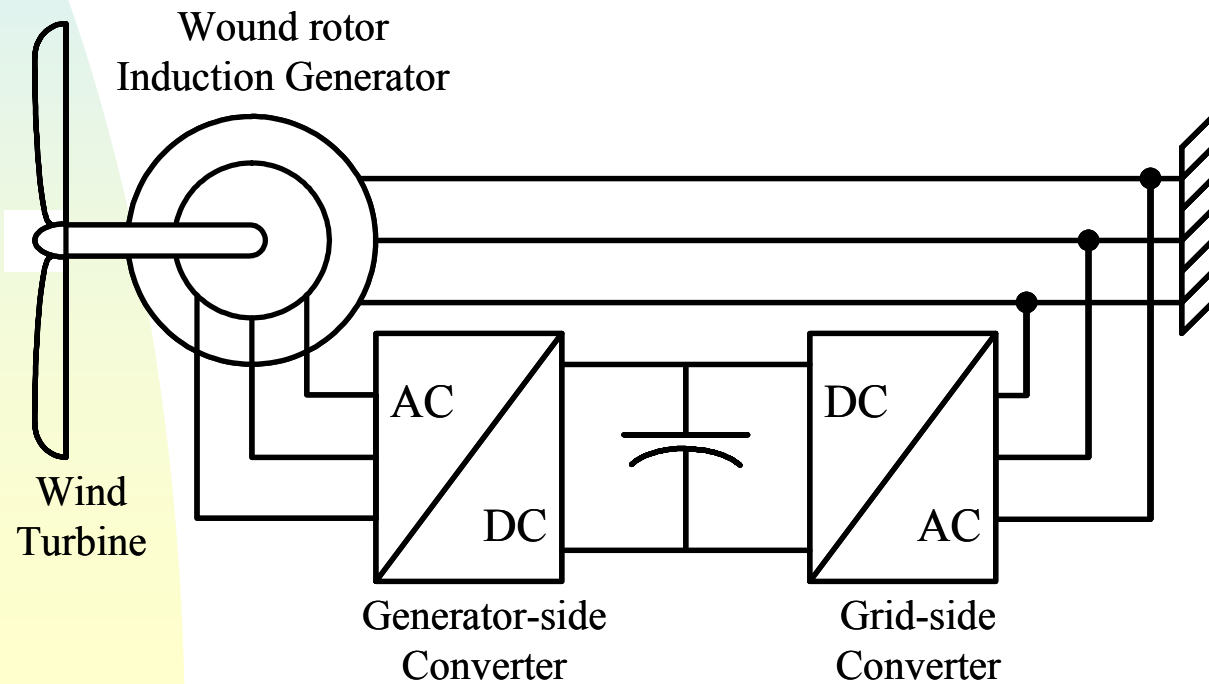
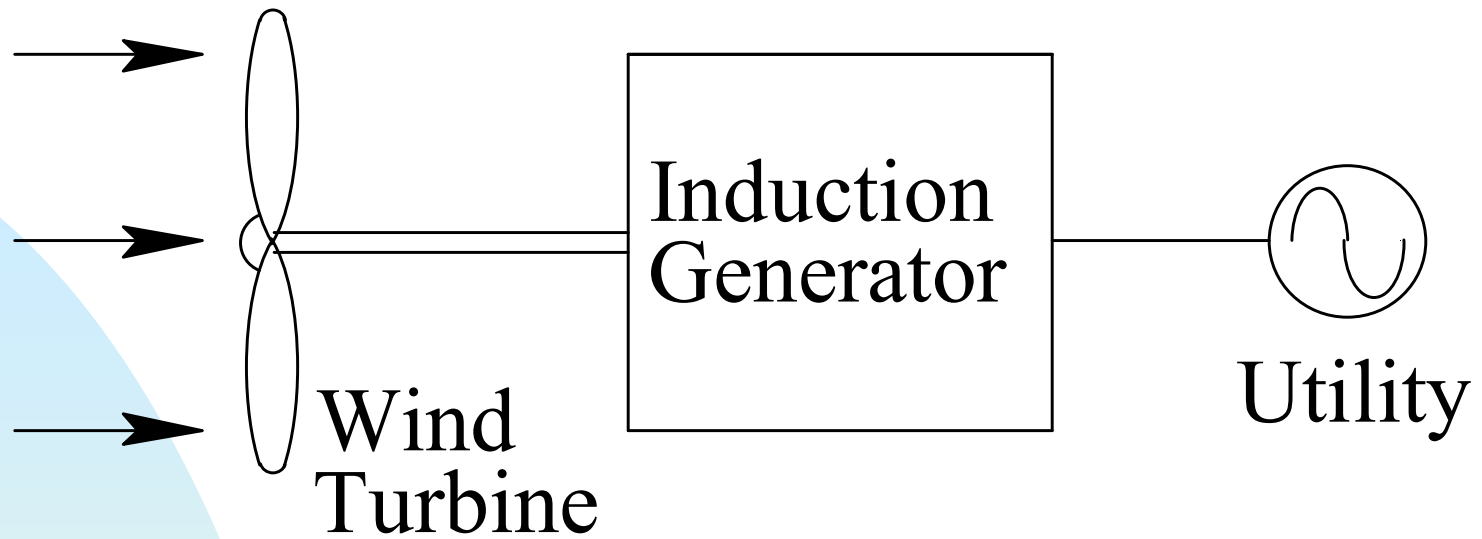


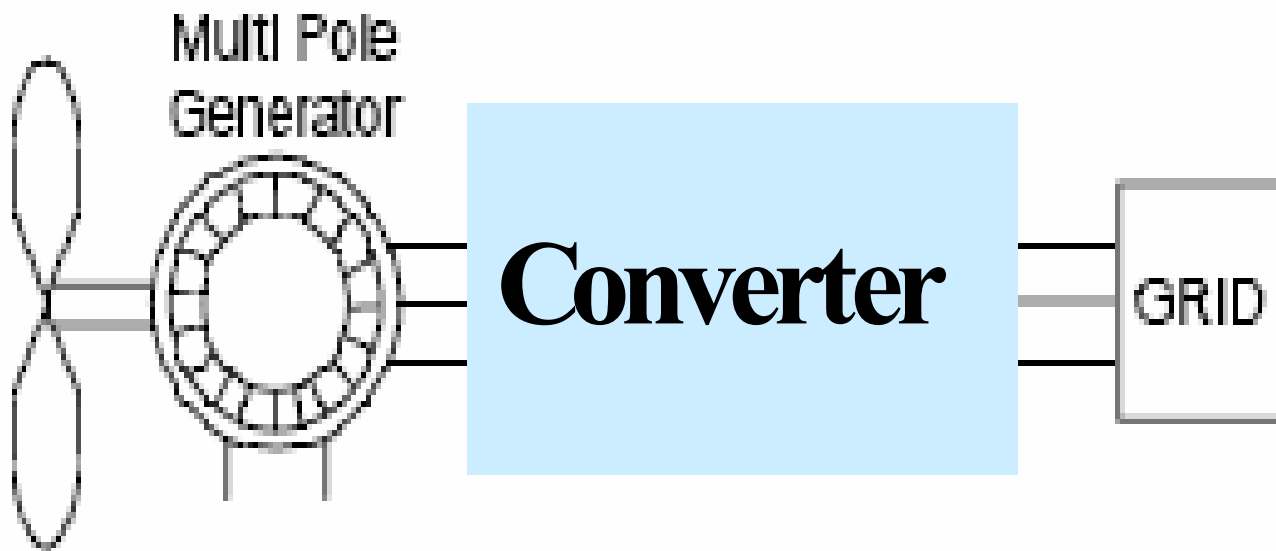
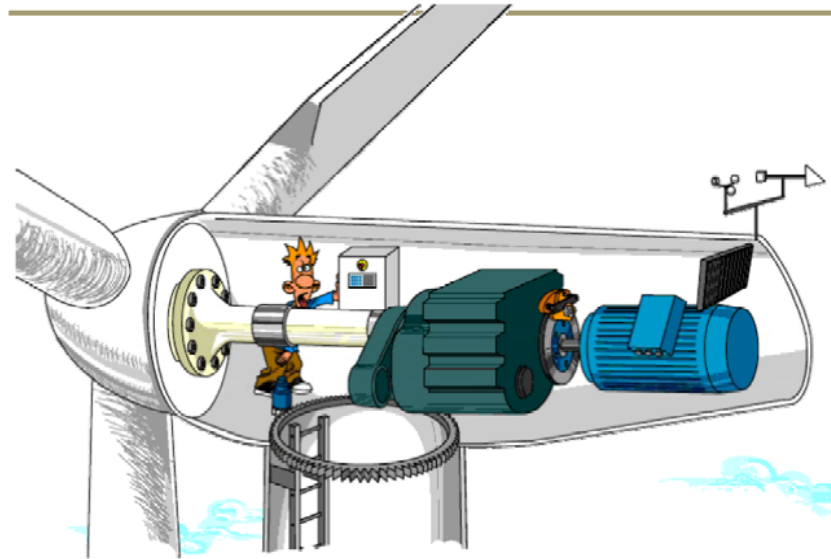
Laboratories



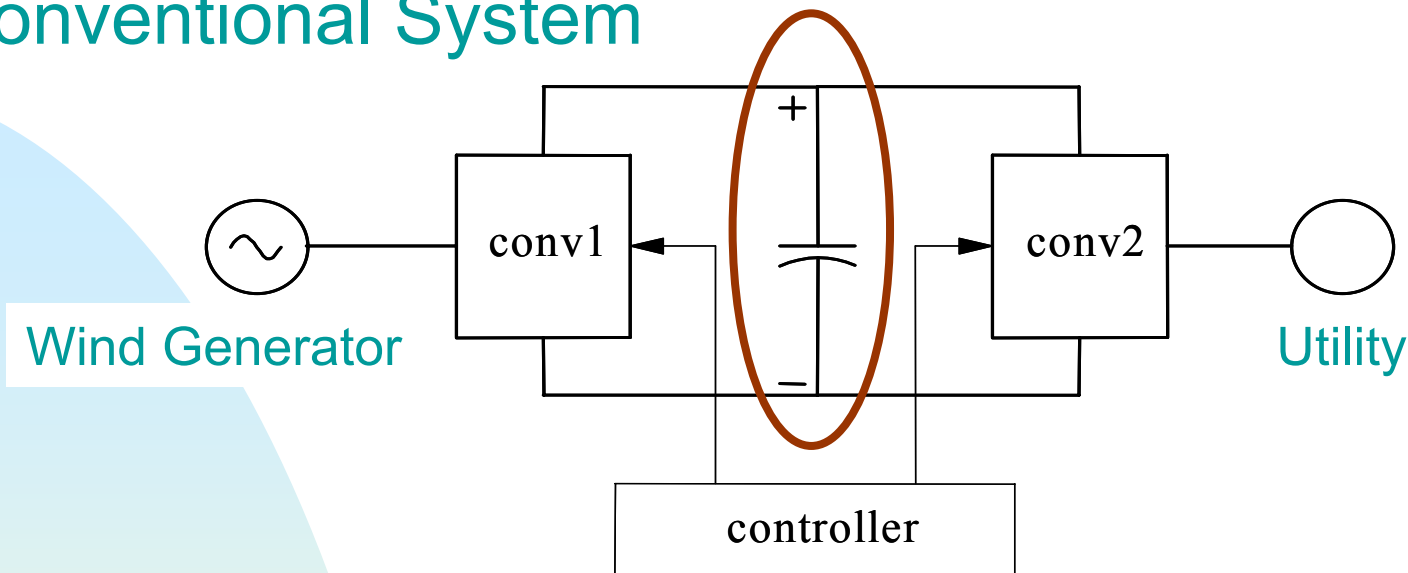
Fall 2006 Enrollments: Drives – 130, Power Systems – 76, Power Electronics – 94

Reforming Undergraduate Education in Electric Energy Systems - 1.23 M\$, Aug 2006 – Aug 2011





Conventional System



Problems with the Storage Capacitor:

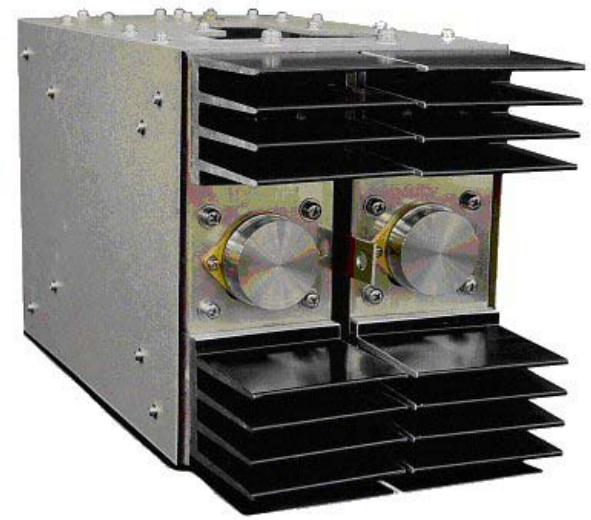
1. Weight and cost
2. Reliability
3. Inrush Current at switch-on
4. Not suitable for high temperature operation
5. Difficult to integrate Motor and Power Electronics

Advantages of SiC Devices

- Lower Losses; Higher Efficiency
- High Temperature; Compact Design

Press Release 2006

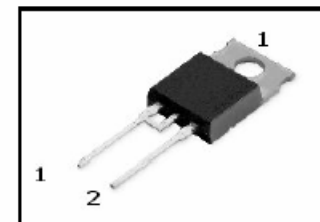
- 110 kVA SiC-based Inverter by Kansai Electric and CREE
- 50% less conversion losses compared to Si inverters



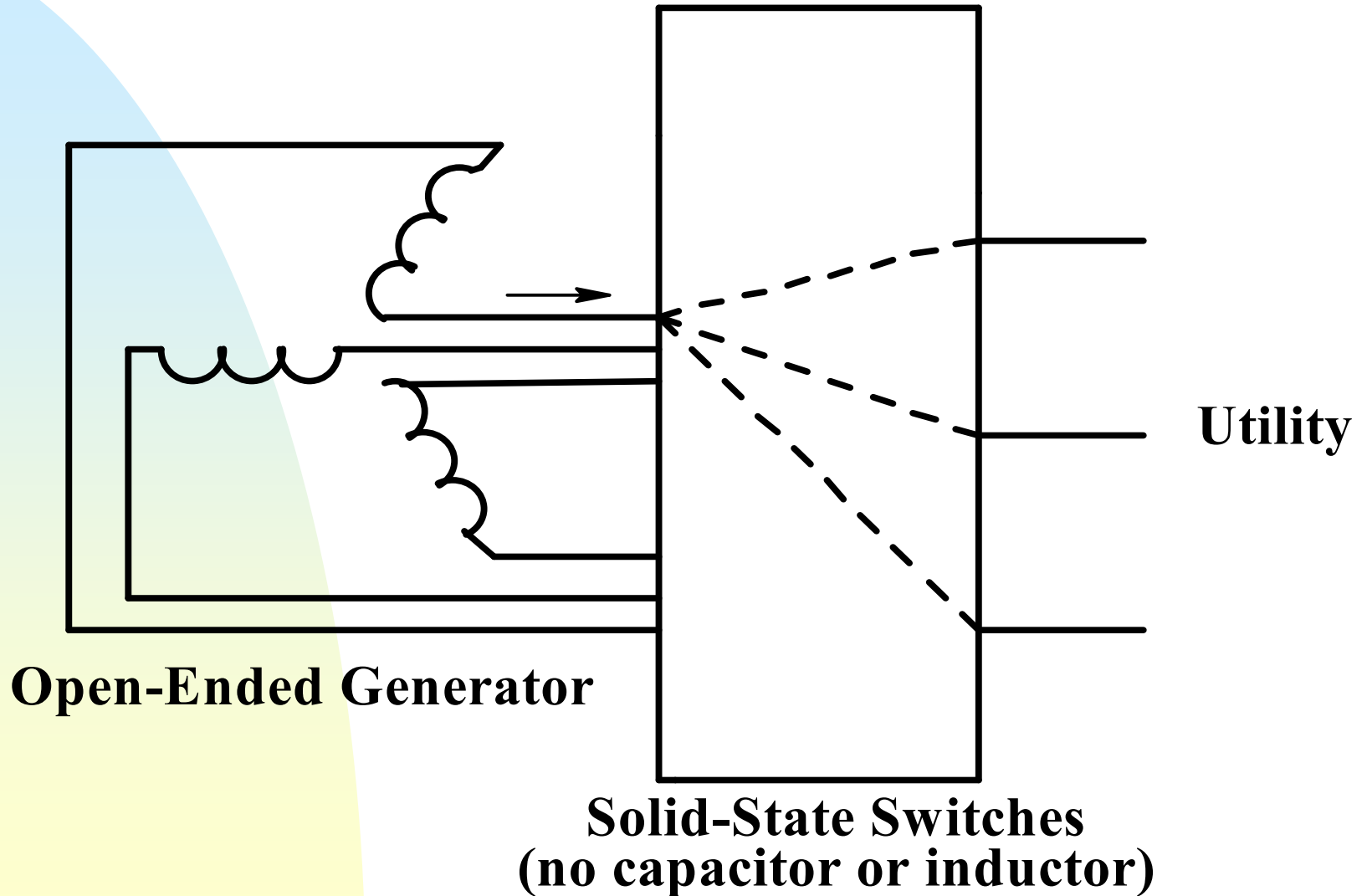
Product Summary

V_{DC}	600	V
Q_c	38	nC
I_F	16	A

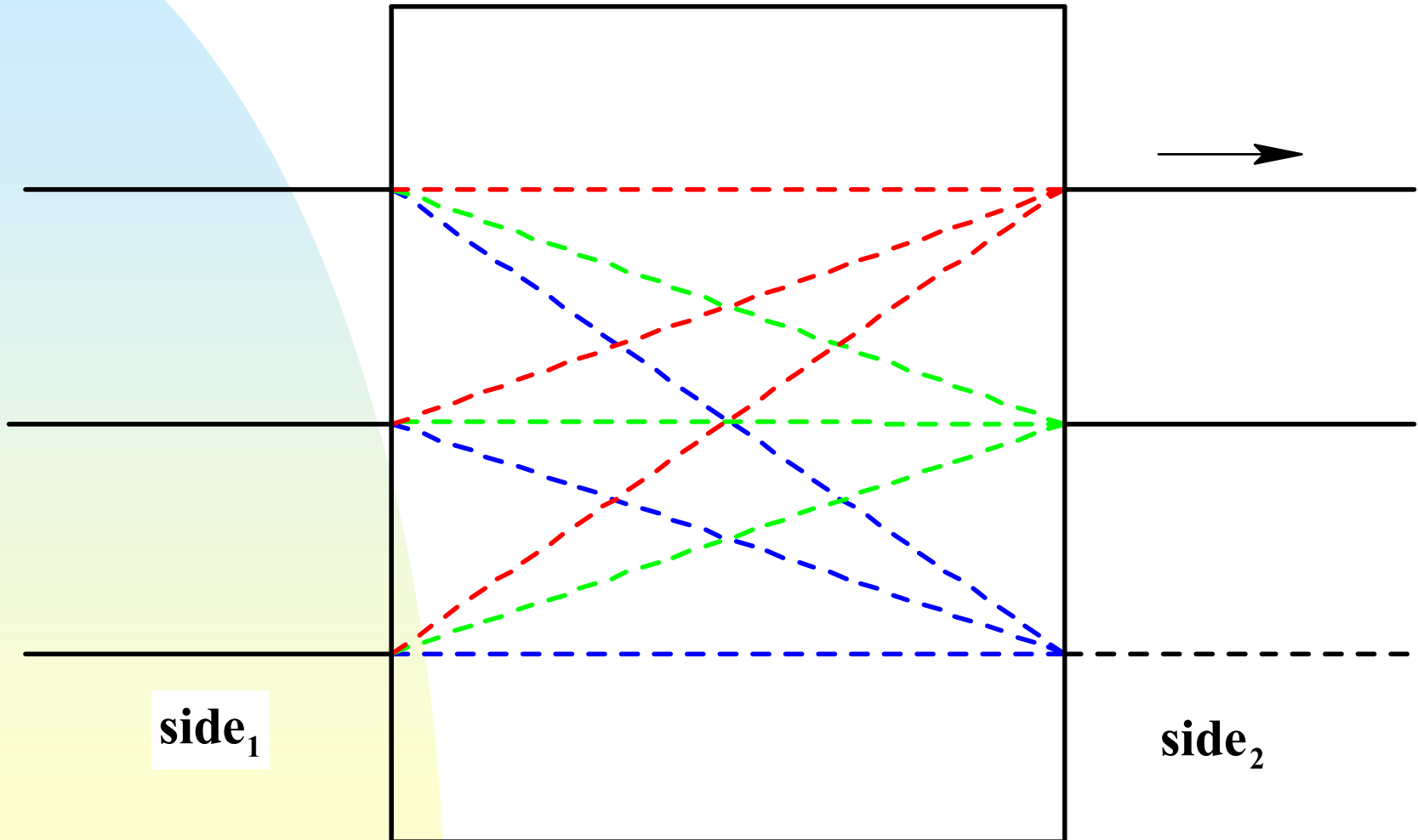
PG-TO220-2-2



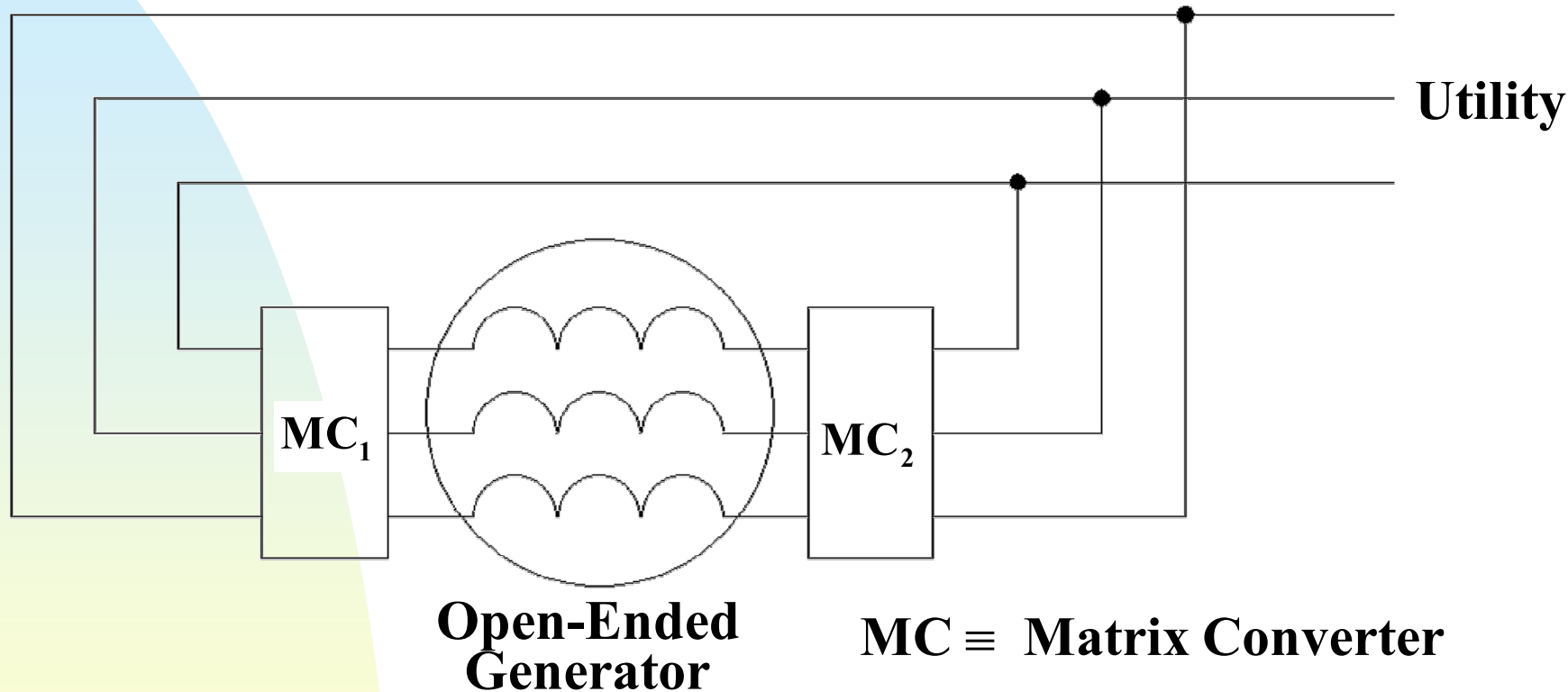
Proposed Topology



MC \equiv Matrix Converter



Open-Ended AC Generator with Matrix Converters



New
Math

0.5

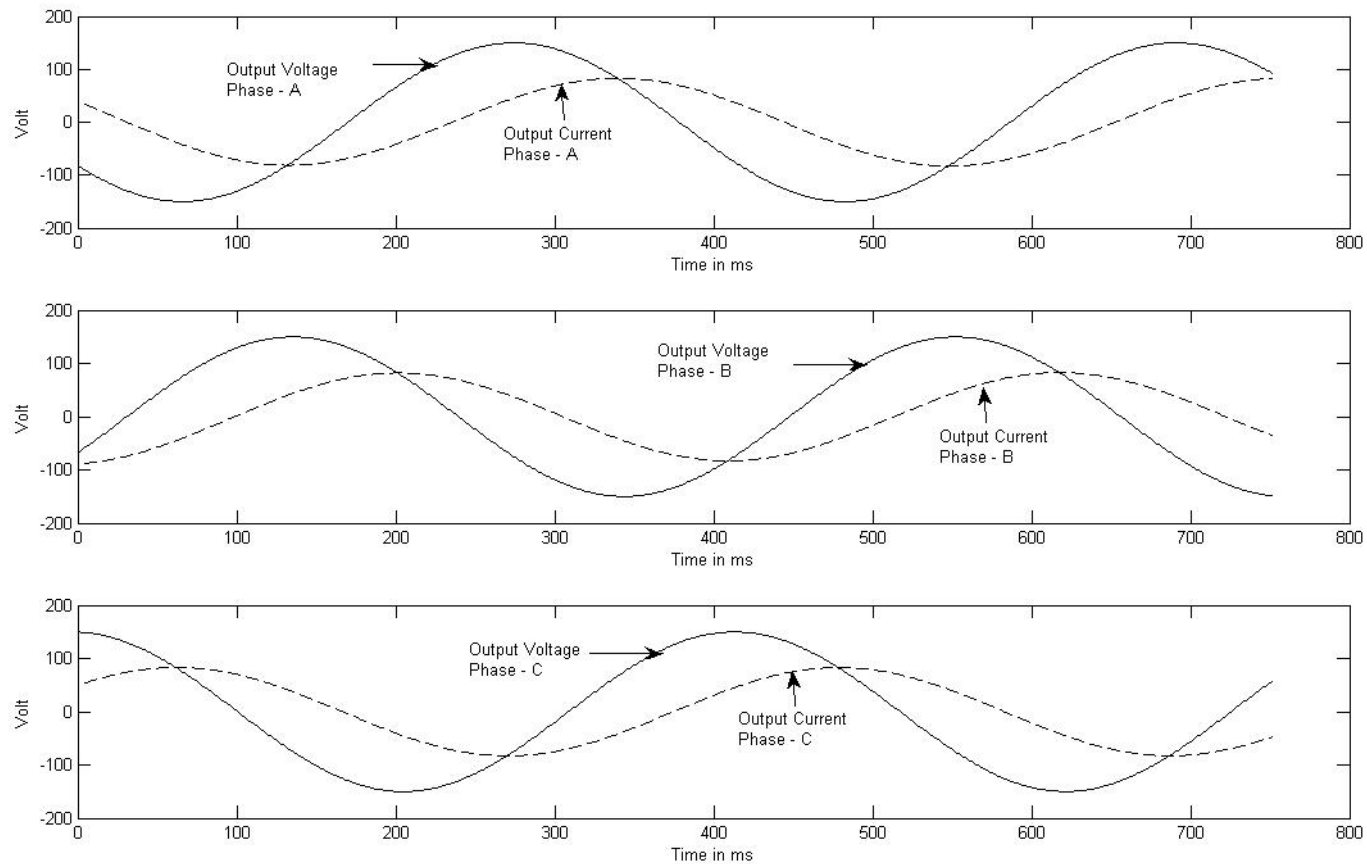
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0.5

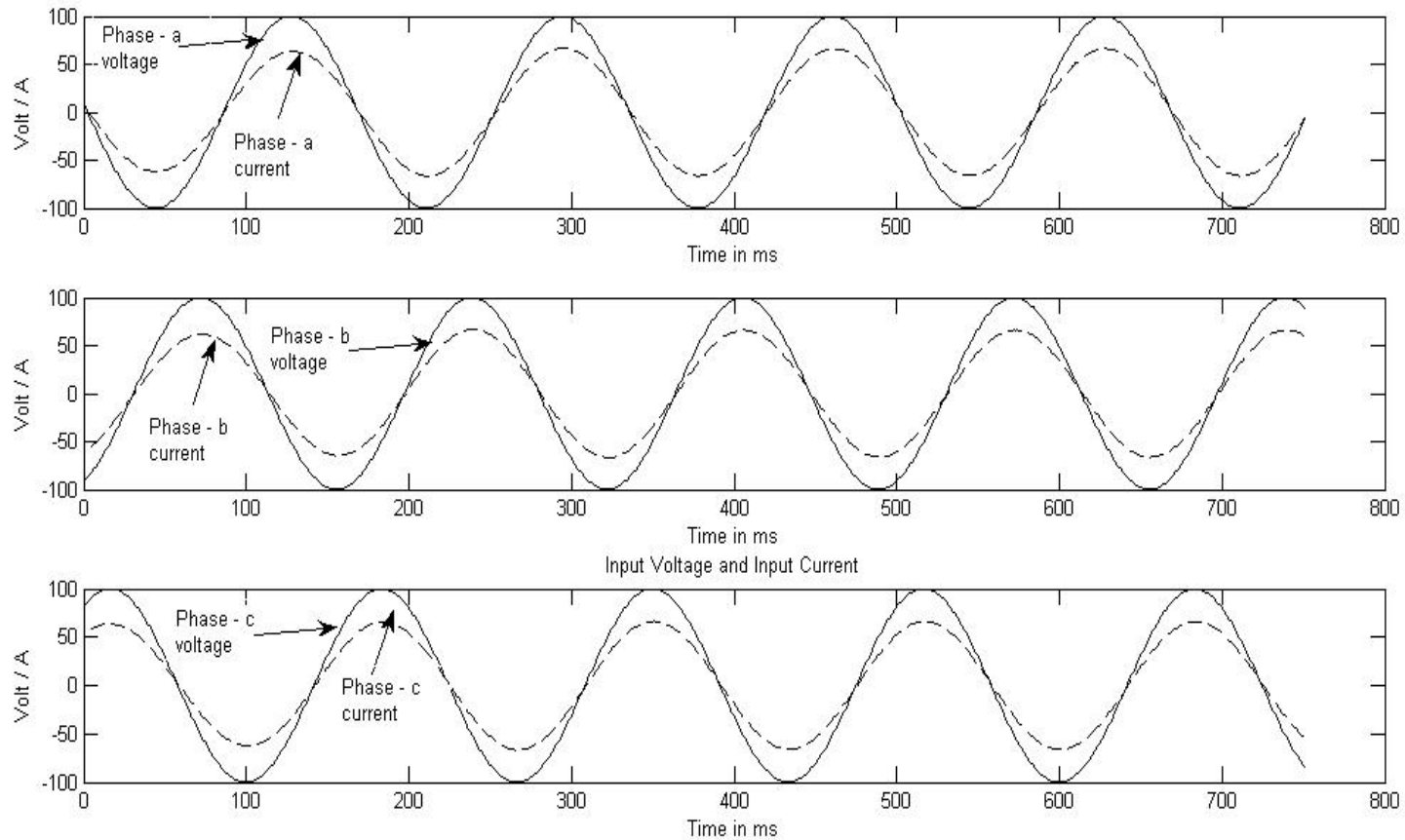
=

1.5

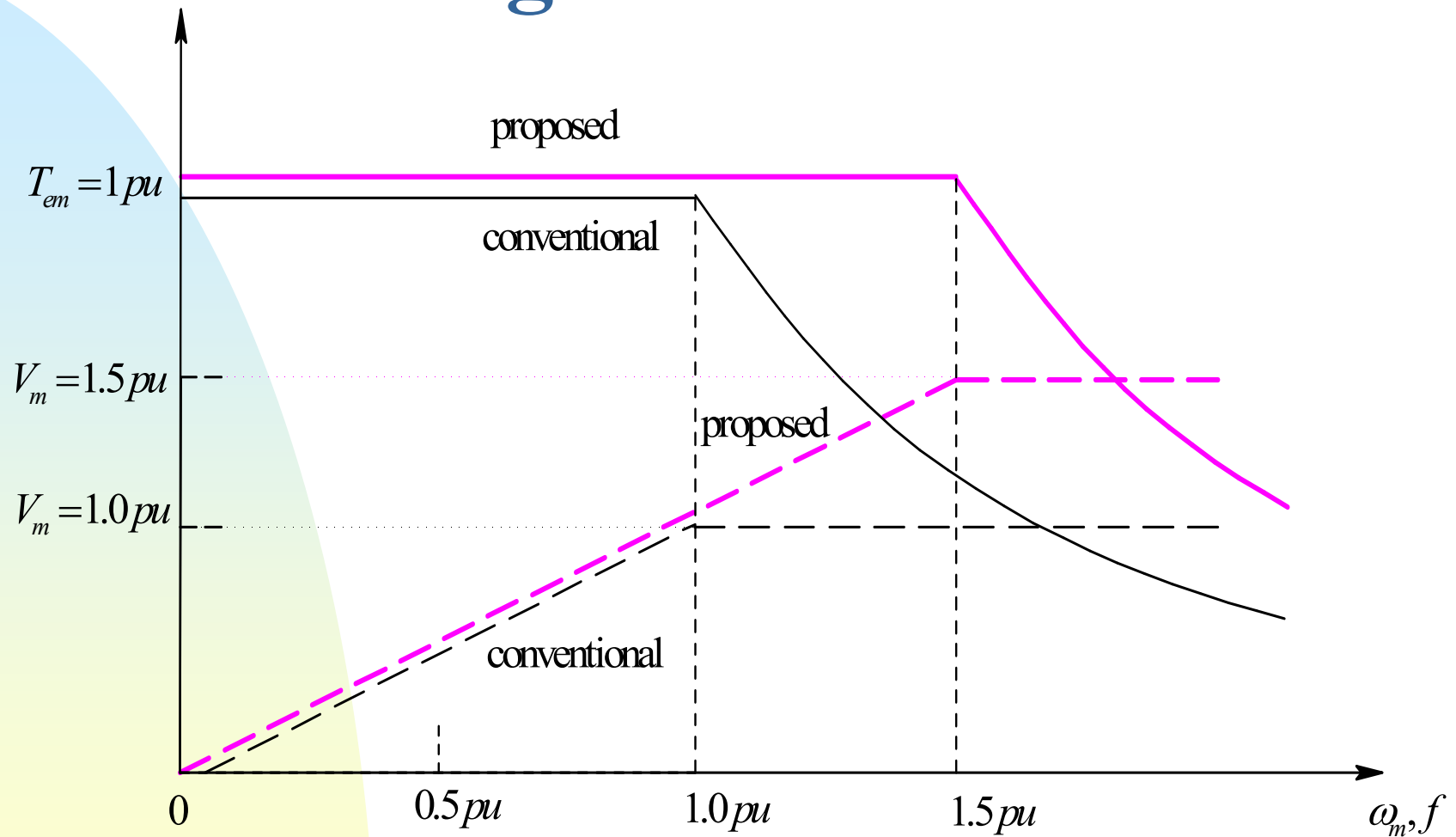
Simulation Results: Output Voltages and Currents



Simulation Results: Input Voltages and Currents



Capability Curves with Common Mode Voltages Eliminated



Power Semiconductor Price Trends

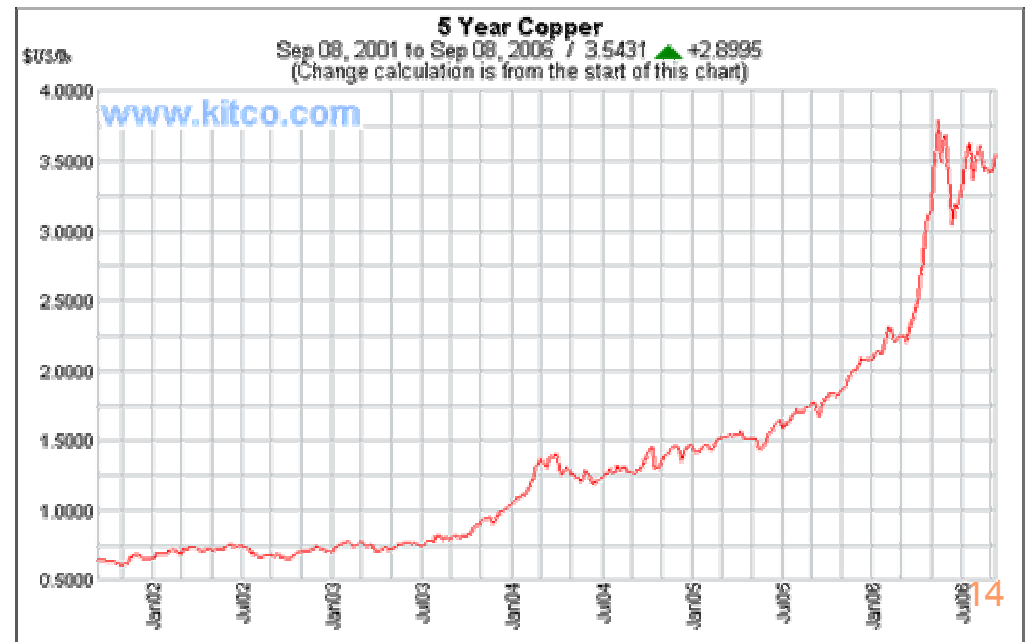
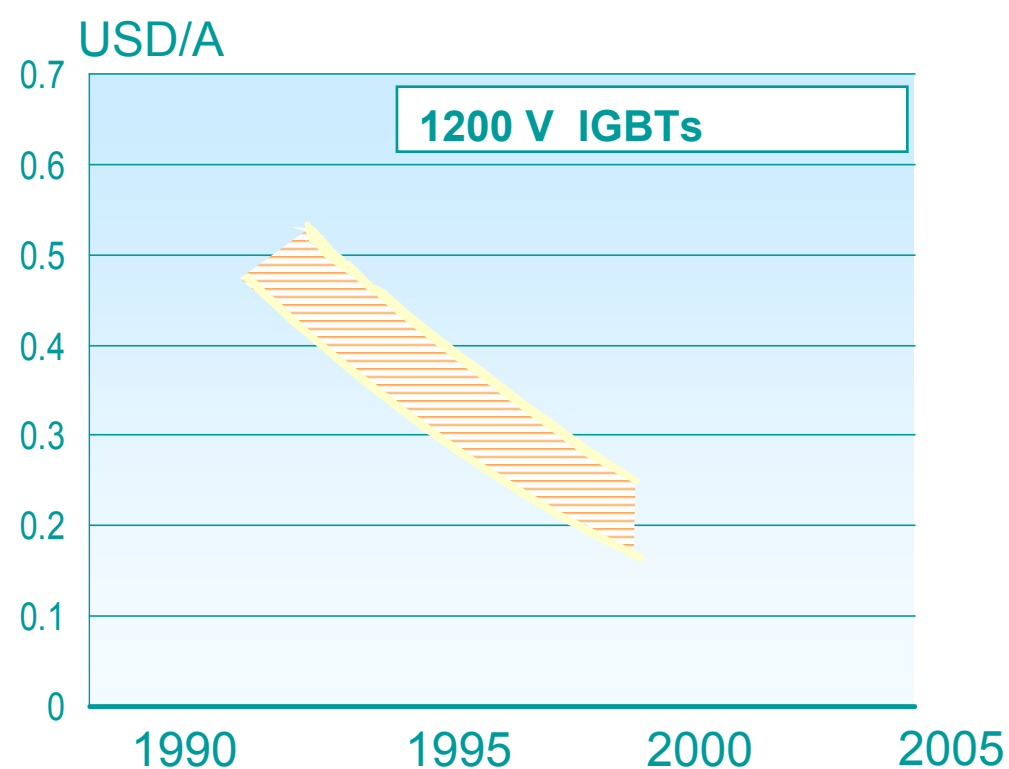
Drivers

New technologies

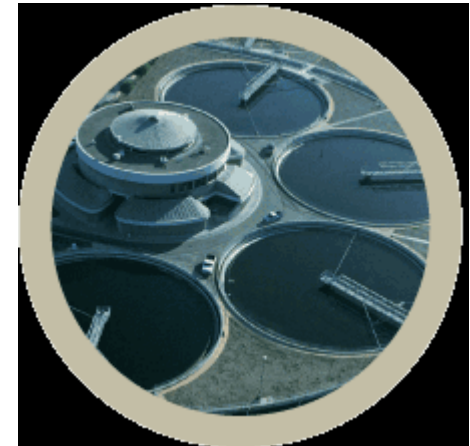
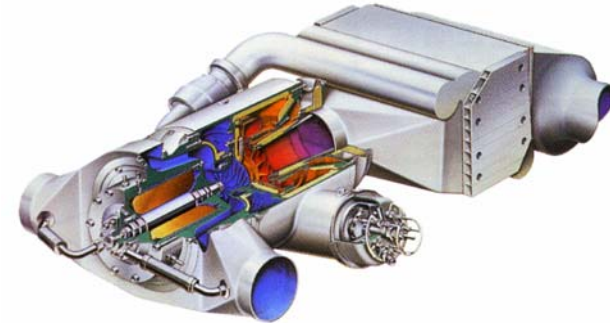
Design for
manufacturing

High volume techniques

Copper Prices

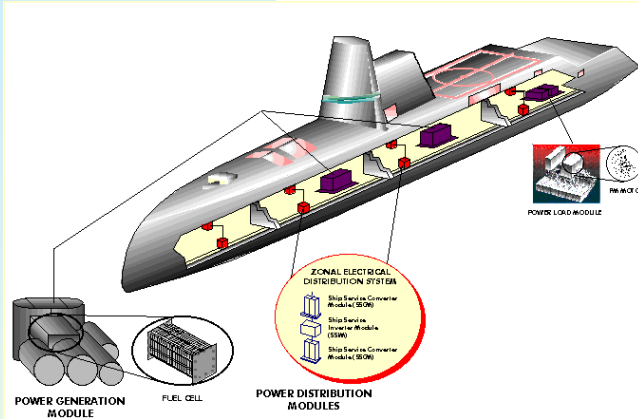


Major Applications

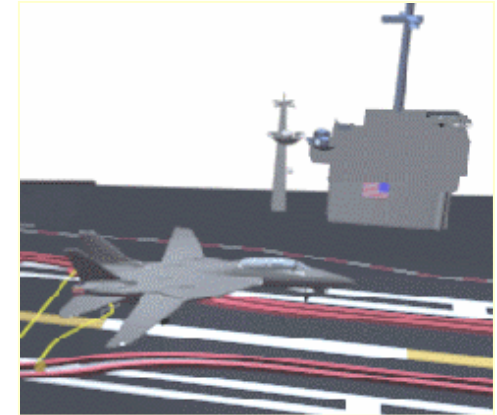


DoD Electric Power System Applications

Electric Warship

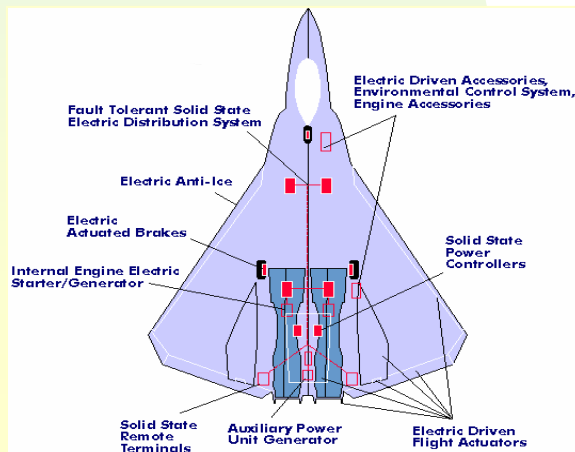


Electromagnetic Arrest and Launch



Pulse Power Weapons & High Power Sensors

More Electric Aircraft

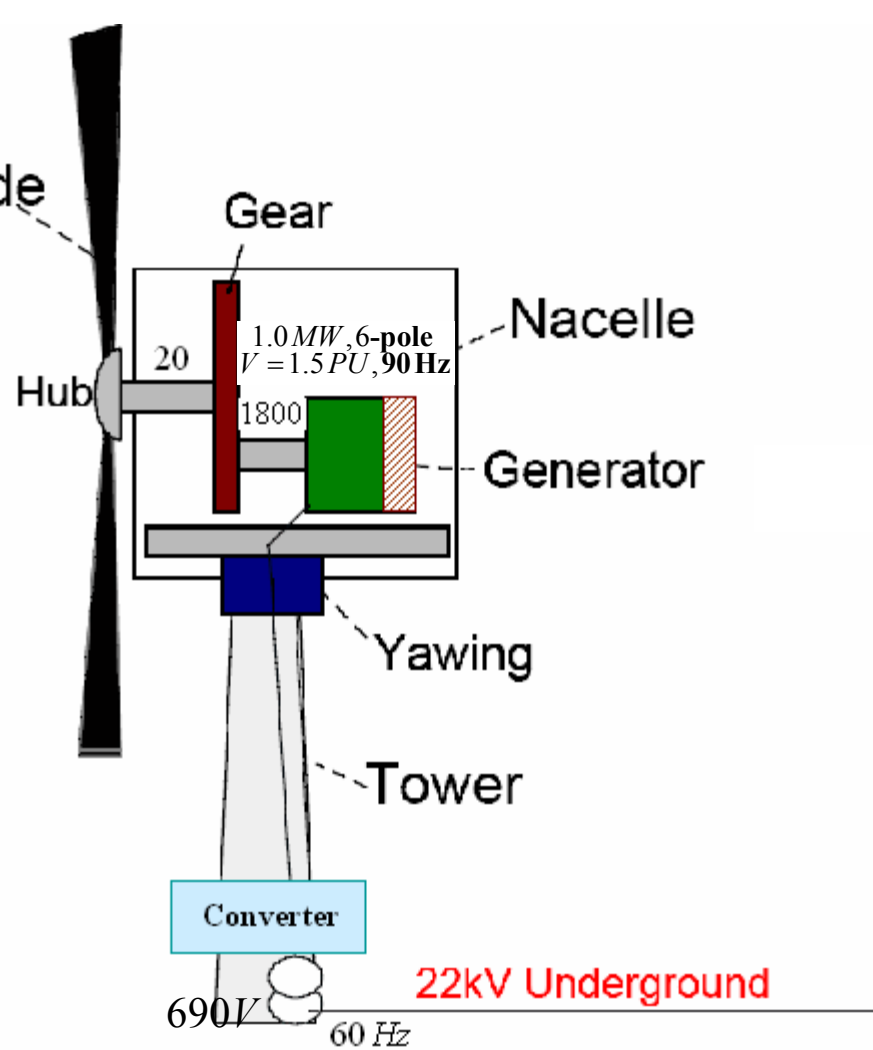
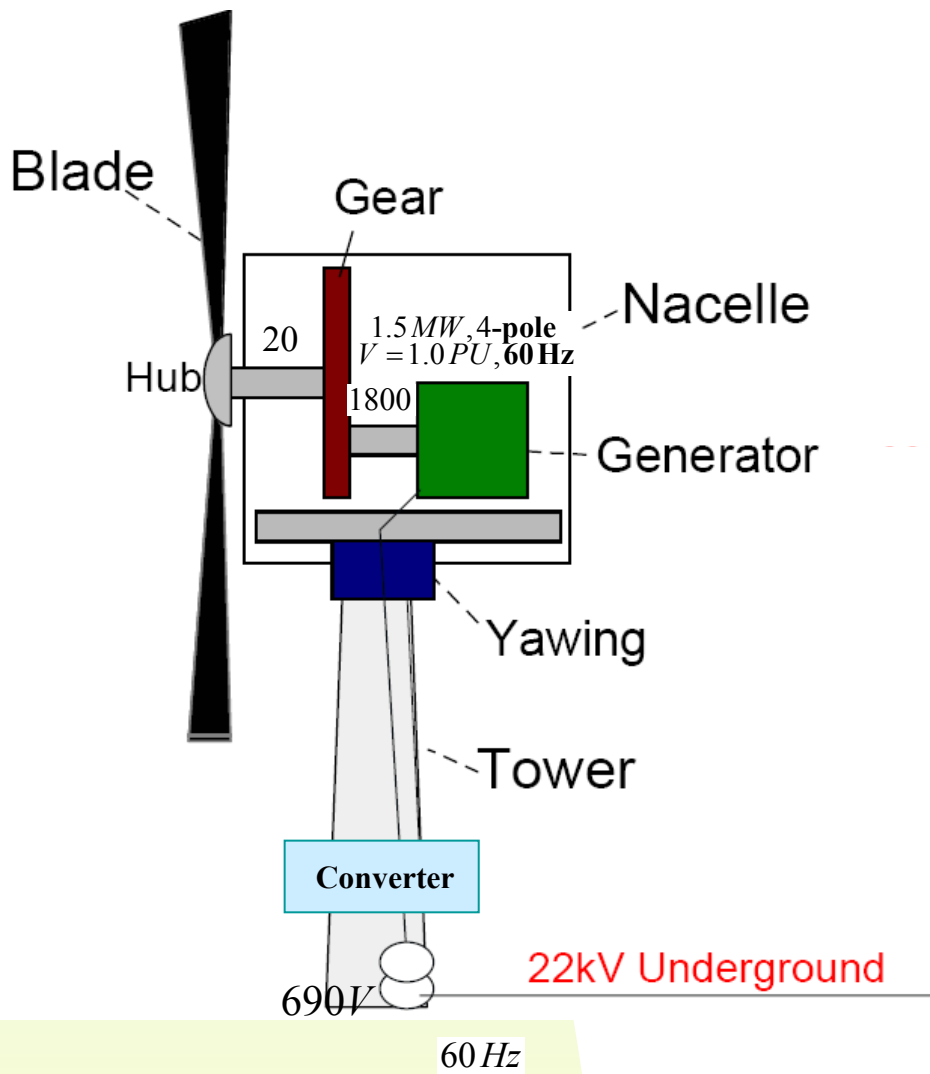


Reconnaissance, Surveillance, Targeting Vehicle (RSTV)



Simultaneous Benefits

- Increases available voltage and Power to 150%
 - Generator could be $1/3^{\text{rd}}$ smaller
- Bearing currents eliminated
- Slot insulation reduced by a factor of 1.73
- Higher efficiency (may be?)
- Utility-side power factor is controllable
- Increased Reliability due to Capacitor Elimination
- SiC Ready



Direct Drive

