

Annual Power Engineering Exchange (APEX)

An Introduction to Interleaved Converter Topology: How Kirchhoff's Current Law Can Help Prolong Fuel Cells Lifespan

MARTINO ADISUWONO
GRADUATE ENGINEER - BECA

EEA.CO.NZ



*Thank you to our sponsors
for their support.*



1

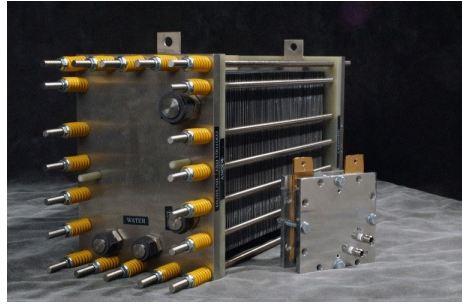
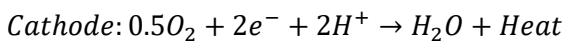
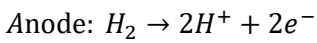
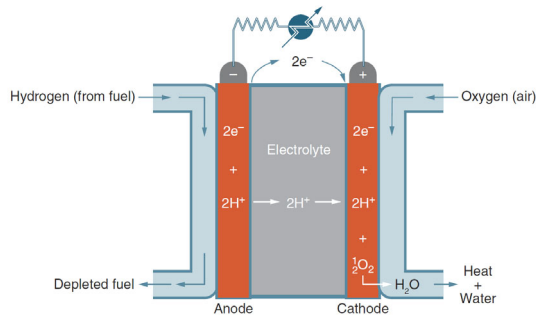
Presentation Outline

1. What are fuel cells?
2. How is it connected to loads / grids?
3. Why does it have lifespan issue?
4. How can we deal with this problem?



2

What are fuel cells?



What are fuel cells?

Fuel Cells Key Advantages:

1. Renewable & not weather dependent
2. High Efficiency (50 ~ 70%)¹ ---- Wind² ≈ 40% , Coal ≈ 33%, Solar³ ≈ 23%
3. High Power Density
4. Water and Heat as the only by-products

¹ X. Zhang, "Current Status of Stationary Fuel Cells for Coal Power Generation," Clean Energy, pp. 1-14, 2018.

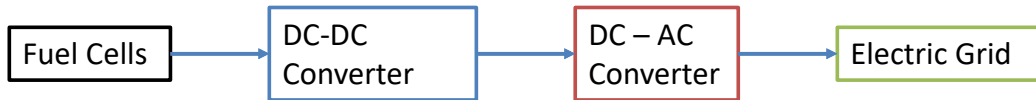
² <http://www.ftexploring.com/energy/wind-erngy.html>

³ <https://news.energysage.com/what-are-the-most-efficient-solar-panels-on-the-market/>

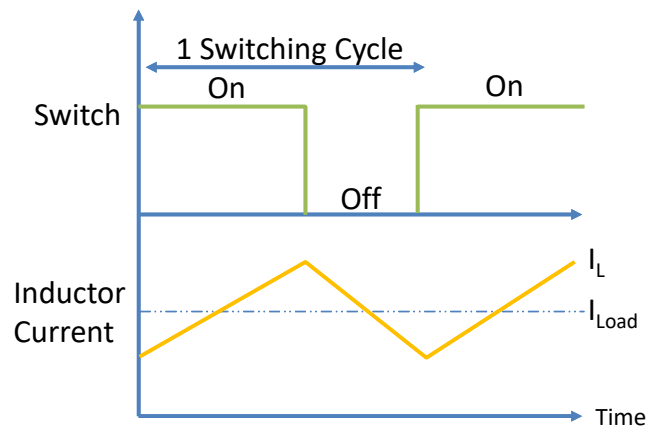
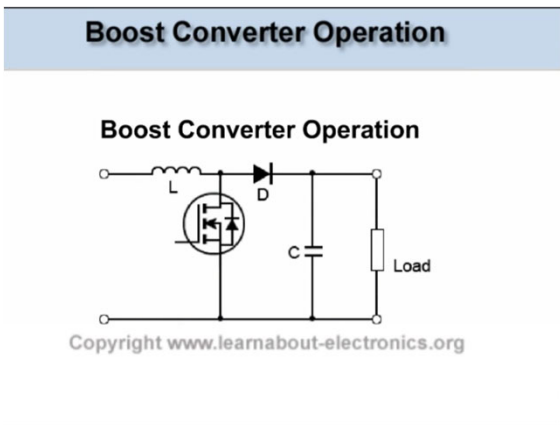


How can it be connected to the grid / load?

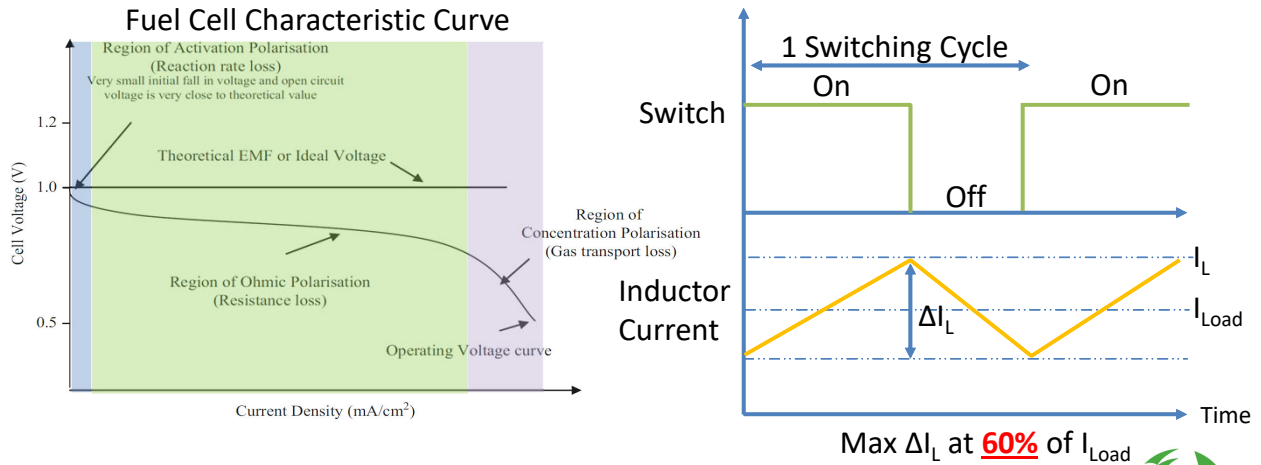
Typical voltage output of a single cell is only **0.5V – 1V**



Why does it have lifespan issue?

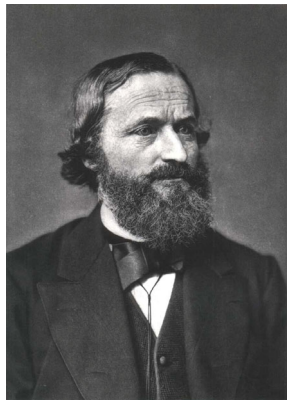


Why does it have lifespan issue?



7

How can we deal with this problem?



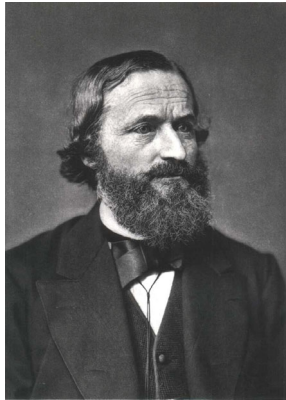
Gustav Kirchhoff
1824-1887

"The algebraic sum of all currents entering and exiting a node must equal zero." – Kirchhoff's Current Law



8

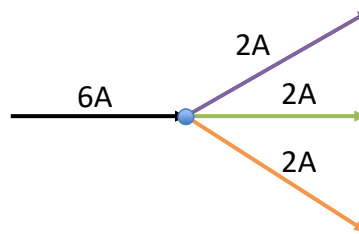
How can we deal with this problem?



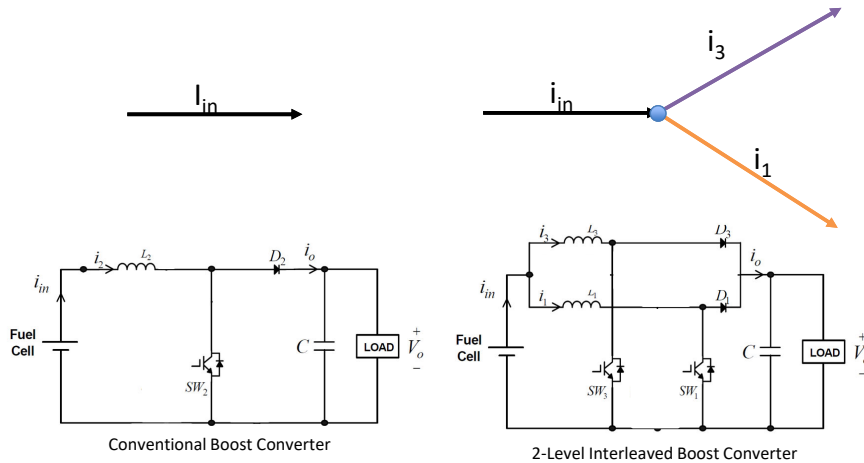
Gustav Kirchhoff
1824-1887

~~“The algebraic sum of all currents entering and exiting a node must equal zero.” – Kirchhoff’s Current Law~~

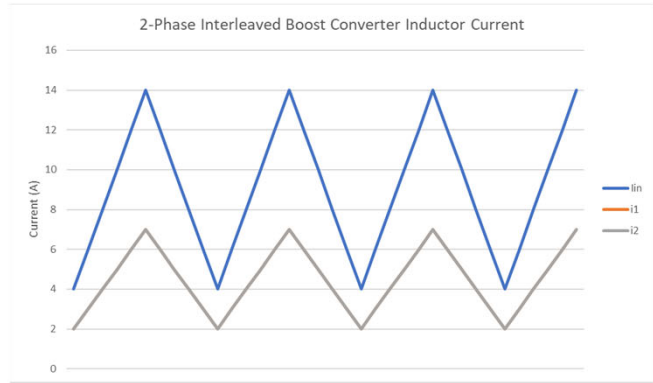
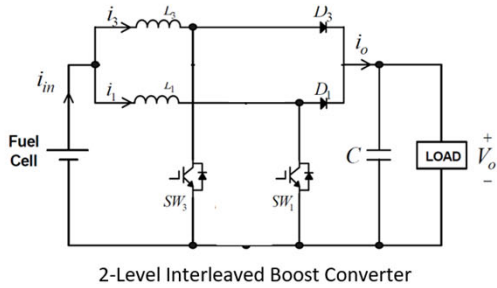
“Current in = Current out”



How can we deal with this problem?

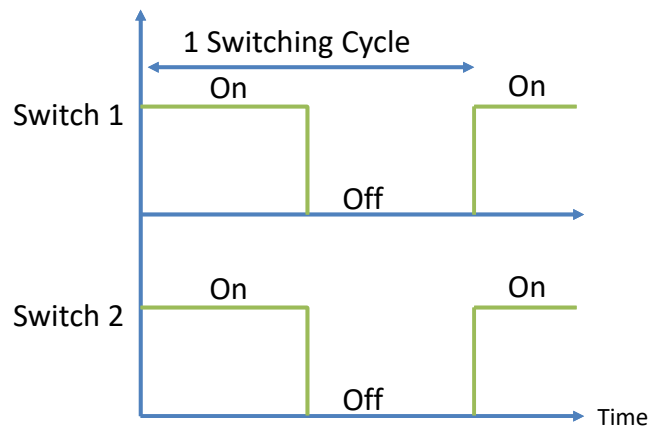
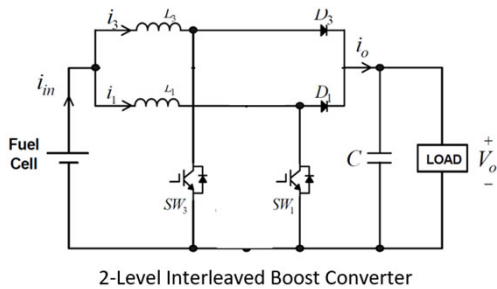


How can we deal with this problem?



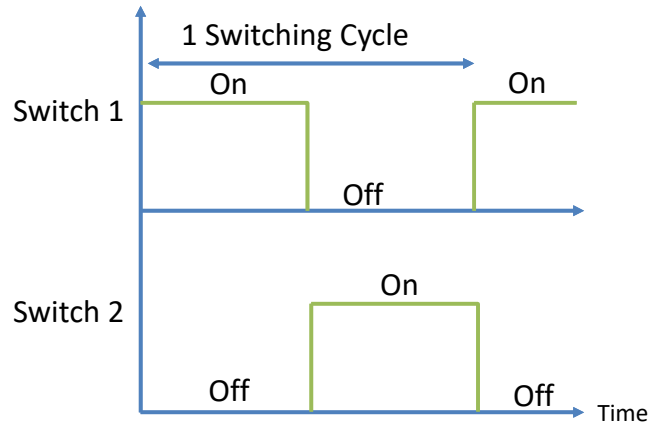
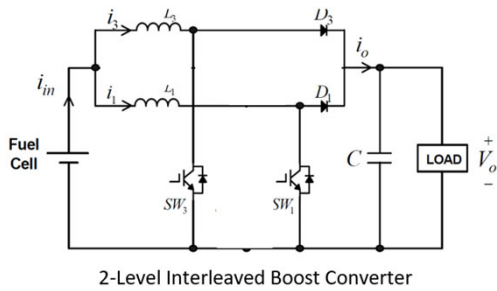
11

How can we deal with this problem?

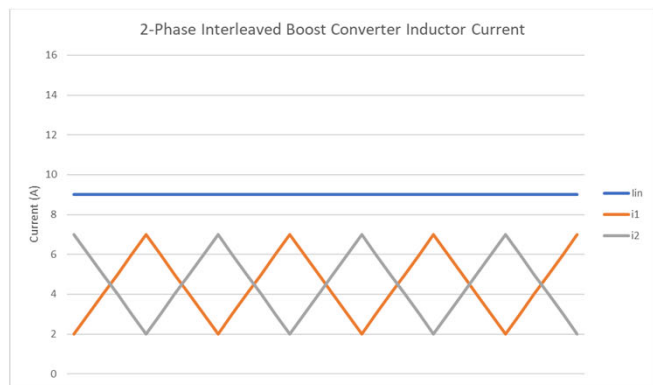
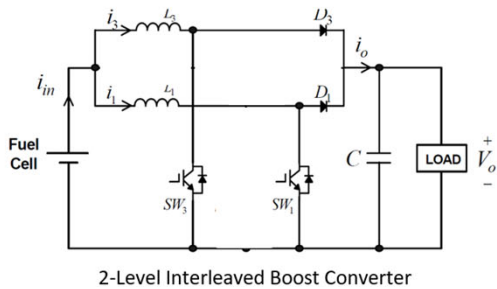


12

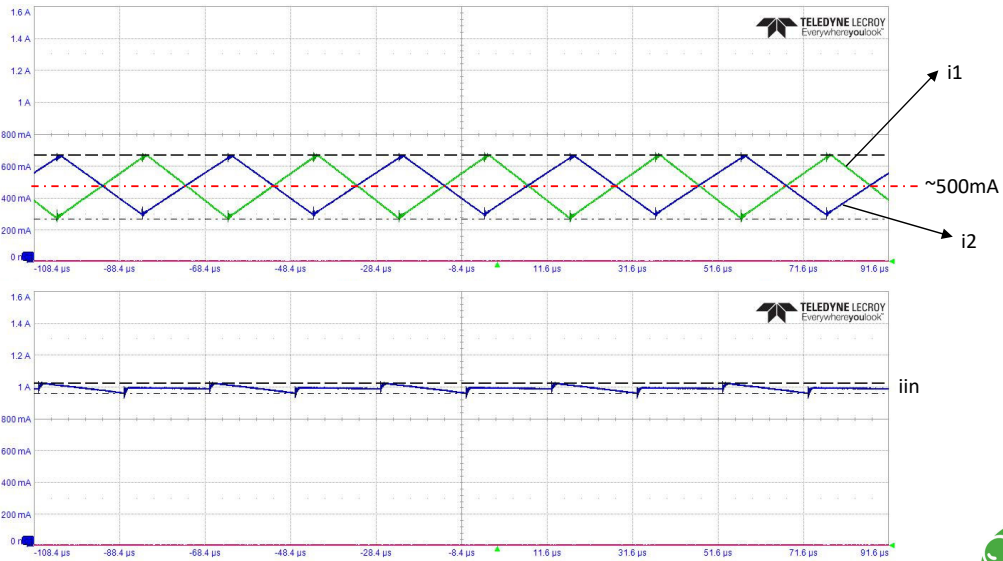
How can we deal with this problem?



How can we deal with this problem?



How can we deal with this problem?



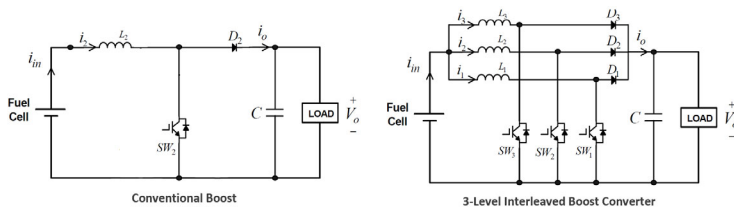
How can we deal with this problem?

Additional Benefits:

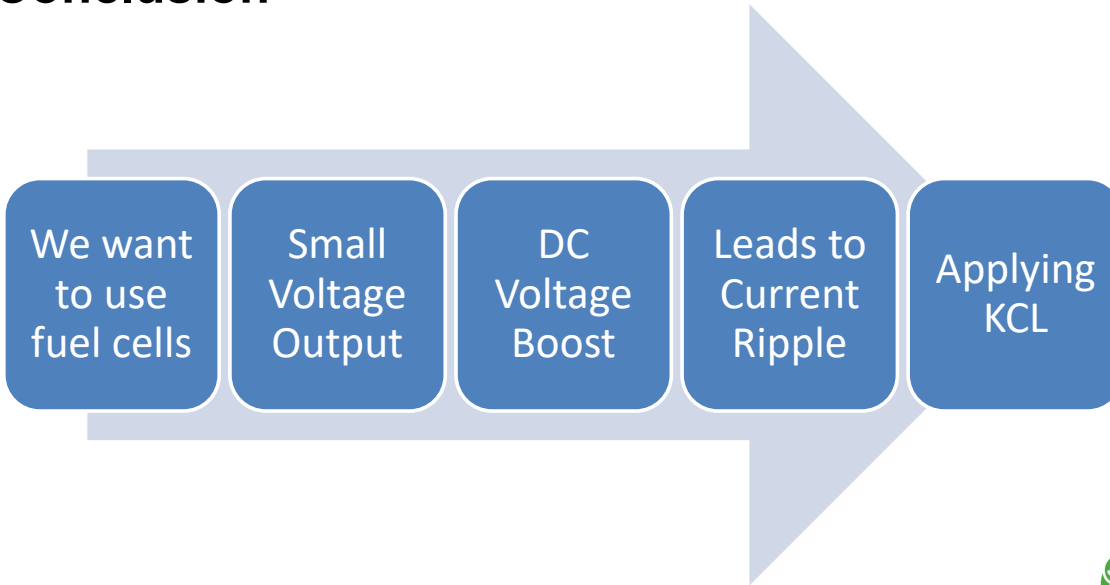
1. Lower Inductor Current
 - Smaller Inductor Required
 - Higher Efficiency

2. Higher Reliability

3. Lower Output Voltage Ripple



Conclusion



**Simplicity
is the ultimate
sophistication.**



THANK YOU Q&A / Discussion

Email: martino.adisuwono@beca.com
LinkedIn: [martino.adisuwono](#)

