



B-TRAN

Transforming Electric Power Switching

October 2019

IDEAL  POWER

NASDAQ: IPWR

Overview

Agenda

- What is B-TRAN
- Performance
- Commercial impact
- Potential markets
- Sustainable advantage
- IP footprint
- Business roadmap

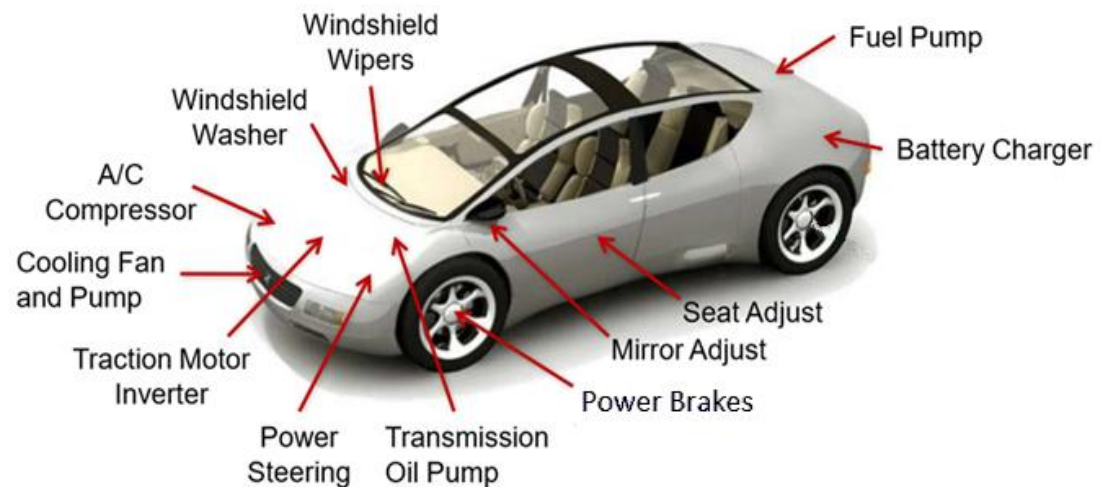
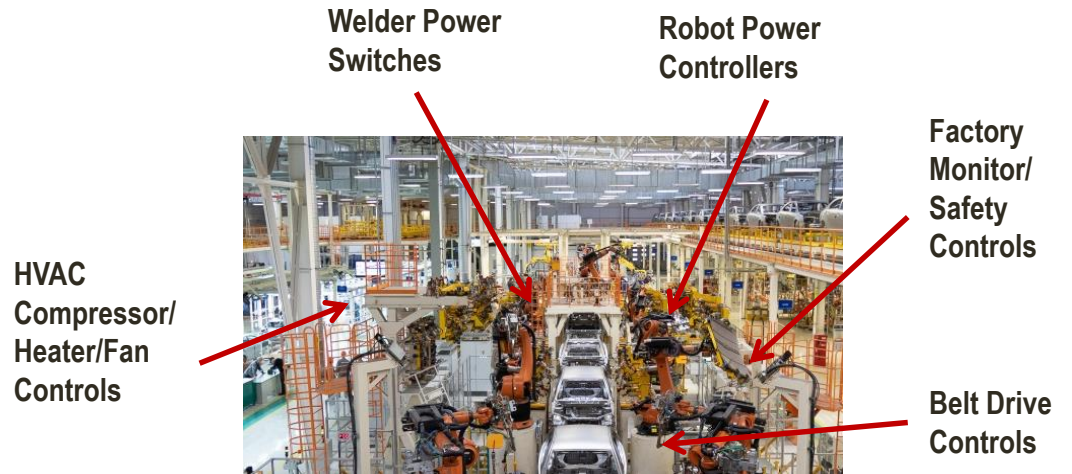
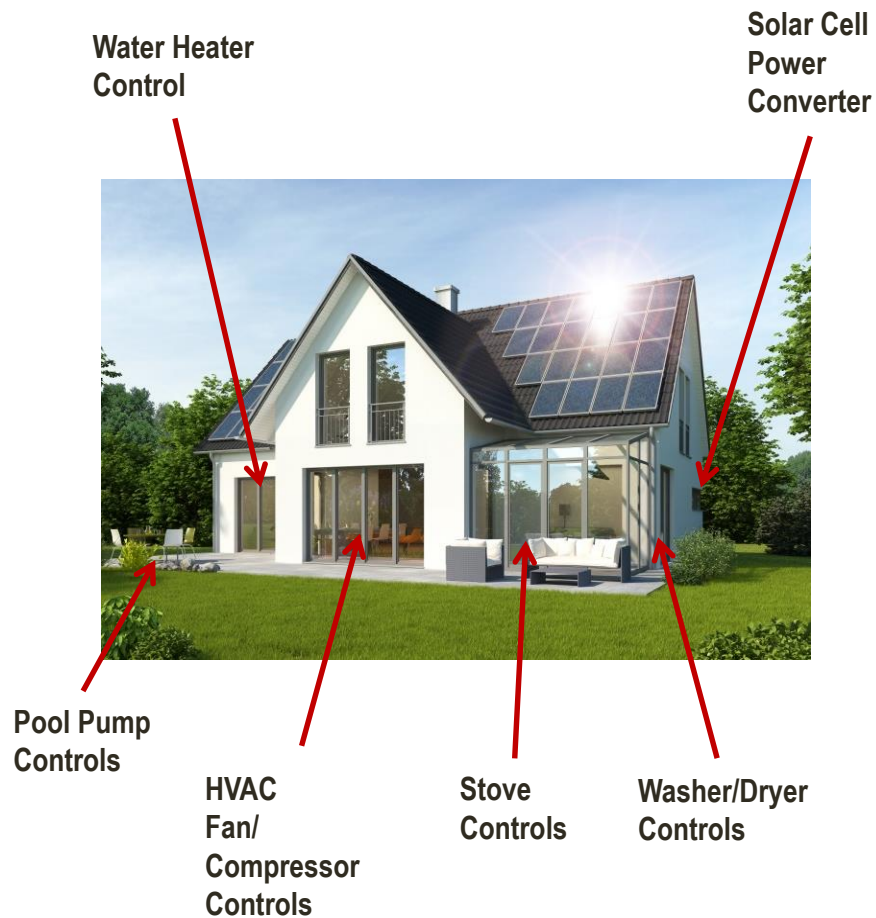
All statements in this presentation that are not based on historical fact are "forward looking statements." While management has based any forward looking statements included in this presentation on its current expectations, the information on which such expectations were based may change.

These forward looking statements rely on a number of assumptions concerning future events and are subject to a number of risks, uncertainties and other factors, many of which are outside of our control, that could cause actual results to materially differ from such statements.

Such risks, uncertainties, and other factors include, but are not limited to, whether the patents for our technology provide adequate protection and whether we can be successful in maintaining, enforcing and defending our patents, whether demand for our products, which we believe are disruptive, will develop and whether we can compete successfully with other manufacturers and suppliers of power semiconductor products, both now and in the future, as new products are developed and marketed.

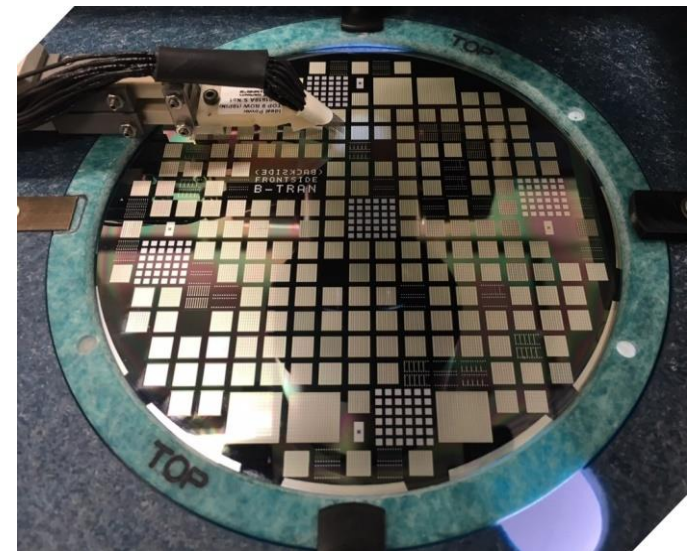
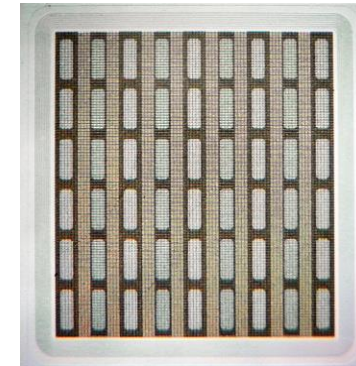
Furthermore, we operate in a highly competitive and rapidly changing environment where new and unanticipated risks may arise. Accordingly, investors should not place any reliance on forward looking statements as a prediction of actual results. We disclaim any intention to, and undertake no obligation to, update or revise forward looking statements.

Electric Power Switching is Required Everywhere

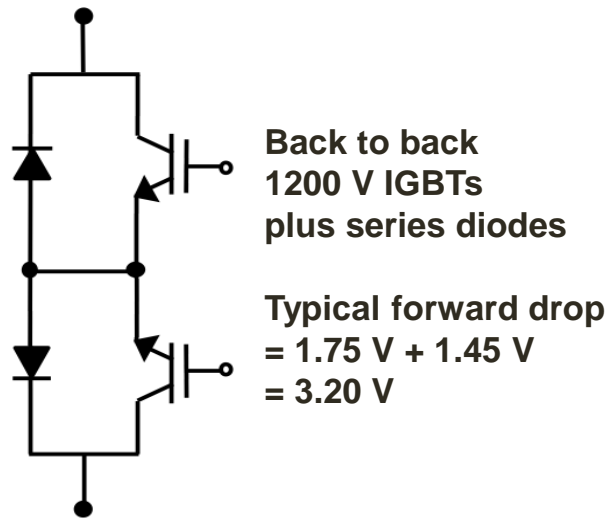


B-TRAN Will Address Most Power Switching Needs

- B-TRAN is a proprietary semiconductor power switch
- B-TRAN architecture has 3 compelling advantages
 - Bi-directional switching
 - Smaller, more compact designs
 - Lower losses = lower user costs
- First parts are being fabricated using mature silicon wafer bipolar processing equipment
- New is
 - The design (architecture)
 - Fabrication of both sides of wafers



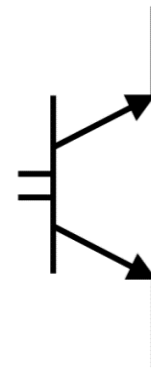
B-TRAN Bi-directional Switching



Back to back
1200 V IGBTs
plus series diodes

Typical forward drop
 $= 1.75 \text{ V} + 1.45 \text{ V}$
 $= 3.20 \text{ V}$

Conventional
IGBT Switch



1200 V bi-directional
B-TRAN

Typical voltage drop
 $= 0.2 \text{ V B-TRAN die} + 0.45 \text{ V from}$
internal resistance
 $= 0.65 \text{ V}$

B-TRAN

- B-TRAN replaces 4 devices in a bi-directional switch
- Effective forward drop $< 0.65 \text{ V}$

Conduction losses ~ 5x better than IGBT + blocking diode

B-TRAN Designs: Simpler, More Compact, Lower Power Consumption

IGBT Power Switches



Amps	Voltage Loss	On 50% of Time	Loss as Heat
100	x 3.2V	x ½	= 160 Watts (0.160 kW)



B-TRANS



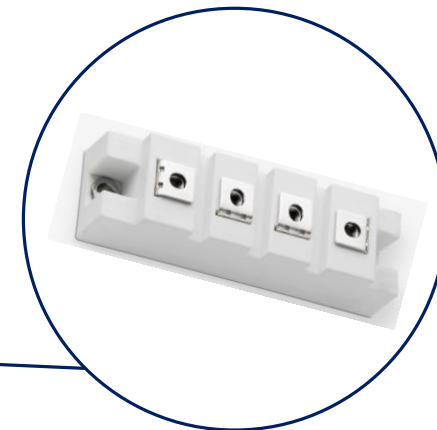
Amps	Voltage Loss	On 50% of Time	Loss as Heat
100	x 0.65V	x ½	= 33 Watts (0.033 kW)

Example: B-TRAN Will Deliver Important Operating Cost Reductions

IGBT Power Switches



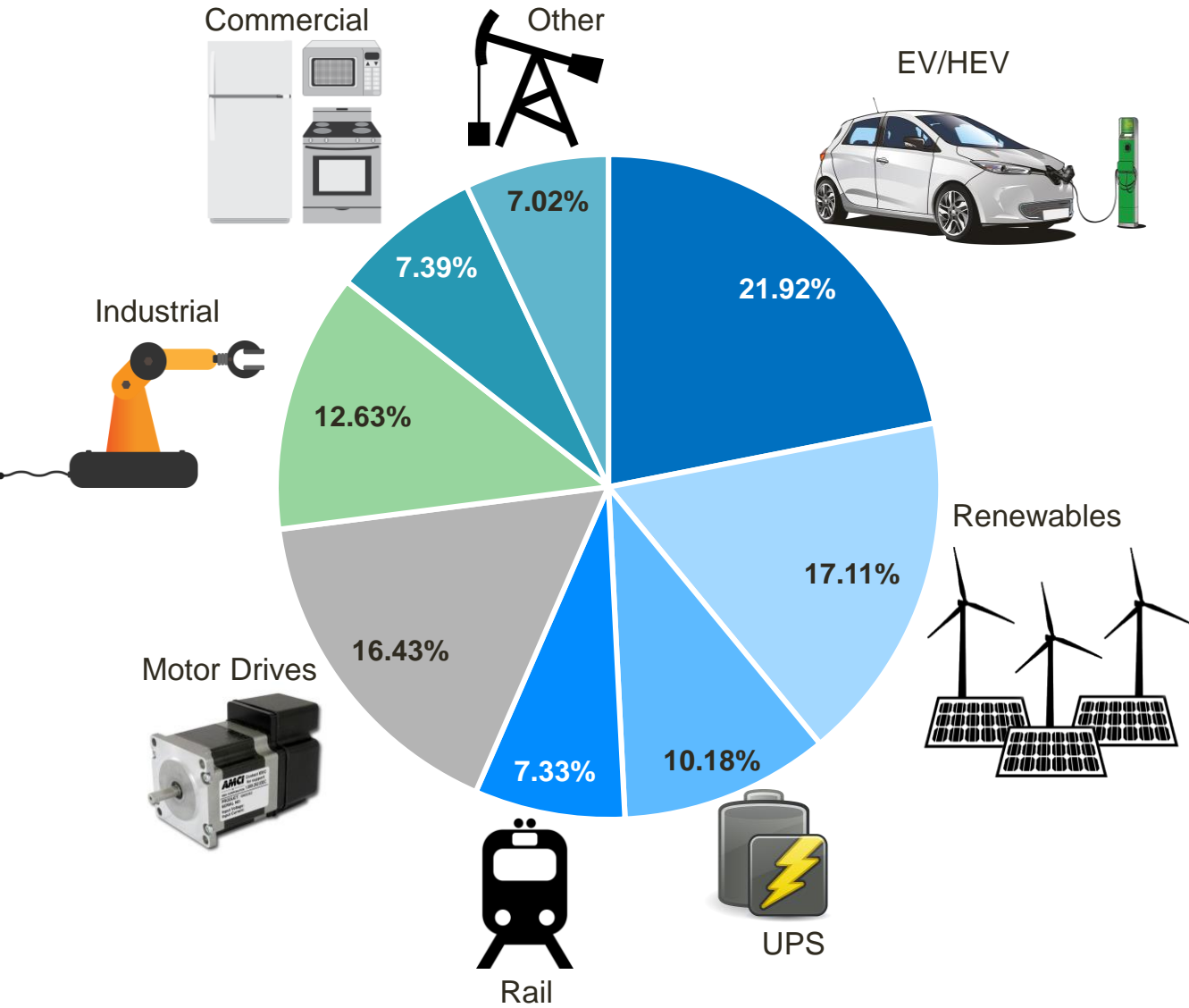
B-TRANs



IGBT Switch Pairs	Loss (in Kilowatts)	Hours	Days	Utilization Factor	Electric Power Cost/kWh
7	160×10^{-3}	x 24	x 365	x 1/2	x 0.10
Annual Cost = \$490.56					

B-TRAN Switches	Loss (in Kilowatts)	Hours	Days	Utilization Factor	Electric Power Cost/kWh
7	33×10^{-3}	x 24	x 365	x 1/2	x 0.10
Annual Cost = \$103.22					

IGBT Market



- Current \$4.9B IGBT market going to \$7.4B by 2022
- 10.6% projected CAGR
- EV/HEV segment projected to grow to nearly 50% in 2022

B-TRAN Enables Opportunities in Important Verticals



Data Center UPS

- Higher efficiency
- Lower operating cost
- Simpler thermal management
- Lower capital cost
- \$600M/year¹



Renewables

- Integrated storage
- Higher efficiency
- Size reduction
- Cost reduction
- \$1.4B/year¹



Traction/Rail

- Higher efficiency
- Size reduction
- Weight reduction
- Simpler thermal management
- \$500M/year¹



HEV/EV

- Range increase
- Simpler thermal management
- Cost reduction
- \$1.9B/year¹

¹ Global Insulated-Gate Bipolar Transistor Market (2016-2022) by Mordor Intelligence

Examples of B-TRAN's Impact



Data Center UPS

- Power demand growing >13%/year
- Energy use is largest operating expense
- For a typical data center, improving UPS efficiency from 90% to 95% saves about \$110,000 per year²

² *Data Center Best Practices Guide* by Pacific Gas & Electric



H/MVDC Transmission

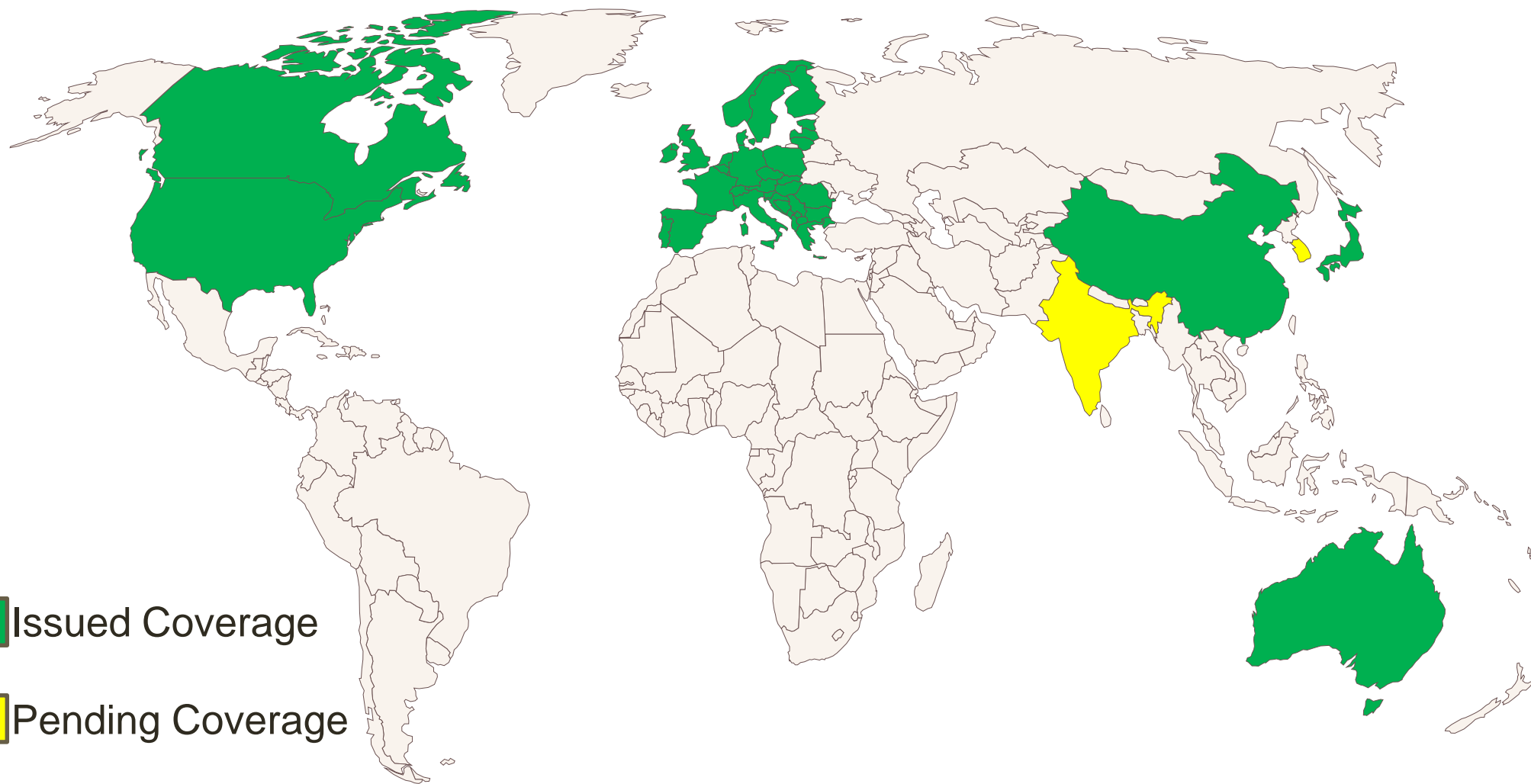
- Emerging \$7B market by 2024
- Enabled by solid state breaker

HEV/EV

- Power devices 20% of losses
- B-Tran's 67% lower losses = ~7% mileage (range) increase[↑]



Ideal Power's IP



47 Issued Patents; 36 Pending Applications

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