

McGill  
Electric Snowmobile



**CLEAN SNOWMOBILE  
CHALLENGE™**

# Who is the McGill Snowmobile for?

- Zero emission research bases
  - Ski patrol or maintenance crew
  - Beginner snowmobile tours
  - European hotels and resorts
- 
- Powertrain modeling and simulation to optimize vehicle design for specific applications



**CLEAN SNOWMOBILE  
CHALLENGE™**

# Whistler 2010



photo: Andy Dittich, wpnn.org

# Whistler Ski School





# Val d'Isere 2009



# Greenland



# Common Application Characteristics

- Low speed
- Short distance
- Hauling equipment
- Good manoeuvrability
- Several recharging stations



**CLEAN SNOWMOBILE  
CHALLENGE™**



# Sled Characteristics

- Battery Pack: Lithium-Ion
  - 3.2 kWh
  - Range: 15 km
  - Onboard charger
- Motor: 3-phase AC
  - 12 kW, 37 Nm at 0 rpm
  - Fixed speed transmission

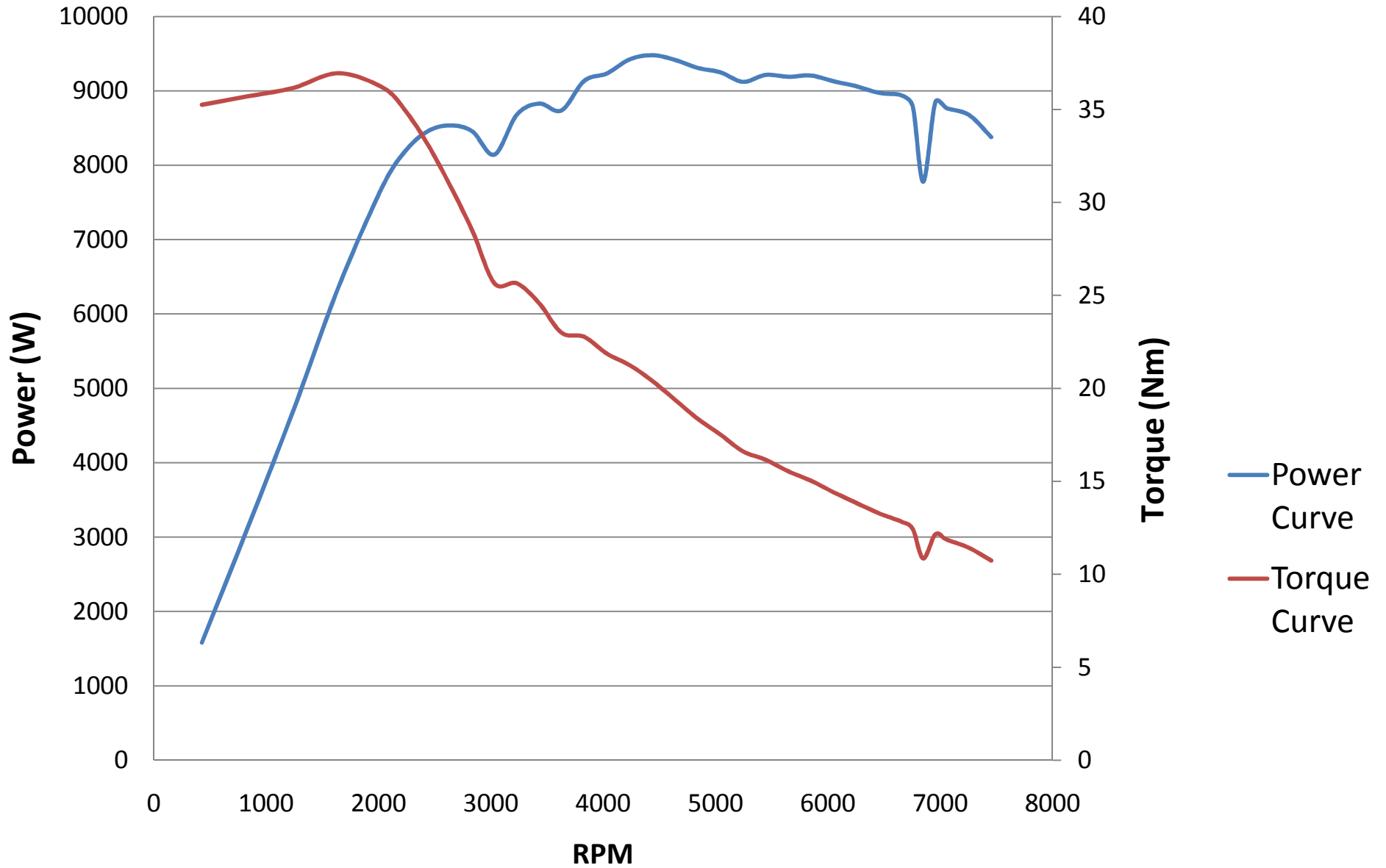


**CLEAN SNOWMOBILE  
CHALLENGE™**



# Power and Torque vs Rpm

## 60V Lead Acid Pack



# Ergonomics and Ease of Use

- Smooth and progressive throttle response
- Programmable performance characteristics
- Driver position/control unchanged
- Reverse switch
- Optional rear seat
- 120 V inverter



**CLEAN SNOWMOBILE  
CHALLENGE™**

# Serviceability and Durability

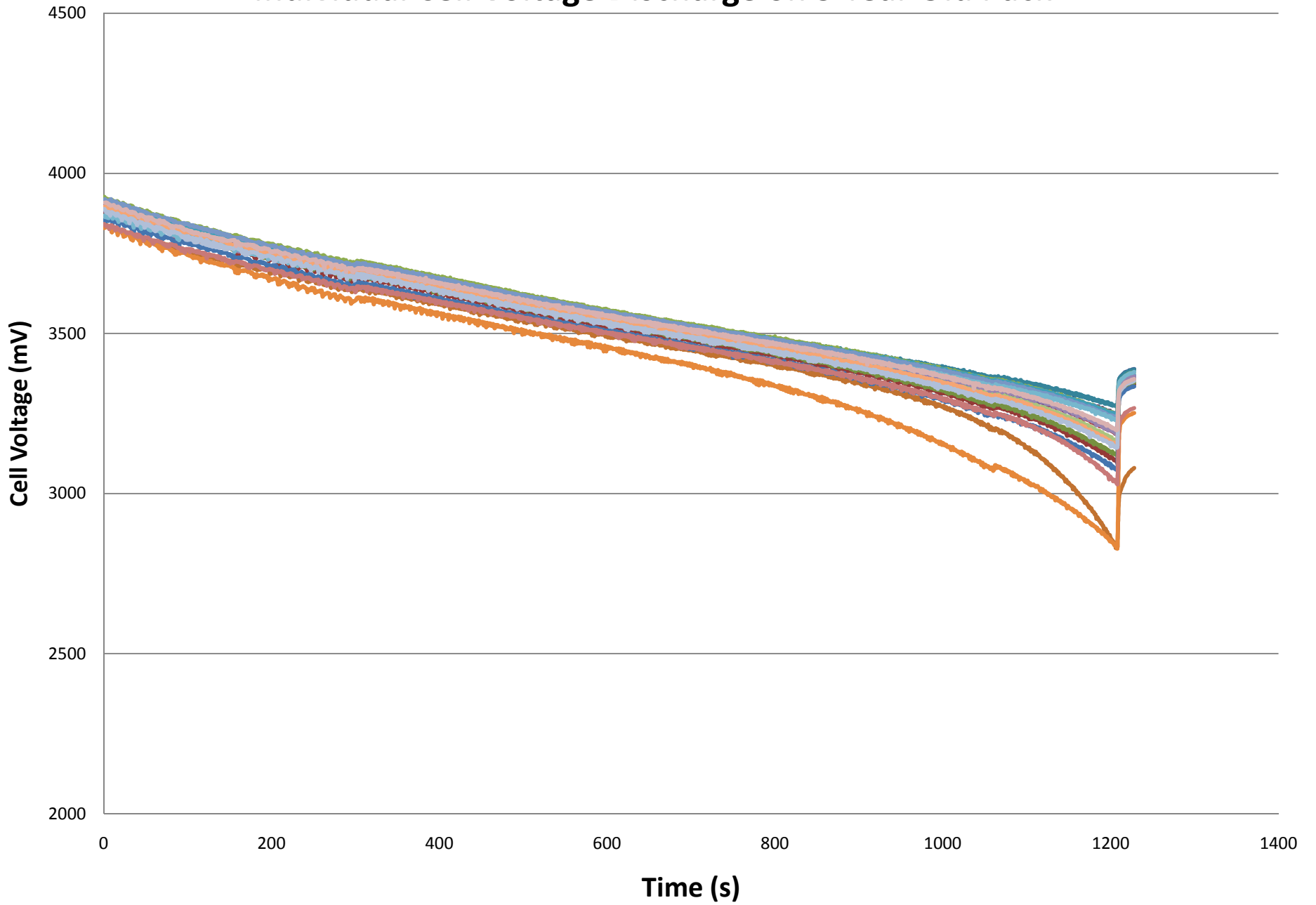
- Mechanical:
  - No motor maintenance
  - Regular maintenance except 1<sup>st</sup> step down ratio
- Electrical:
  - No maintenance expected
- Battery health after 5 years of abuse: 70%



**CLEAN SNOWMOBILE  
CHALLENGE™**



# Individual Cell Voltage Discharge on 5 Year Old Pack



# Cost Analysis

- Encourage recovery of chassis with broken engines
  - Conversion cost: \$5,000 - \$7,000 excluding energy accumulator
  - Battery selection determined by customer needs



**CLEAN SNOWMOBILE  
CHALLENGE™**

# Cost Analysis

With:

- 15 000 km life expectancy
- \$8,000 battery pack (battery, BMS, box)
- 1,000 recharges
- \$200 electricity
- \$0.55/km



**CLEAN SNOWMOBILE  
CHALLENGE™**



# Environmental Impact

- Reuse of several stock components
- Lightweight
- High efficiency powertrain (above 80%)
- No carbon dust
- Regenerative braking
- Too quiet for densely populated areas (ski resort)



**CLEAN SNOWMOBILE  
CHALLENGE™**

# Conclusion

- Optimized design
- Market viable solution



**CLEAN SNOWMOBILE  
CHALLENGE™**