Towards Sustainable Racing
Simon Watkins
“Brilliantly clever, amazing engineering but utterly pointless, and irrelevant to the real world.”

— Max Mosley
Kimi Raikkonen at Albert Park 2007 Australian GP

Big energy changes
300 to 100 Km/h
All wasted heat
Potential for energy recovery

Irreversible (non-conservative)
- Air resistance
- Mechanical friction (tyres, bearings)

Reversible (conservative)
- Potential
- Kinetic

Regenerative braking permitted in some car races
Braking energy used in acceleration (as in Prius etc)
Racing drive cycle ideally suited to regenerative brakes
KERS in F1

• F1 must “respond in a responsible way to the world's environmental challenges” Max Mosley, F1 President

• 60 kW (80 Hp) for 2009 season

• All electric systems – except Williams flywheel system – CF rotor ~90,000 rpm ~ 50kg
What is FSAE?

Eight events, including design, economy, but also:

- “An opportunity to see failure on a first-hand basis”
- “A powerful integrating force that builds strong teams with a relentless focus on outputs”
- “The best way to get noticed by Formula 1 teams”
- “A learning exercise where students realise the non-reversible nature of time and money like no other”
- “Largest student engineering competition in world”
- “The most motivating thing ever seen in Universities”
- “A bunch of crazy petrol heads having fun in an unsustainable way”
2008 Car Technical Overview

- 2004 RMIT Racing R04 – CF tub with steel sub frame RRR
- Retrofit with non-regenerative electric motor and batteries
- Plans to use electricity from RMIT Energy park
- Demonstrated at 2008 FSAE FISITA World Championships
- Lap times comparable with mid-field petrol cars
2008 Car Technical Overview

- Rear wheel drive single motor
- Advanced DC 7” brushed motor
- Curtis Controller

- 30 Thundersky 40Ah Li-Ion
- 100V, 400A Max
2009/10 Car Technical Overview

- Currently in design and manufacturing stage
- Twin Vectrix motors with regenerative capability
- Space frame chassis for maximum adjustability
- To compete in all-electric FSAE race Germany 2010
Powertrain

- Two brushless DC motors with electronic differential
- 65 Nm @ 0 – 3000 rpm
- 20 kW @ 3000 - 6000 rpm
- 4.6:1 speed reduction via a planetary gear system
Electronics, Telemetry (with LaTrobe)

To obtain data from sensors

- Voltage, current, temperature
- Throttle and steering positions
- Brake and accelerator positions
- Vehicle speed, acceleration

- Wirelessly transmit the data to the Pit crew
- Crash and short circuit protection
Concluding Points

- Regenerative systems are electric
- The fastest vehicles are electric
- Fertile area for research, sponsorship
- New breed of engineer needed
Potential Opportunities for SAMME/SECE/TAFE

• Front/rear regeneration?

• Motor/generator design?

• Supercapacitor or battery?

• When to push the button?
Thanks!
Any Questions?
High performance EVs

Ultimate EV 0-100 km/h 2.5s

Wrightspeed 0-100 km/h 3.07s

Killacycle sub 8s quarter mile

RMIT sustainable FSAE car
Vehicle Simulation

Velocity vs Distance

Drag Forces vs Velocity

Sum of Forces

- Aero Drag
- Aero Lift
- Rolling Resistance

Driving Force
- Total Drag Force