SCHOOL OF MECHANICAL, INDUSTRIAL & AERONAUTICAL ENGINEERING

Reduction of Fuel Consumption and CO_2 Emmissions using a Hybrid Drive Train in a Truck Logistics Operation

MECN4006 - Research Project (KIE13)

Tumisang Kalagobe (800363), supervised by Professor F. Kienhofer

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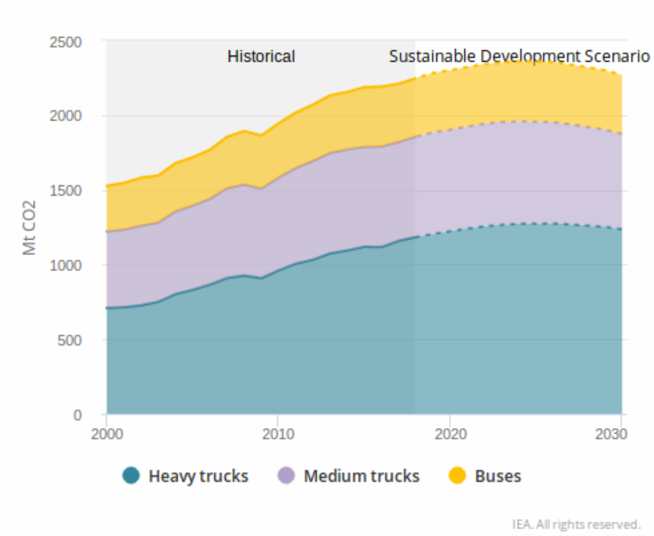
University of the Witwatersrand, Johannesburg

Land based logistics are a major contributor to global CO_2 emissions [Teter, 2019]



Objectives? Simple!

1. Pass this presentation

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1. Pass this presentation
2. Pass the research project

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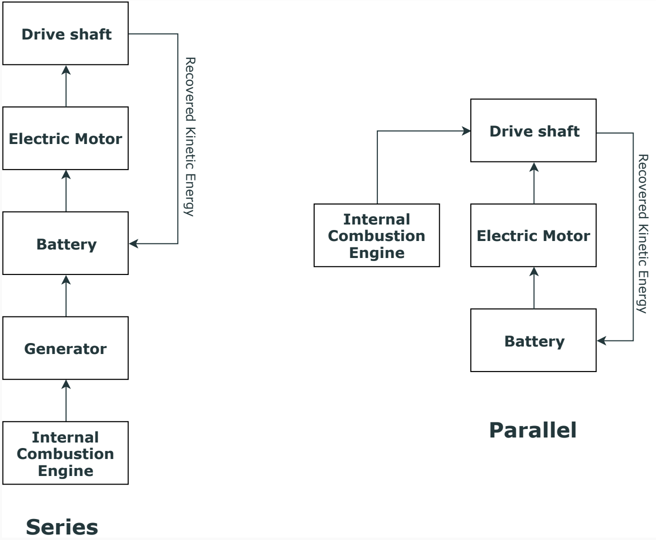
1. Pass this presentation
2. Pass the research project
3. Graduate 🎓

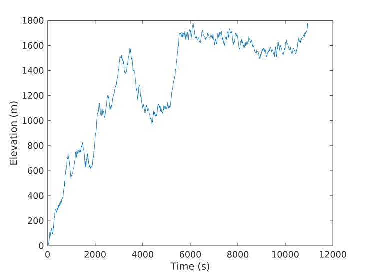
Research Objectives (for real this time 😎)

1. Determine the reduction in fuel consumption, costs and CO_2 emissions when using the series and parallel hybrid drive train configurations for various drive cycles, including that proposed by Yacoob in 2018 [Yacoob, 2018].
2. Create a control logic and transmission that can achieve objective 1 while maintaining the speed requirements of the drive cycle.

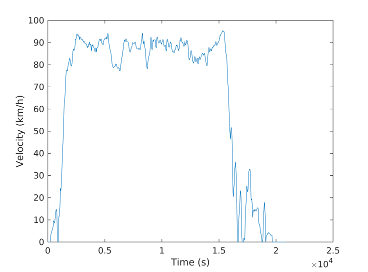
In the modelling phase a quasistatic approach is used with independent subsystems



The semitruck trailor is modelled for HHDDT drive cycles and typical logistics operations

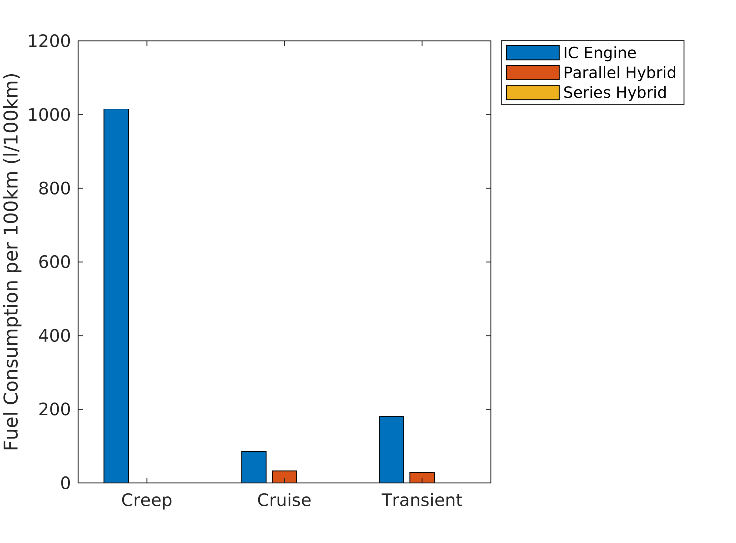


(a) Durban to Johannesburg

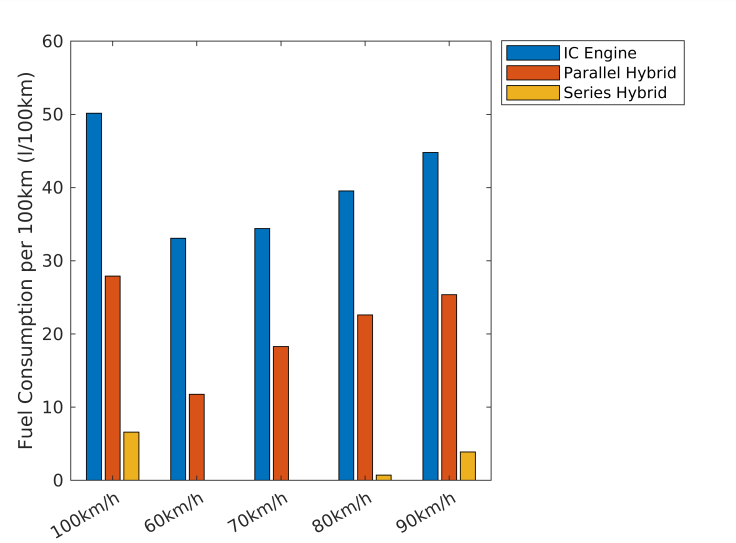


(b) The HHDDT Cruise Drive Cycle

The Heavy Heavy-Duty Diesel Truck drive cycles do not yield satisfactory fuel economy results



Up to 80% reduction in fuel consumption and CO_2 emissions is achieved with hybrid drive trains



Conclusions and recommendations for future studies

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- The full hybrid reduces fuel consumption by up to 50% for the chosen test cases
- Dynamic drive cycles should rather be modelled using a dynamic model, as opposed to the quasistatic approach
- The developed quasistatic IC engine model deviates from the expected 37 litres per 100km by 10% or less for constant velocity drive cycles

QUESTIONS?

Teter, J. (2019).

Trucks & buses (heavy-duty vehicles) - tracking clean energy progress.

https://www.iea.org/tcep/transport/trucks/.

[Accessed 30 Jun. 2019].

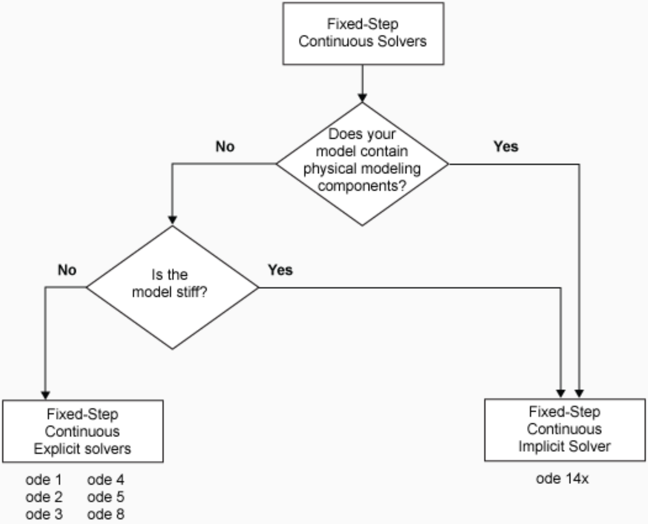
Yacoob, A. (2018).

Green transport.

Honours Thesis, University of the Witwatersrand.

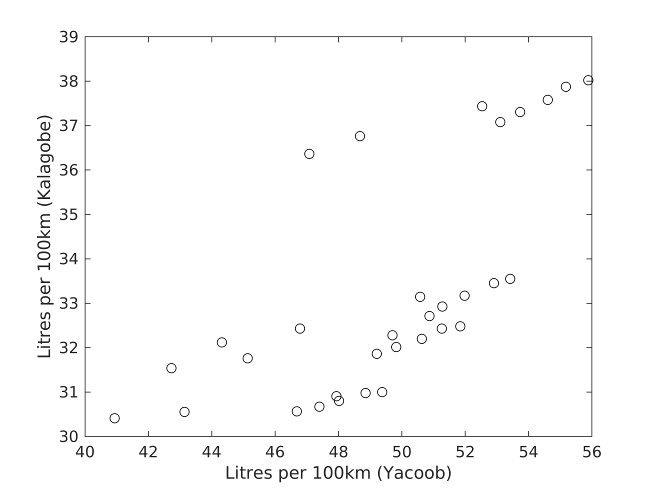
BACK UP SLIDES

Solver selection



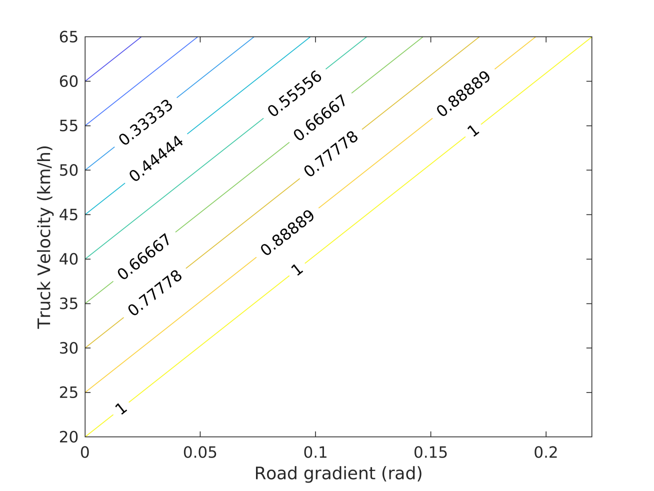
Model has been validated against literature

$$r = 0.6784$$

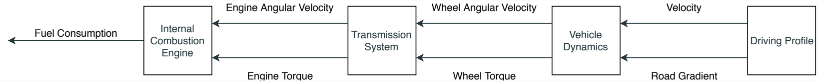


Torque split factor

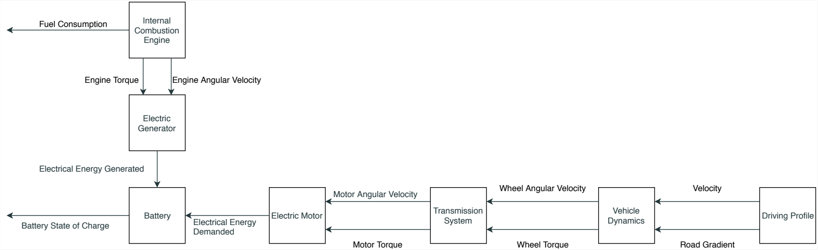
$$u(\alpha, v) = \frac{1}{\alpha_{max}}\alpha - \frac{1}{v_B - v_A}v + \frac{v_B}{v_B - v_A}$$



Conventional internal combustion engine model



Plug-in hybrid drive train model



Full hybrid drive train model