

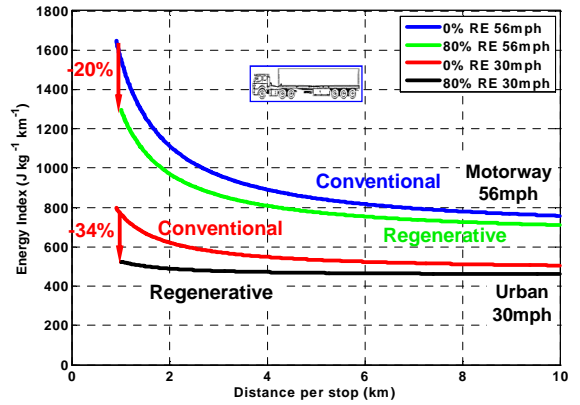
Project Overview

Problem:

- Urban freight delivery by truck is **growing**
- Current methods are **inefficient** with regards to the energy expended per tonne of material moved
- Using **longer vehicles** with steerable trailer axles can **reduce energy consumption** by up to **25%**
- Using **regenerative braking** can **reduce energy consumption** by a further **30%**

Goals:

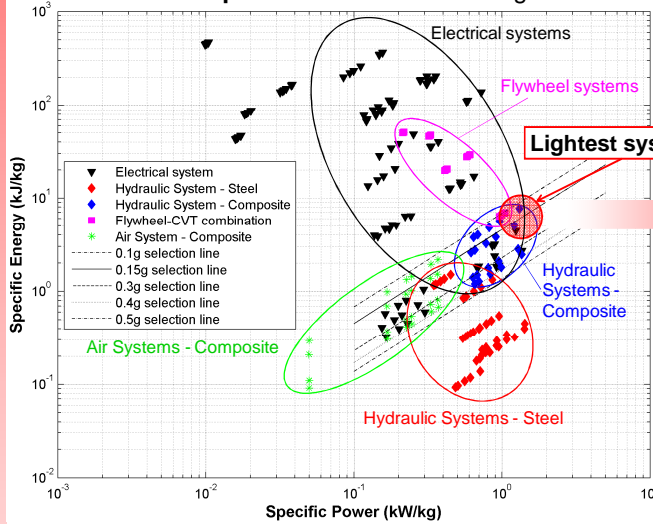
- Develop an **ultra low-energy urban freight delivery vehicle**
- Prove the **viability** of constructing a trailer with **steered axles and regenerative braking**



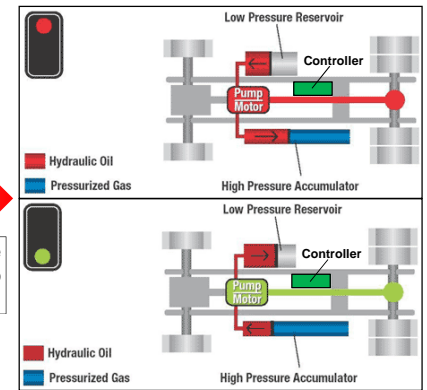
A hybrid tractor semi-trailer in urban delivery can use up to 34% less fuel than a conventional tractor semi-trailer

Step One: Choice of Technology

- Compare the different technologies



Hydraulic Systems are **lightest** (they are also the **smallest**).



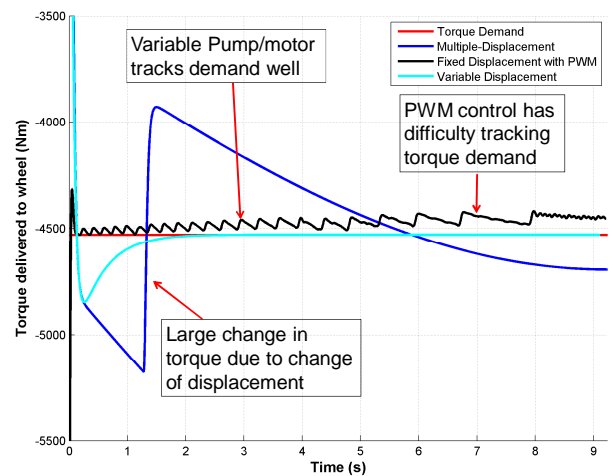
Existing parallel hydraulic hybrid concept (Permo-Drive Technologies Ltd.)

Step Two: Choice of Hardware

- There are **three possible ways** to implement this using **available technologies**:

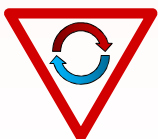
- Variable displacement pump/motor.**
- Fixed-displacement pump/motor controlled via pulse-width modulation.**
- Multiple displacement pump/motor, with two or three different displacement settings.**

- Each of these was **simulated**, and the **results look promising** for each technology
- The choice of which technology **depends on geometric constraints**.



Conclusions

- Hydraulic technology** is **20% lighter** and **55% smaller** than competing technologies
- Three different hardware strategies** are available, each with **different advantages**
- Future Plan:** **Design and build** a regenerative axle for the CVDC trailer



Regenerative Braking

ArvinMeritor
Camcon
Denby Transport
Firestone

Fluid Power Design
FM Engineering
Goodyear
Haldex

CVDC

Intec Dynamics
Mektronika Systems
MIRA
QinetiQ

Shell UK
Tinsley Bridge
Volvo Trucks