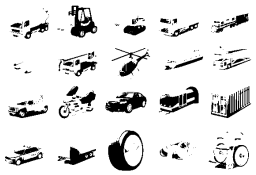
Transport Summary



Peter Watson

Transport

- What governs how efficient our cars can be?
- limited by friction/wind-resistance
- Since autos rely on heat, will need to understand how to convert heat to energy (later)

Transport

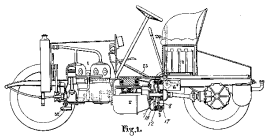
- Are hybrid or plug-in cars the answer?
- Does public transport (buses and trains) use energy more efficiently?
- lets see

Energy and transport

- To drive at a constant speed, need ~40kW at 60 km/hr~15 m/s
- ~ 2.4 MJ/km ~ 0.07 litre/km
- which becomes ~7 litres/100km
- However 1500 kg car would have KE of 200kJ
- Need to supply this every time you accelerate
- becomes heat when you brake

Hence hybrids

- K.E. of car converted back to electric energy
- **Can't** change cruising power consumption
- Not exactly a new idea!



Hence hybrids

- Work best in cities, with start-stop

OC Transpo has 154 fuel-efficient hybrid buses, but they are contributing to fuel costs being overbudget.

The diesel-electric buses are designed to perform best on low-speed routes with frequent stops and starts. The city eyed the routes for the hybrids because the repetitive stop-and-go eats up diesel fuel and increases costs.

When the city bought the buses, Transpo's intention was to just use them on these kinds of routes, but there aren't 154 of them and the transit department needed to run the buses elsewhere in the city. Those other routes, such as express routes, don't provide the same kind of fuel efficiency for the hybrids.

JON WILLING ,OTTAWA SUN

Transport

- Can we reduce the pollution due to transport?
- Worst gas is CO_2 (carbon dioxide) need to understand why this matters

Transport

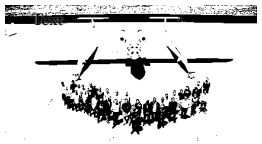
- Why is it so much easier (cheaper) to travel horizontally than vertically?

How about space travel?

Virgin Galactic has managed to reduce drastically the price of getting to space and over time will reduce it still further.

The starting price for flights is $200,000 with refundable deposits starting from $20,000.

This gets you 150 km up!



e.g. space shuttle

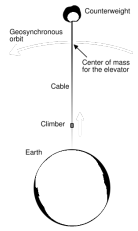
- K.E. ~ 3 TJ = 3×10^{12}J
- **All** gets converted to heat
- Temp ~ 3000°C

- To cross the Atlantic (4000 km) is ~$1000
- Almost all the difference is K.E.!
- We don't have hybrid space-craft!

Can we be smarter?

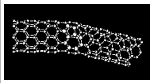
Space Elevator

- Still has energy problems (doesn't matter how we get something into orbit, energy is a constant).
- Need to be at geostationary orbit ~ 36000 km



- Needs materials with huge tensile strength and low density

Need	Strength	Density
	150 Gpa	1000 kg/m³
Steel	5	9000
Kevlar	2	1000
Carbon nanotubes	150 (maybe!)	1000

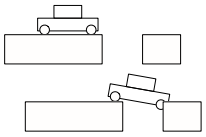


If a sink-hole opens up in front of you, should you

1. Accelerate so as to leap over the hole?
2. Stay at the same speed?
3. Brake as hard as possible so that you fall into it slowly?
4. Pray?

Before

After



So depends critically on how far front of car falls

- **Very roughly**, if width = 5m
- If v < 4m/s (15 km/hr), you fall in and survive
- If 4m/s<v< 10 m/s (36 km/hr) you crash and die (well, maybe not!)
- if v > 10 m/s, you cross the hole