Lou Christeson – Presentation at Surfers Sunrise Rotary Club 24/05/19

A brief CV of Lou:
Worked 54 years in the electricity distribution industry

Started work with Hawkes Bay Power authority as apprentice / come tech trainee - later became Test Dept supervisor & then assistant engineer.

Taught Electricians Trade certificate & Advanced Trade certificate as an extra job for a year.

Left H.B. To move to Auckland after 14 years to assist in the installation & subsequent fault finding of short comings with the first computerized SCADA system installed in the Southern Hemisphere. [SCADA = System Control & Data Acquisition]

Worked with the Auckland power authority for 22 years until I took voluntary redundancy in 1995 [BEFORE the Auckland CBD power outage for 6 weeks in 1998]

Worked for 5 years as a Grid operations engineer with Transpower NZ before moving to United Networks in Auckland which controlled most of the electricity distribution in the top end of the North Island bar Auckland south of the bridge & shortly after that back to the Auckland power authority I had taken redundancy from after they acquired United Networks in a takeover bid here I worked until retirement in 2012.

I am currently President of the Runaway Bay Probus Club

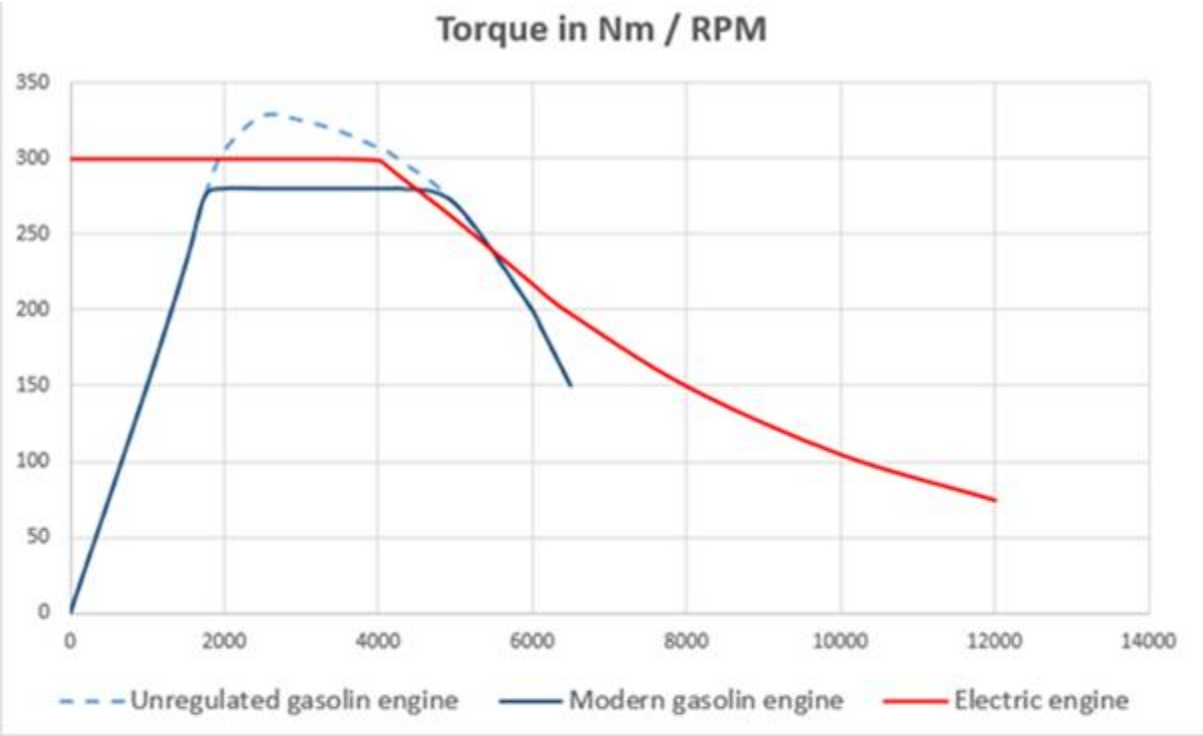
Qualifications - N Z Certificate in Electrical Engineering - [Heavy Option], Advanced Trade certificate, Registered Electrical Inspector [expired] & registered Electrical Technician, as well as various computer programming certificates as related to the SCADA systems I worked on.

Electric Cars and relevant Electricity Generation and Distribution

I started looking seriously again at electric cars after, what I thought, were ridiculous comments made during the election, I had recently ridden in a friends Tesla car & I've got to say I was impressed by the smoothness & acceleration it was capable of for a car weighing over 1800Kg -- 0 to 100 km/h in under 3 secs.

If we look at efficiency of various forms of propulsion – steam is last at 3 to 10% petrol 12 to 30% & Electric 80 to 95%

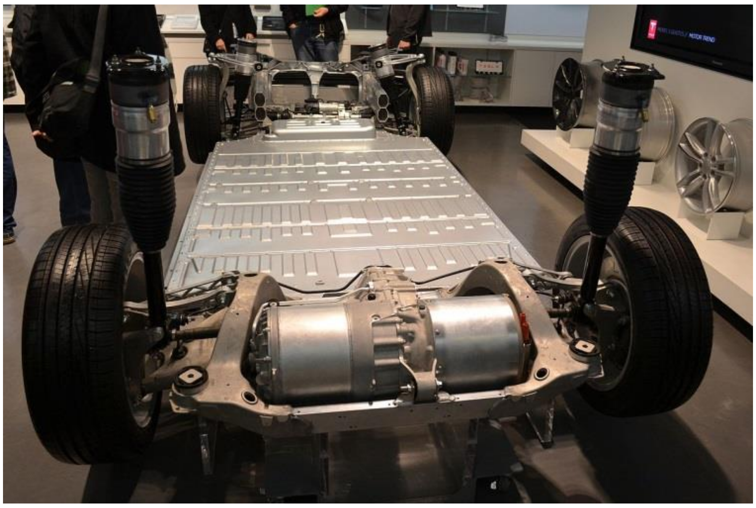
If we compare the torque electric motors give it is virtually flat from 0 to 4000 rpm whereas petrol only really cuts in between 1500 & 5000 rpm



The Tesla basics

The entire drive train consists of two electric motors, sandwiching a fixed-ratio final drive. The motor revs to about 15,000 r.pm. It produces good torque at zero r.p.m. and (in some models) peaks at over 400HP. No clutch, torque converter or variable-ratio gearbox is needed. The motor is an ordinary AC induction motor. It has no brushes and (apart from the bearings) one moving part. It contains no rare earth magnets. The inverter is solid state. No exhaust system, turbocharger, oil pump, coil, distributer, intake air filter, complex vibration damping or heat shields; no pistons, valves, pushrods, camshafts, lifters, catalytic converters……….

The motor can also act as a brake, known as re-genitive breaking which as the name implies, recovers energy by acting as a generator (much of the energy used to climb a hill is put back into the battery rolling down the other side).



The range too is impressive at up to 300 Km & being able to be recharged on a supercharger to another 270Km range in 30 mins.

However the number of superchargers around are few & far between in Australia.

A supercharger charging station usually comprises a 100Kw per point plug so that a 20 plug station would produce a loading of 2 Mw – the equivalent of about 670 houses -

& these points would take nearly an hour to charge each vehicle. Which would most likely mean it would be a great place to build a coffee shop.

Add to this the Tesla Model S 'Standard Range' is now listed at **$135,390** drive-away. & If you wish to move up to the '**Long Range**', you'll pay **$140,050 drive-away**, while the **P100D with Ludicrous Mode** has been listed at **$164,465 drive-away**.

Sales Stategy

The normal sales strategy for vehicles in US is that the profit margin for sales is low but profit is made in on going servicing of the vehicles sold, this strategy doesn't work well with electric vehicles because the on-going maintenance is low, no oil changes, filter changes, - the electric vehicle is very low maintenance as there are so few moving parts, even brake wear is low because of the re-genitive breaking, this is one of the reasons that Elon Musk has chosen to sell his cars on line.

The Nissan Leaf, which is evidently the most popular electric car, has a battery capacity of 24Kwh [which evidently equates to about 2.6 lts of petrol in energy output]

Due to the good energy economy, it has a driving range from 140 km with modest speed in the summer to about 80 km in the coldest winter months. As can be seen the ambient temperature plays a huge part in the energy available.

These ranges may seem small, but it most likely cover the vast majority of people's driving needs. The new model however has a 40 Kwh battery which extends the range to about 270Km.

However, imaging having a car with 2.6 ltr fuel tank, which it takes 8 hours to fill at home, or 25 minutes on a supercharger, would you, buy it for $50000 + on road costs?

Later this year Hyundai is bringing a new Kona model to Australia, it will have 100Kwh battery which will enable charging up to 90% full charge via 40A plug in 9.5 hours or using a 10A standard household plug, 35 hours. It will retail for between $58,500 & $64,490 depending on options, by comparison the petrol model will retail at between $29,500 & $35,000

The battery life for these cars is increasing with a presently predicted life of 70% capacity left after 8 years. The replacement cost of the battery at the moment is about AU$430 [$300USD] / per KWH so that a 75Kwh battery would be worth AU$32200 [USD$22500] the only good thing is that prices have been decreasing at about 14% /year for the last 5 years [halved]

In the stakes for where the most lithium used to make the batteries for these cars comes from - Australia rates number 1 in the production & number 3 in the total reserves

<u>How are we going to charge these cars</u>

When I heard talk of increasing the number of new cars to be Battery powered by 2030 to 50% my first thought was how are we going to charge them, when I looked on the internet I found a study done by Jack Ponton of Edinburgh University, on what would be required to convert Britain's car fleet [this doesn't include trucks & heavy vehicles] to all electric & his take was this –

1. *If you want to do this with wind turbines, you are talking about **16,000 more wind turbines**, four times as many as they have at the moment, and he estimated that would occupy some **90,000 square kilometres**, which is approximately the size of Scotland."*
2. *If you were going to use nuclear power - The most detailed calculation shows they'd be looking at **five Hinkley sized nuclear stations** [3200 MW – 2 reactors] [37b$ x 5 =185 b$ AU] to run*

Country	Production	Reserves[note 1]	Resources
World total	**43,000**	**16,000,000**	**53,000,000+**
Chile	14,100	7,500,000	8,400,000
People's Republic of China	3,000	3,200,000	7,000,000
Australia	18,700	2,700,000	5,000,000
Argentina	5,500	2,000,000	9,800,000
Canada	480[note 2]	180,000	1,900,000
Portugal	400	60,000	100,000
Brazil	200	48,000	180,000
United States	870[note 3]	35,000	6,800,000

this. It would be the best way, the most efficient way to get electricity because nuclear power stations can run 90 per cent of the time.

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First Minister Nicola Sturgeon for Scotland - has pledged to phase out the internal combustion engine by 2032 – eight years ahead of the rest of the UK.
But Prof Ponton said that, even if the issues of power generation and charging points were sorted out, the National Grid could simply not cope with the increased demand.
He said: "It is a nice idea as electric cars are much more efficient, cleaner and actually simpler devices than the current internal combustion engine vehicles.
"Technically, it is an excellent idea. But the problem starts when you begin to think, 'Where are you going to get the energy to run them?'.

Considering we in Australia are having trouble even supplying our current energy consumption at peak times & with the closure of several coal power stations on the horizon we are likely to have problems & of course with renewables most generation will occur during daylight & most cars will be charged during night hours.

Network Infrastructure

This in my opinion is perhaps the biggest problem that is likely to be encountered,

Using current practice when designing electrical infrastructure in a new subdivision a diversity factor is used when accessing the size of cabling, transformers etc.

The average load expected at peak times is usually about 3Kw per household, working on the assumption that not everyone is cooking etc at the same time.

If we now look at 50% of houses having fast chargers fitted to charge their cars this would mean that when the cars were charging they alone would add over 9Kw per household [working on the fact that a 40 A power socket was suggested to be fitted to each house at a cost of $2000 [a cost which I think was perhaps on the high side]. Even if the charging was timed to start later in the evening there is usually HW, heating or air-conditioner load & other incidentals which would push the average load above the nominal 3Kw.

If this led to the replacing of all the power infrastructure the cost & disruption would be huge.

Just a further note about wind turbines & solar, wind turbines are limited in there use depending on wind speed – not enough wind – virtually no generation – & if the wind speed is to high – they have to be shutdown to avoid damage to the unit.

A recent study in the US concluded that if the renewables on a network exceed 18% the possibility of instability increased sharply.

The reason this is important is that the frequency – in Australia 50 cycles/sec is controlled to very close limits – a drop of 1 to 2 cycles a second can cause load shedding to occur to compensate & maintain stability & of course if the wind drops suddenly so does the generation, normally to compensate for this they have what is referred to as spinning reserve, this is generation which is up to speed & will come on line quickly in the case of a sudden drop in generation, in Australia's case this usually refers to coal powered stations.

When wind turbines comprise a very high proportion of generation this loss may happen quickly & to such a magnitude that compensation can not occur quickly enough & loss of supply will be initiated to save a Grid collapse, I have seen comments by local grid operators who expressed fears of this happening but cannot say too much publicly for fear of raising the ire of renewable energy factions.

As an aside on this subject some years ago when I was in a control centre we had a failure at a wind farm in the middle of the NZ Nth Is – the farm had a theoretical output of 40Mw, maintenance was called to the site & got generation up & running again with an output of 30Mw, I answered the phone to another contractor & when I hung up I noticed that the generation was back to zero again, I rang the wind farm site again & told the technician to have another look at the problem & was told 'It's alright, the wind has just dropped off'!

One of the things I've heard talked about since I moved to Queensland are complaints that the power network is 'gold plated' & this the reason for high power bills. Having worked in Auckland prior to the CBD blackout & seeing the results of cutting back on network reinforcement, staffing levels & maintenance I can assure you that when things go wrong a gold plated network pays for itself in spades.

In Auckland the engineering staff had lobbied to replace the 110Kv cables that supplied to the CBD because they were aging & the ever-increasing number of leaks that were occurring in these hi-pressure gas insulated cables.

The cost of this was considerable so the board continually delayed the project, - to compound the situation they made redundant the 110Kv cable jointers who carried out repairs under the assumption that they could use contractors to do this work, in retrospect it is staggering to realise that no checked to see that there were no other people in NZ who did 110Kv gas cable repairs as no one else had these types of cables or in fact used 110kv cables extensively.

This meant they had to get jointers from Sydney to carryout repairs & after the first repair & arguments over charges, the Sydney contractors refused to come back to carryout repairs to the next faulted cable unless they were paid upfront, after delays & arguments a second cable failed , the money was paid upfront but by then the excessive load put on the remaining cables caused a domino effect which caused the failure of the remaining cables.

It is interesting that even though there was a government enquiry into the causes of the outage, the whole truth was never exposed, the salaried decision makers however were all replaced over a short period of time – even though they had argued for replacement of these same faulty cables!