ELECTRIC VEHICLE CONVERSION

NISSAN SILVIA S13

by

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WHY?

- Reduce GHG emissions
- No ICE maintenance required
- Fuel prices
- ICE blew head gasket
- Vehicle in good condition
- Good boot & engine bay space
- Ian able to assist

PREPARATION

- Design rules & DPI application to modify
- Calculations – performance/cost
- Decisions
  - Range & Cost
  - AC or DC?
  - Lead acid or Lithium?
  - Direct drive or via gearbox? Clutch?
  - Power steering?
  - Airconditioning/heating
- Drawings

ICE VS EV COSTS

ICE vs. Electric Conversion Comparison					S.Gates	11/08/2007				
Inputs										
Dist driven per day	85	km								
No of days driven per year	100									
Petrol Version:			Electric Version:			Conversions				
Fuel Cost	1.4	$/litre	Loan Int Rate for Conversion & Batteries	9	%	0.09	Fraction			
Fuel Consumption	8.5	L/100km	Loan period for Conversion	10	yrs					
Engine Maintenance interval	10000	km	Electricity Cost	0.21	$/kWhr	(Synergy 100% renewable energy after 4c/kWhr price ris				
Petrol Engine Maintenance Cost ea Interval	$400		Electricity Consumption (from Batt, Motor input)	16	kWhr/100km					
Engine Replacement cost	$2,000		Range Reqd on Full Batt charge	80	km					
Engine Replacement Interval	200000	km	Depth of Discharge at Req'd Range	80	%					
			Battery Life Cycles	2000	Cycles					
			Vehicle Operating Voltage, nominal	144	V					
			Voltage per cell	3.5	V					
			Battery Cost per WHr	0.55	$					
			Max Power Req'd	75	kW	0.95	Fraction			
			Battery Charging Efficiency	95	%					
			Battery Max Discharge rate	5	C					
			Tot Elect Conversion Cost (excl Batt)	$11,250						
			Battery - Thunder Sky LFP160 Capacity	160	A-Hr					
			Battery - Thunder Sky LFP160 Wt ea	5.6	kg					
			Battery - Thunder Sky LFP160 Vol ea		m^3					
Calculated:			Dist Driven per Year	8500	km					
Dist Driven per Year	8500	km								
Petrol Version:			Electric Version:							
			Electricity Cost per year	$301						
Fuel Cost per year	$1,012		Battery Capacity req'd	16.0	kWhr					
Avg Annual Engine Maint cost	$340		Batteries	$8,800						
Engine replacement annual amortisation (no interes	$85		No of Batteries in Series	41						
			Tot Battery Capacity req'd	111	A-Hr					
			Theoretical Life of Batteries	18.8	Yrs	Note:Max practical life is approx 10 yrs				
			Max Allowable Current Draw from Batts	556	A					
			Max Allowable power output from Batts	80	kW					
			Max Current Draw @ desired max output	521	A					
			No of Batts - total	29						
			Tot Batts Weight	160	kg					
			Tot Batts Volume	0.00	m^3					
			Amortised Cost of Conversion per Yr, P&I	$1,753						
			Loan Period for Batts only (up to max 10 yrs)	10	yrs					
			Amortised Cost of Batts per Yr, P&I	$1,371						
Total Petrol Version Oper Cost/Yr	**$1,497**		**Batteries Amort & Oper Cost/Yr**	**$1,672**						
			Tot Conversion + Batts cost	$20,050						
			Less Sale of Existing Engine & ECU/EFI	500						
			Tot Nett Conversion & Batts cost	$20,550						

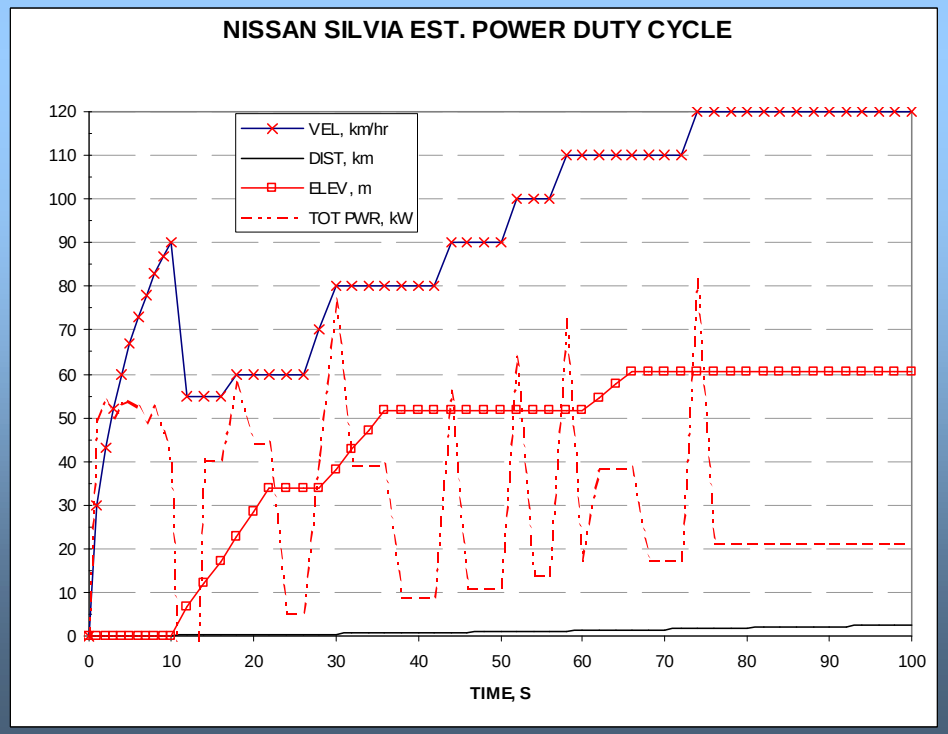
PERFORMANCE ESTIMATE

NISSAN SILVIA POWER DUTY CYCLE MODEL — S. GATES — NOV 4 1994

Inputs			Conversions		
ROLLING FRICT COEFF	0.0150			.5*P*A*Cd VALUE	0.39
VEHICLE & PASSENGER WT	1400	kg	13734	N	
FRONTAL AREA, M^2	1.82				
VEH DRAG COEFF	0.34				
AIR MASS DENSITY, KG/M^3	1.25				
WHEEL RADIUS, M	0.290				
DIFF REDN RATIO	4.300				
G'BOX REDN RATIO	1.500				

Electrical Drive System Inputs					Costs			
No of Cells in Series	40				Batt Cost	0.55	US$/W-Hr	Aug 08
No of Cells in Parallel	1							
Total No of Cells	40							
Cell Capacity each	160	A-Hr						
Cell Voltage ea	2.8	V under load	3.40	Nominal				
Battery Pack Voltage under load	112.00	V, under load	136	Nominal				
Mtr & Ctrl Effic under	0.70							
Calculated:								
Pack Energy	17.9	kW-Hr under load	21.8	kW-Hr Nominal				
Pack Cost	US$	$ 12						

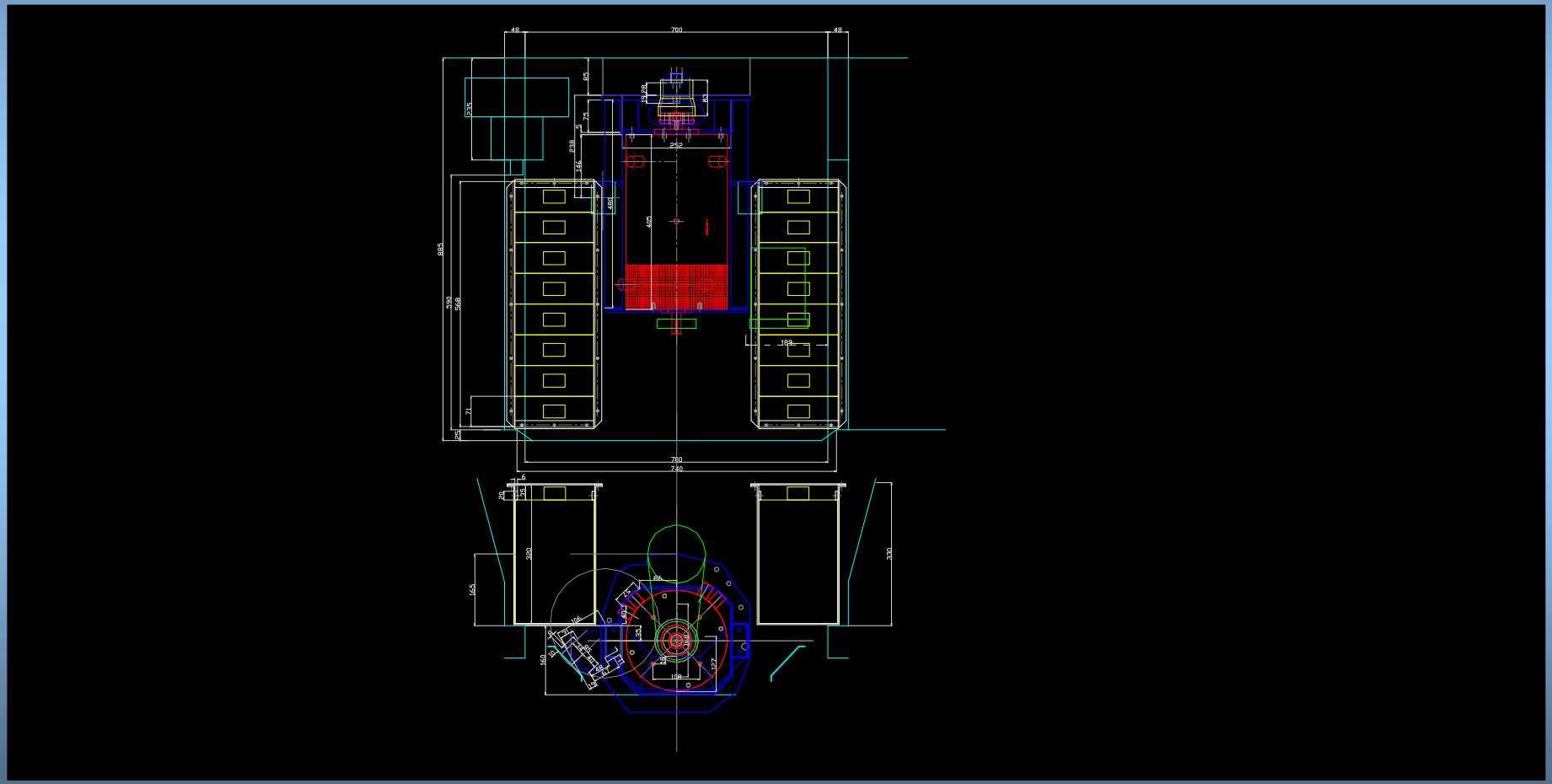
INPUTS					FORCES, N								ENERGY, NM(J) THEOR.					POWER				ELECTRICAL	
TIME, S	VEL, km/hr	DIST, km	SLOPE	ELEV, m	Air Drag, Avg, N	Rolling Drag, N	TOTAL AIR DRAG + FRICTION	CLIMB/ DESCEND	INERT'L	TOTAL FORCE, N	MOTOR SPEED, RPM	MOTOR TORQUE, NM	ACCEL, G's	DRAG & FRICTION	POTENTIAL (CLIMB/DESCENT)	INERT'L	TOTAL, Joules	TOTAL, kWHr	DRAG & FRICTION W	POTENTIAL (CLIMB/DESCENT), W	INERT'L, W	TOT PWR, kW	AMPS REQ'D	"C" Discharge
0	0	0.000	0.000	0	0.0	206.0	206	0	0	412	0	135	0.00	0	0	0	0		0	0	0	0	0	0.0
1	30	0.004	0.000	0	6.7	206.0	213	0	11679	12104	1771	544	0.85	886	0	48661	49547	0.014	886	0	48661	50	632	3.9
2	43	0.014	0.000	0	39.8	206.0	246	0	5061	5552	2538	250	0.37	2492	0	51310	53802	0.015	2492	0	51310	54	686	4.3
3	52	0.028	0.000	0	67.3	206.0	273	0	3504	4050	3069	182	0.26	3607	0	46228	49834	0.014	3607	0	46228	50	636	4.0
4	60	0.043	0.000	0	93.6	206.0	300	0	3114	3713	3542	167	0.23	4660	0	48444	53105	0.015	4660	0	48444	53	677	4.2
5	67	0.061	0.000	0	120.3	206.0	326	0	2725	3378	3955	152	0.20	5756	0	48066	53822	0.015	5756	0	48066	54	687	4.3



COMPONENTS

- Motor: **NetGain Warp 9**
- Controller: **Ian's prototype.. initially**
- Batteries: **40x ThunderSky LFP-160AHA** (128V, 160Ah nominal)
- BMS: **EVPower's TS-90 system**
- Charger: **Zivan NG3**
- DC/DC Converter: **Iota DLS-45**
- Power steering: **Holden Astra EH PS pump**
- Aircon: Original **compressor via aux motor shaft**
- Battery gauge: **TBS Link-10 and/or Ian's EVMS**

DESIGN



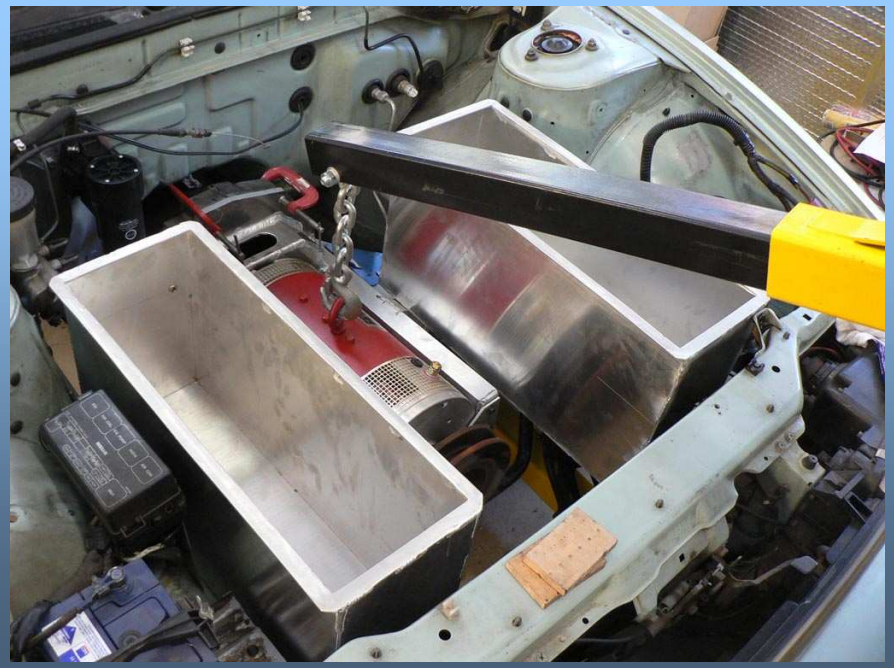
ORIGINAL I.C.E.

(1.8L TURBO, 135kW)

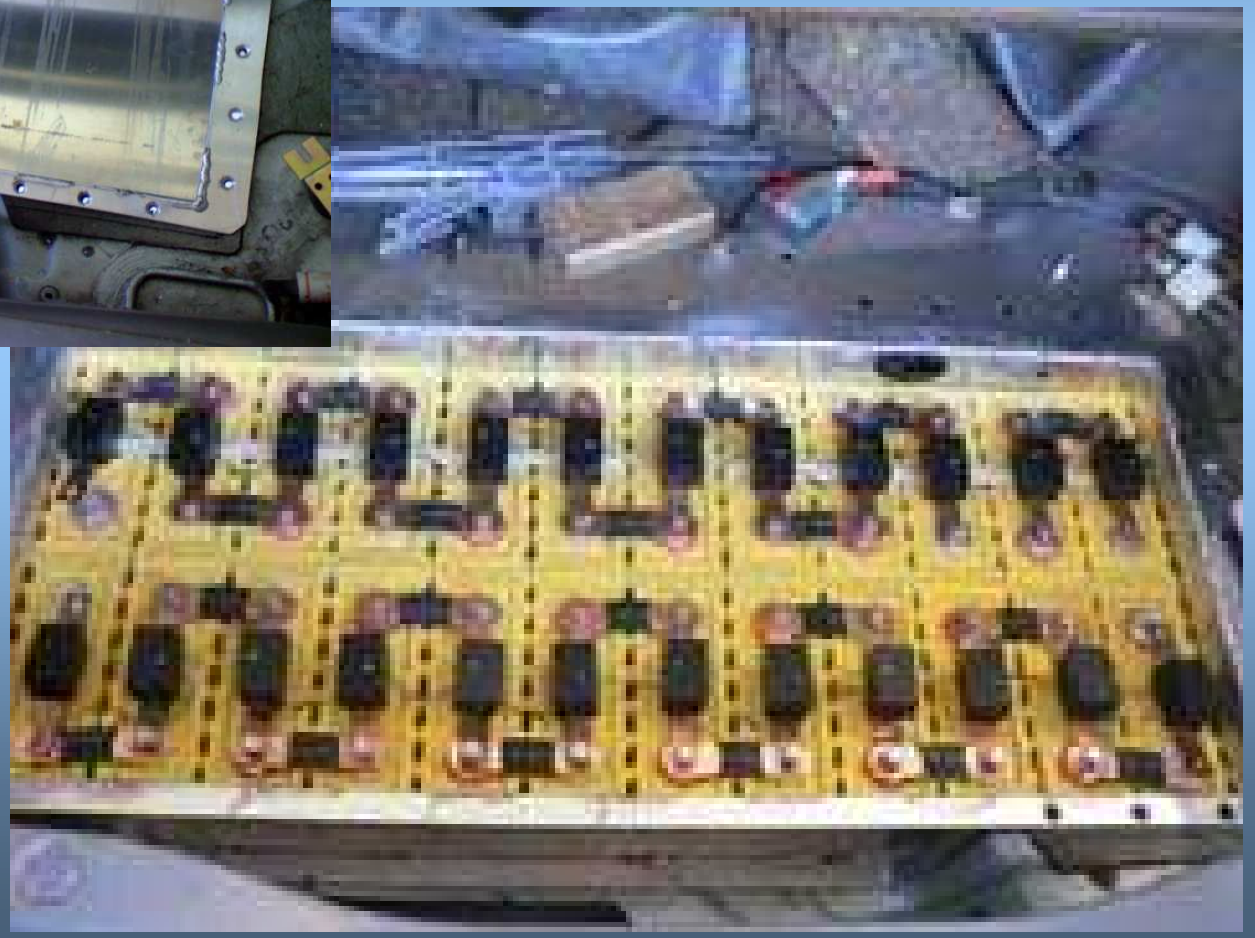
I.C.E. REMOVAL

MODS & MOCKUPS

ENGINE BAY



REAR BATTERY BOX



DETAILS

HOLDEN ASTRA EH POWER STEERING PUMP

12VDC 250W HEATER

HEATER INSTALLED IN ALUM HOLDER TO ADAPT TO OLD HEATER CORE SPACE

SILVIA CLUTCH PLATE

TAPER LOCK HUB

CLUTCH SPLINE

LESSONS SO FAR

- Battery size tolerances
- Solid motor mounts
- Record original gearbox location
- Coupling & motor access
- Gearbox input shaft support
- Electrical schematic very useful for newer cars
- De-gas AC before
- Weighscales