Auto Graphical Insights:

learning from plots of car data

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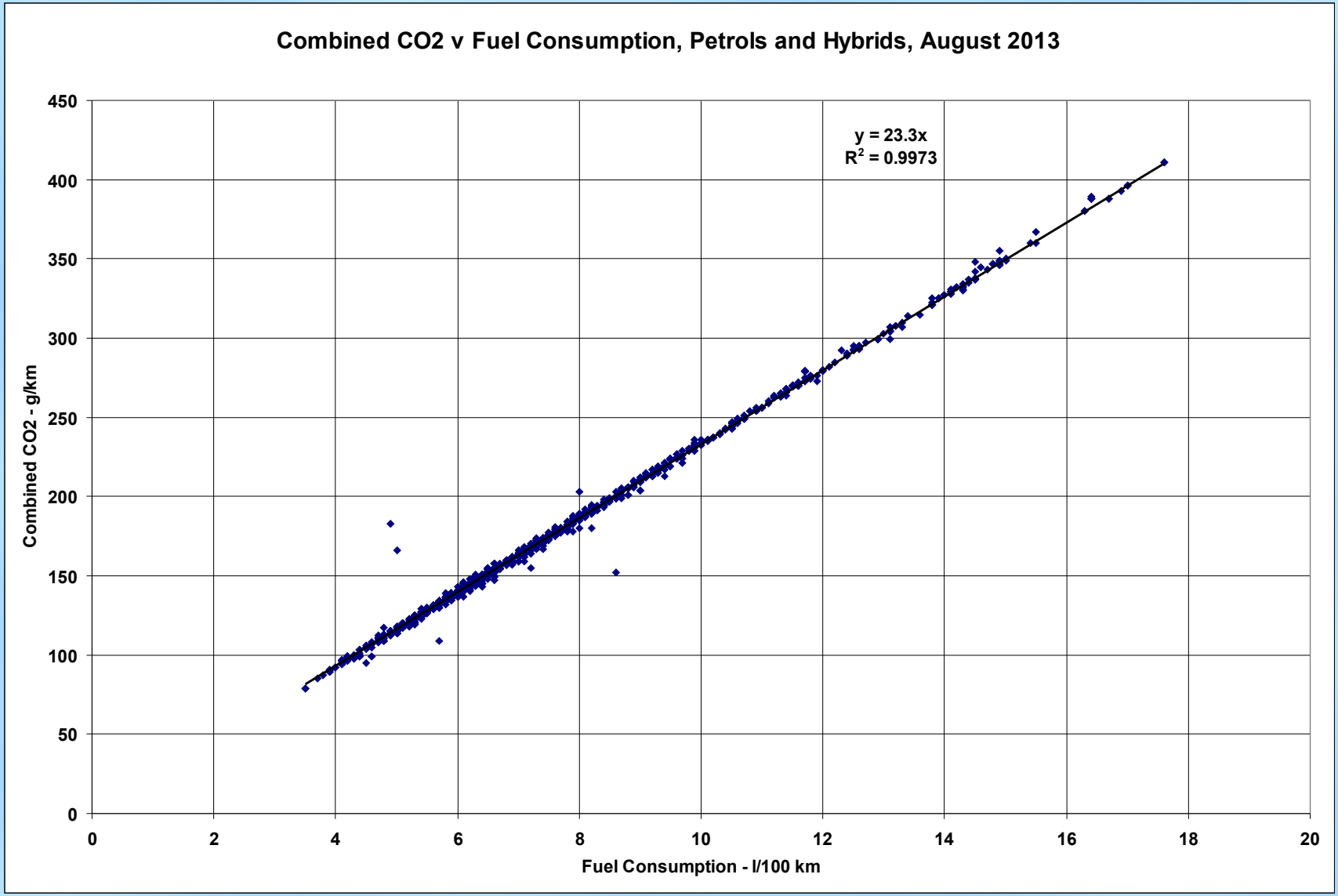
October 2013

Outline: Choosing a Car

Data for all cars on the UK market - fuel consumption and CO2 (taxation)

Data from running a MY 2000 Toyota Prius

Data comparing Lifecycle CO2 of ICEV on renewable fuel with BEV on renewable electricity


Combined CO2 v Fuel Consumption, Petrols and Hybrids, August 2013
y = 23.3x
R2 = 0.9973
Combined CO2 - g/km
Fuel Consumption - l/100 km
0
50
100
150
200
250
300
350
400
450
0
2
4
6
8
10
12
14
16
18
20

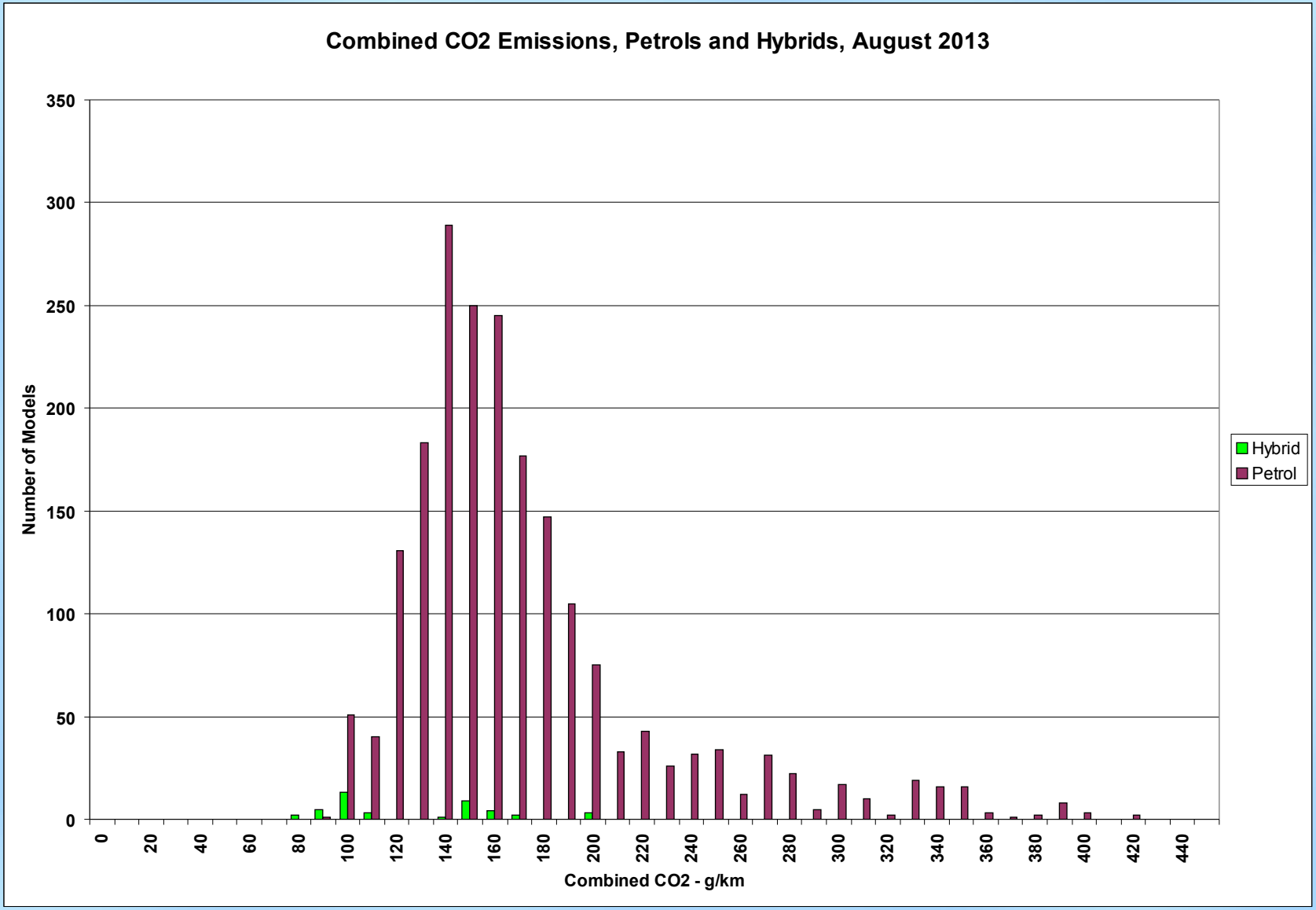
CO2 Emissions and Fuel Consumptions

The test conditions and fuel are fully specified, so ideally all points should lay on the line

Most outlier points should have been caught by the manufacturers or the VCA before publication

Remaining points with high CO2 could be due to high oil consumption - e.g. Mazda RX8's + 3-5%

Wankel motors have only 1 seal with corners, whereas piston engines have 2-3 seals, without


Combined CO2 Emissions, Petrols and Hybrids, August 2013
Number of Models
350
300
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
Combined CO2 - g/km
Hybrid
Petrol

Combined CO2 Values

For the UK market, the range of CO2 is ~ 5 to 1

Cars are taxed on CO2 value, grouped into ‘bands’

The minimum CO2 for Hybrids is 79 g/km and for Petrols is 90 g/km

All vehicles have resistances to motion, so zero CO2 requires use of renewable energy or fuel

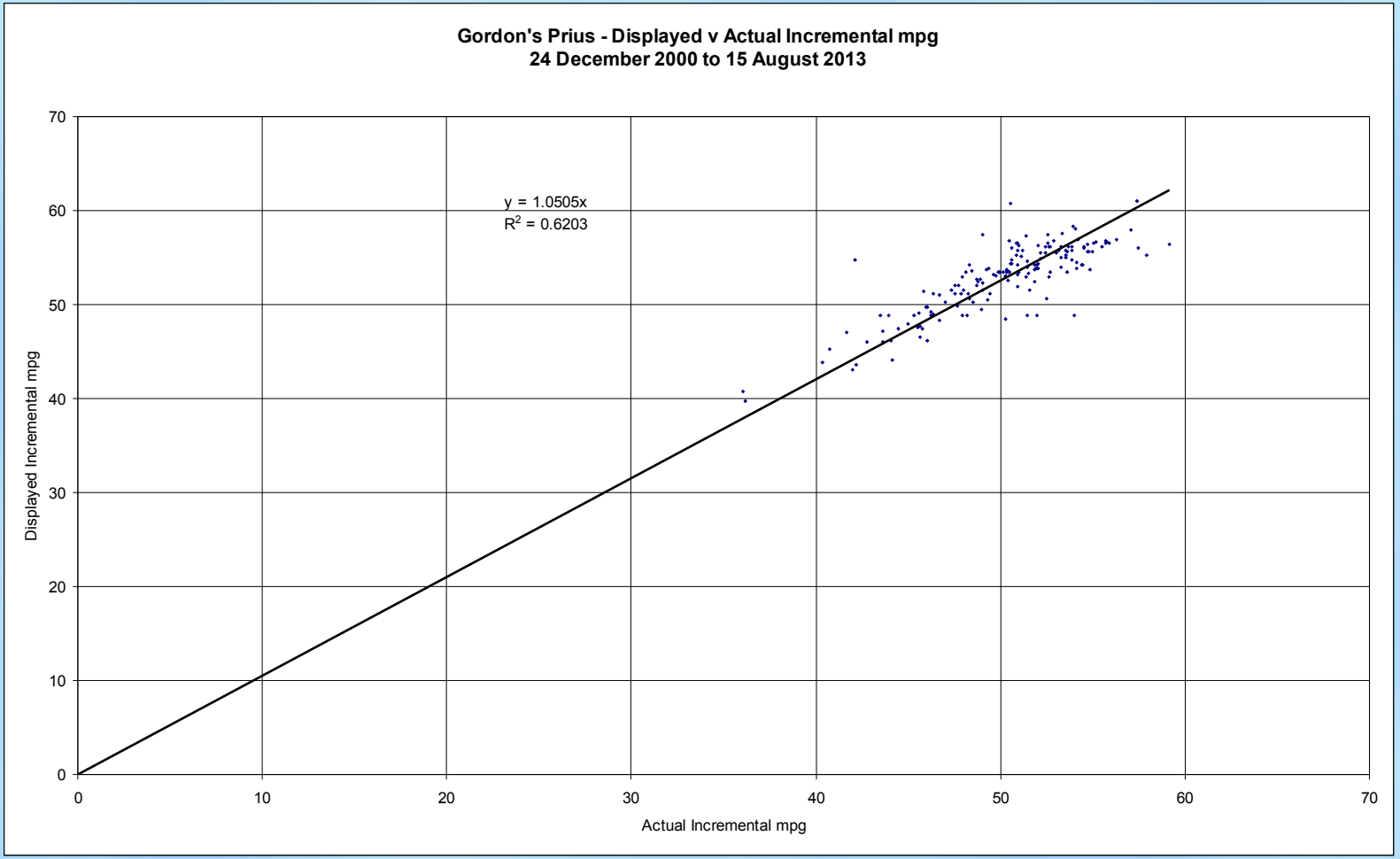
MY 2000 Toyota Prius

Data on Fuel Consumption and Usage

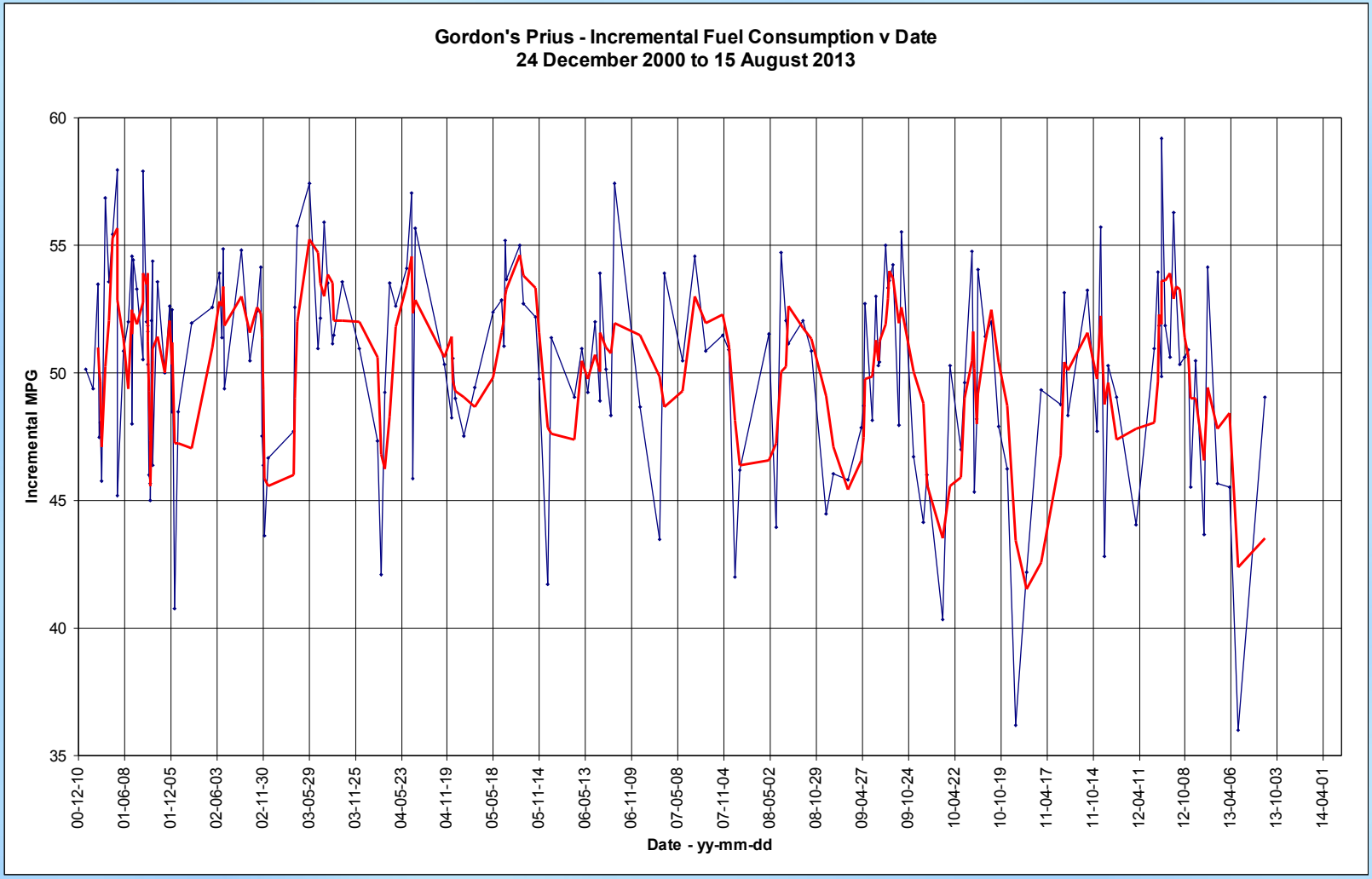
This started with logging of amount, price, and distance at every fillup

The first plots are of fuel consumption versus distance and date

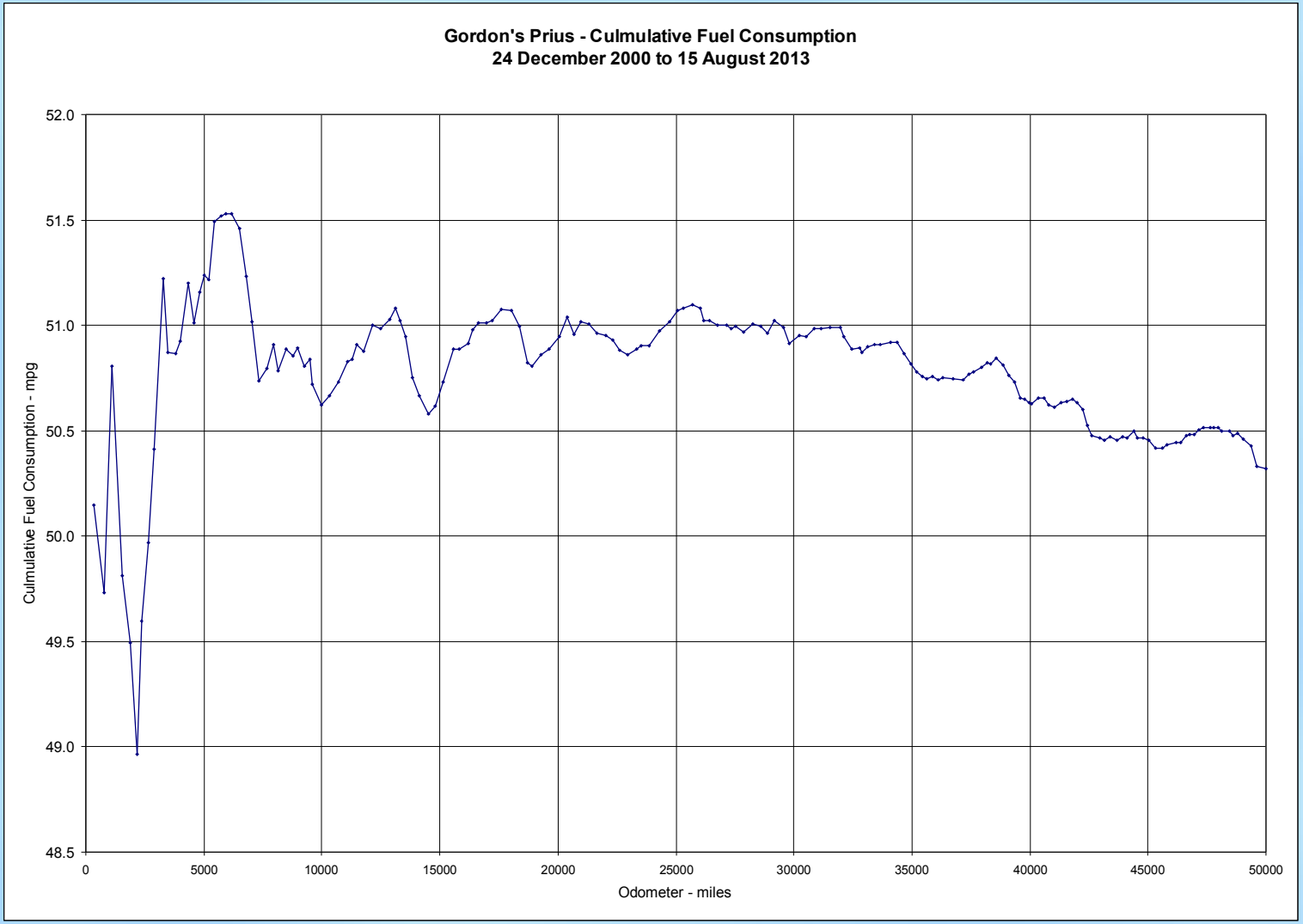
The later plots are of frequencies of fillups versus amount, usage, and distance



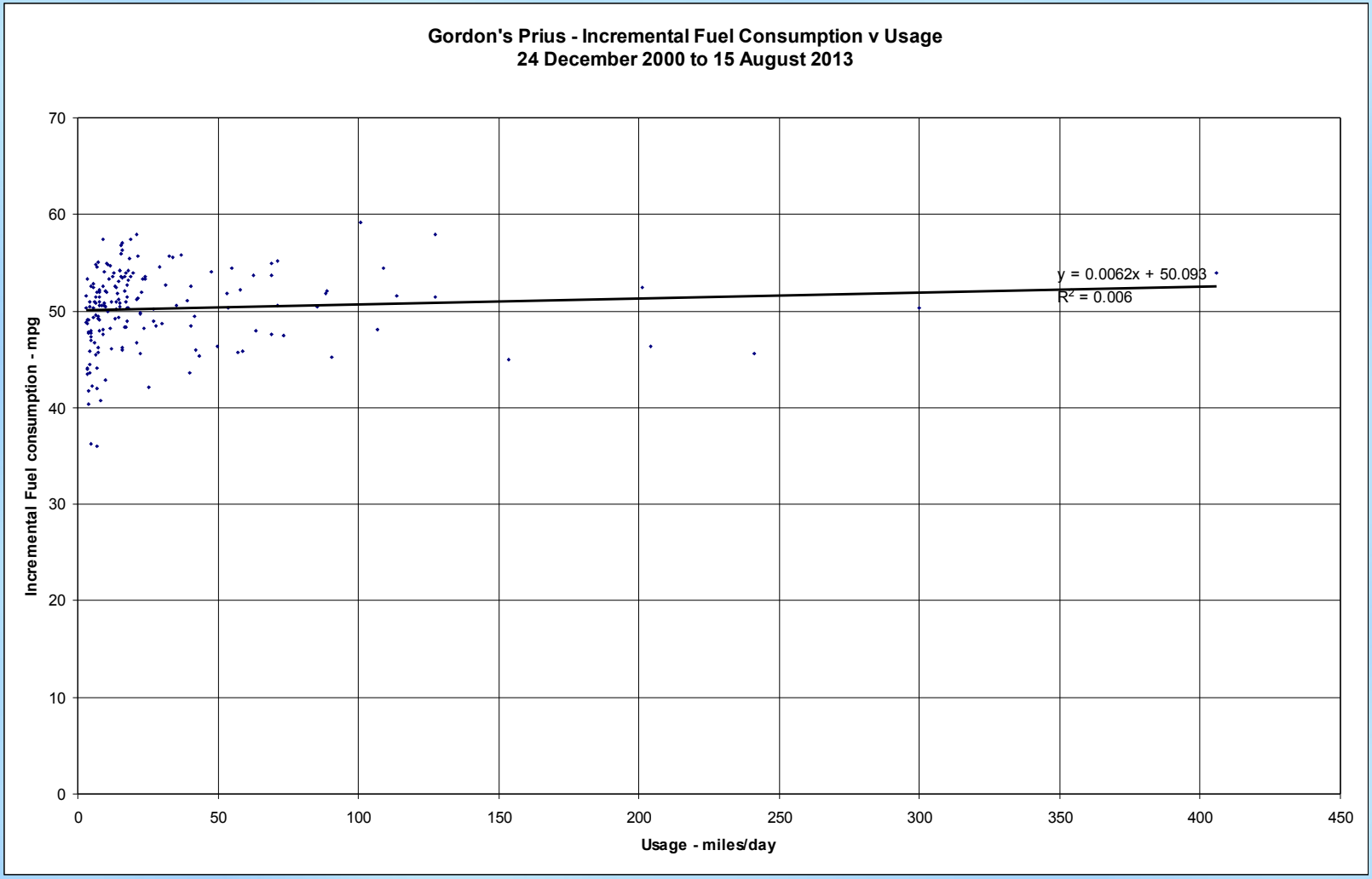
Compared at fillups, y = 1.05 x & R2 = 0.578, so Displayed is only approximately equal to Actual



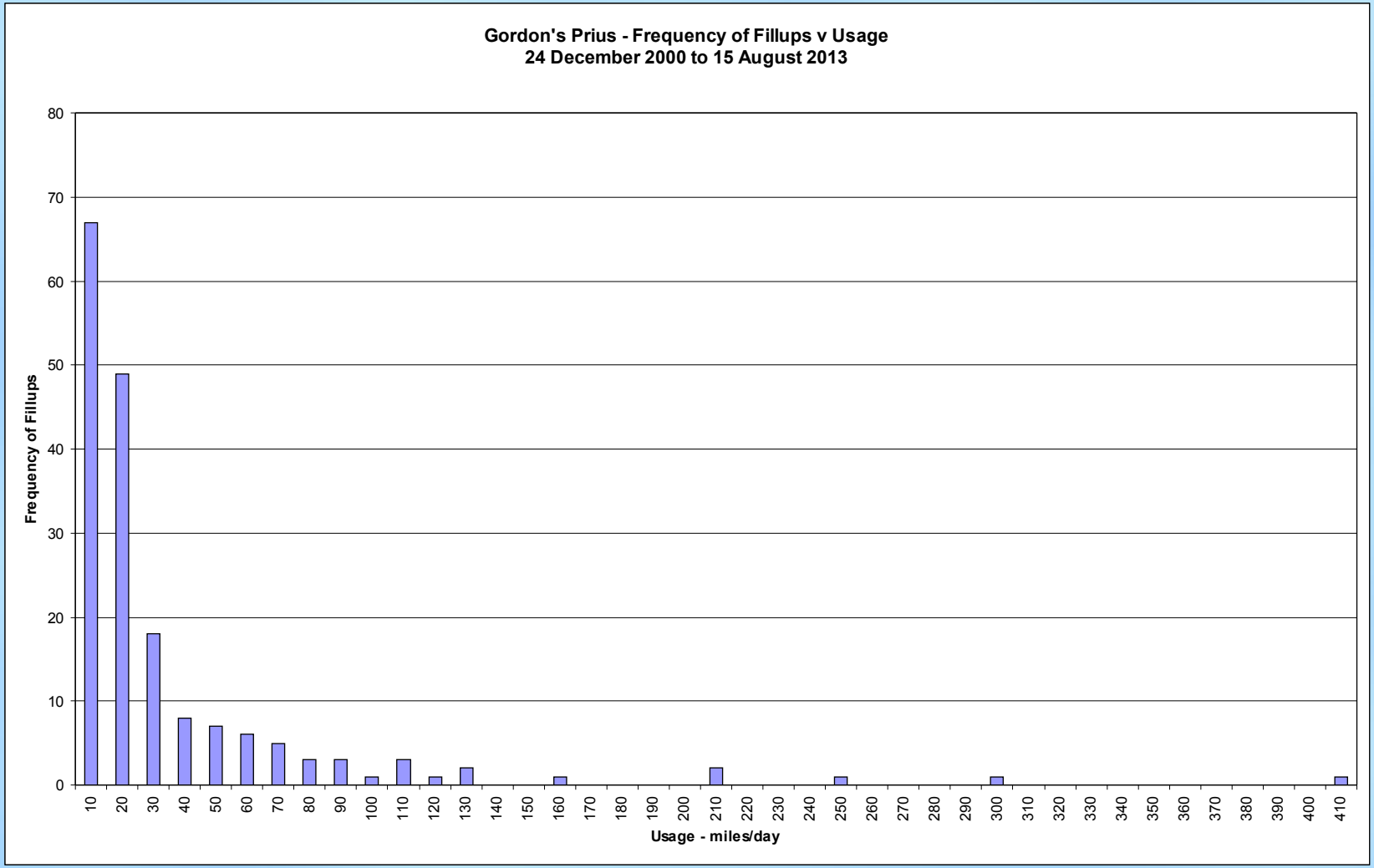
Effect of cold engine in winter outweighs that of use of AC in summer



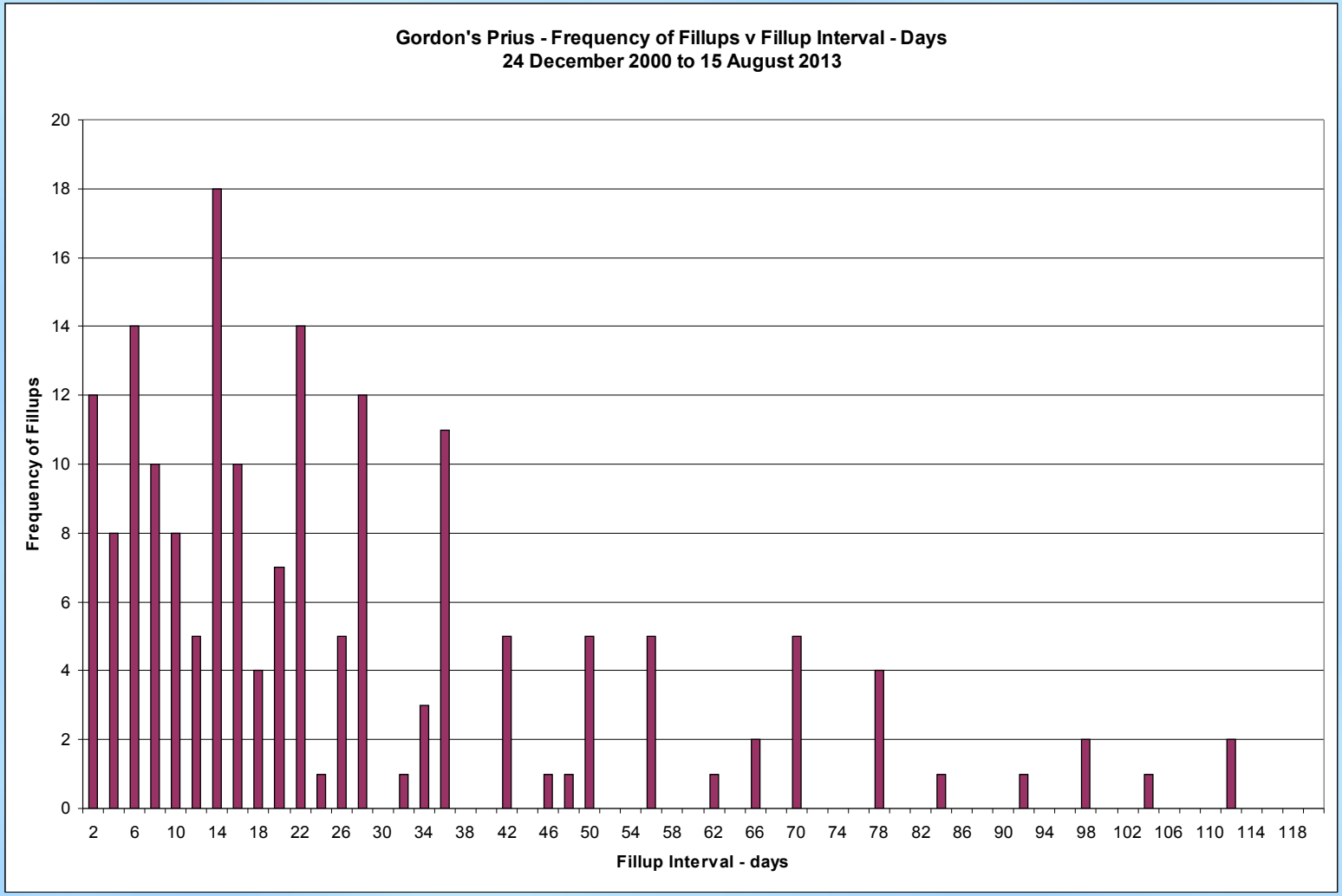
Slight decrease in FE due to usage or deterioration



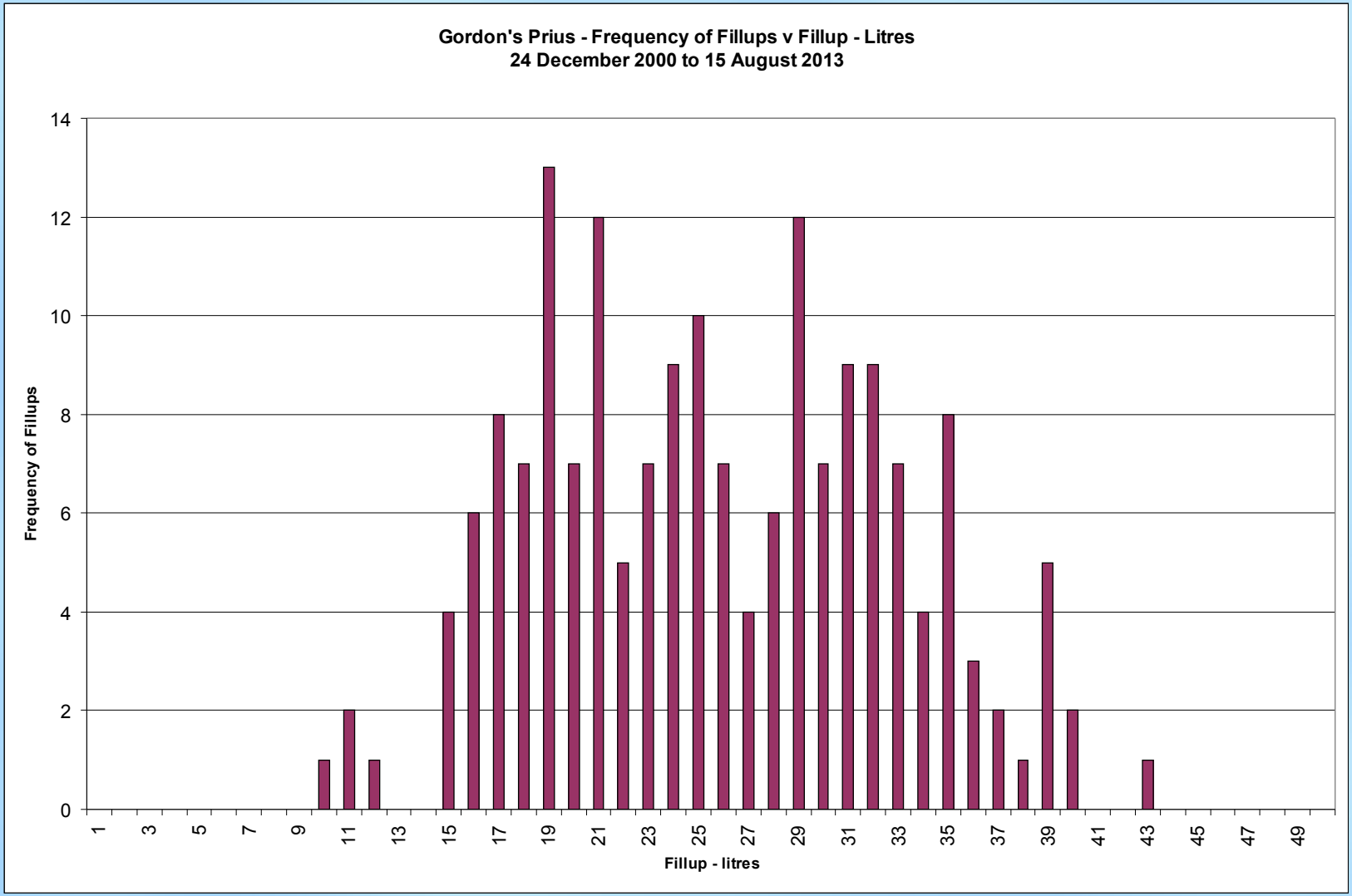
Fuel economy varies little between low usage (low speeds) and high usage (higher speeds)



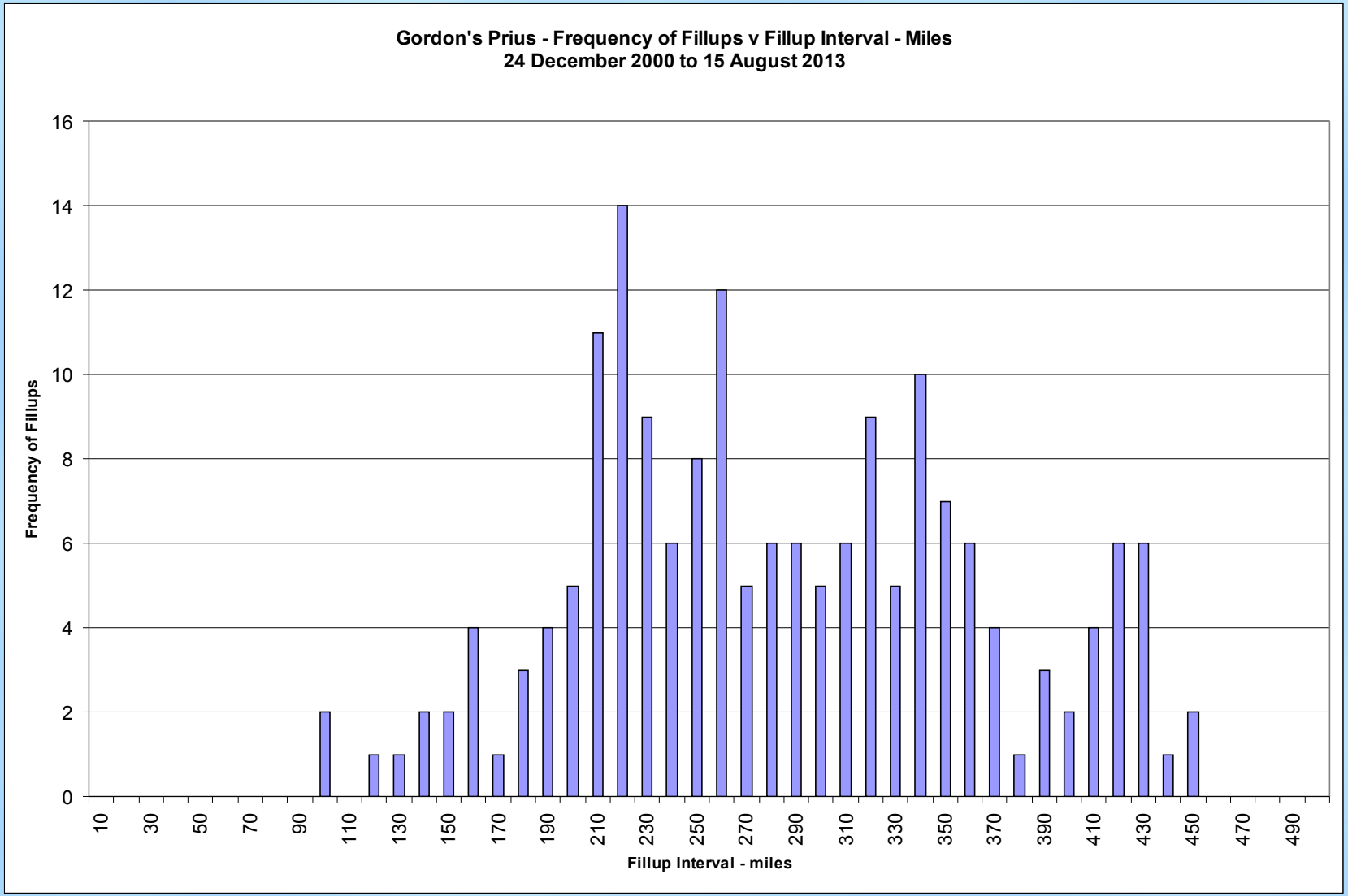
Usage (miles/day) is mostly local shopping, few longer trips, no commuting - 4000 to 5000 miles per year



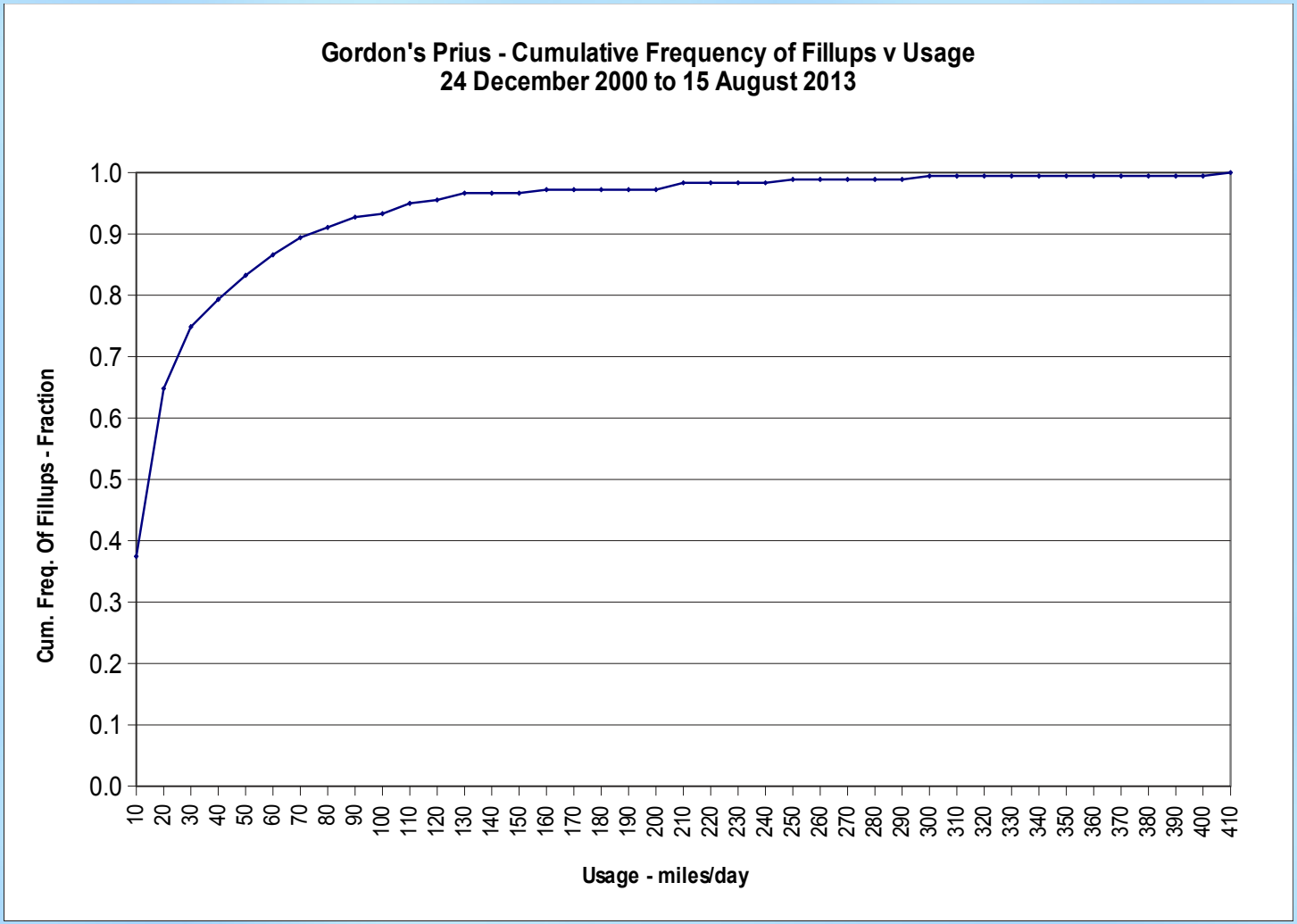
Fillup intervals up to 112 days - over 3 months



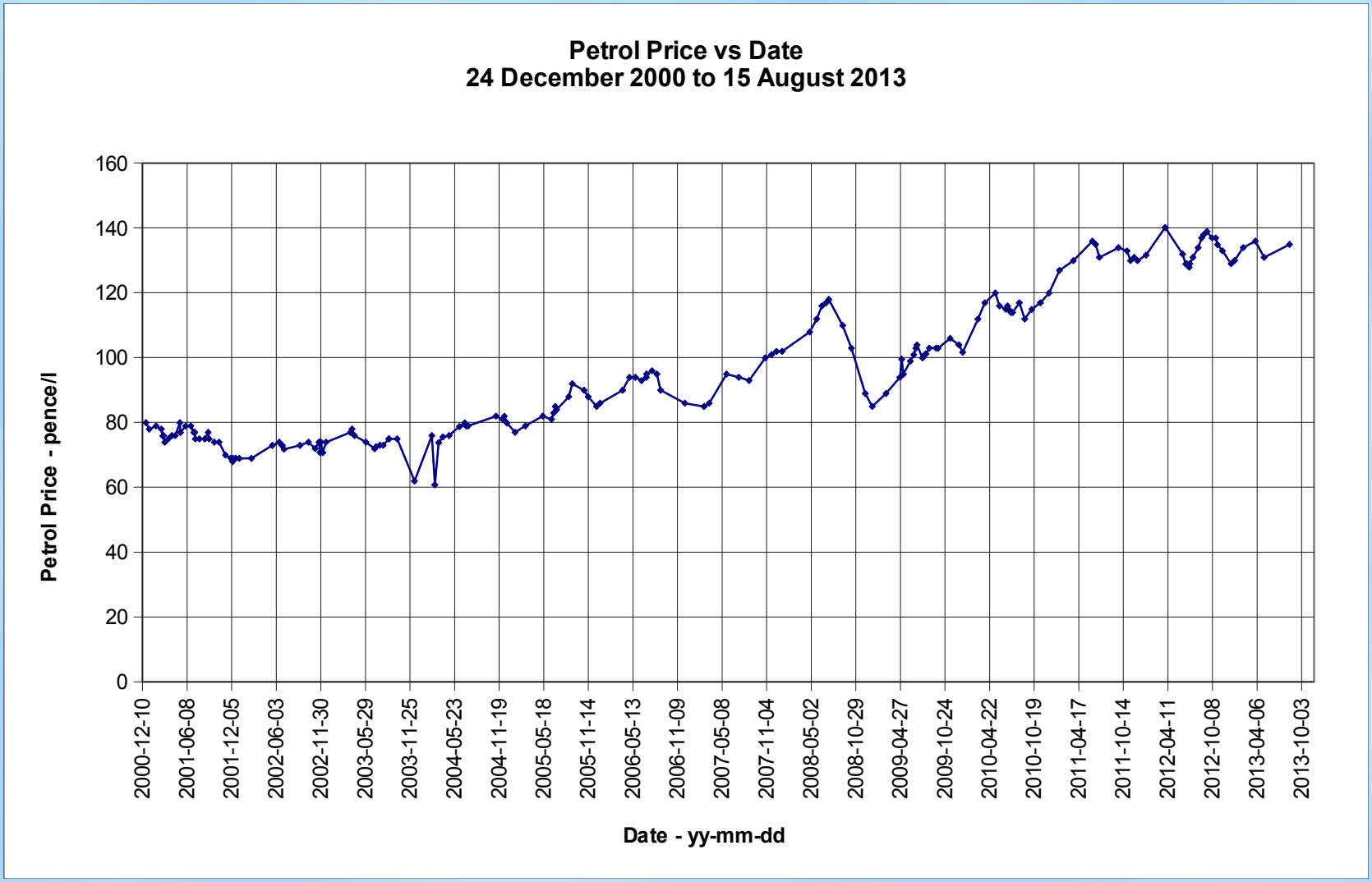
Fillup amounts from 10 to 43 litres (tank capacity 50 l)



Fillup intervals up to 450 miles, good for long trips



80% of fillups within 45 miles/d, 90% within 75 miles/d, but 100% within 410 miles/d



Petrol price has doubled over the last 10 years

Conclusions on Prius

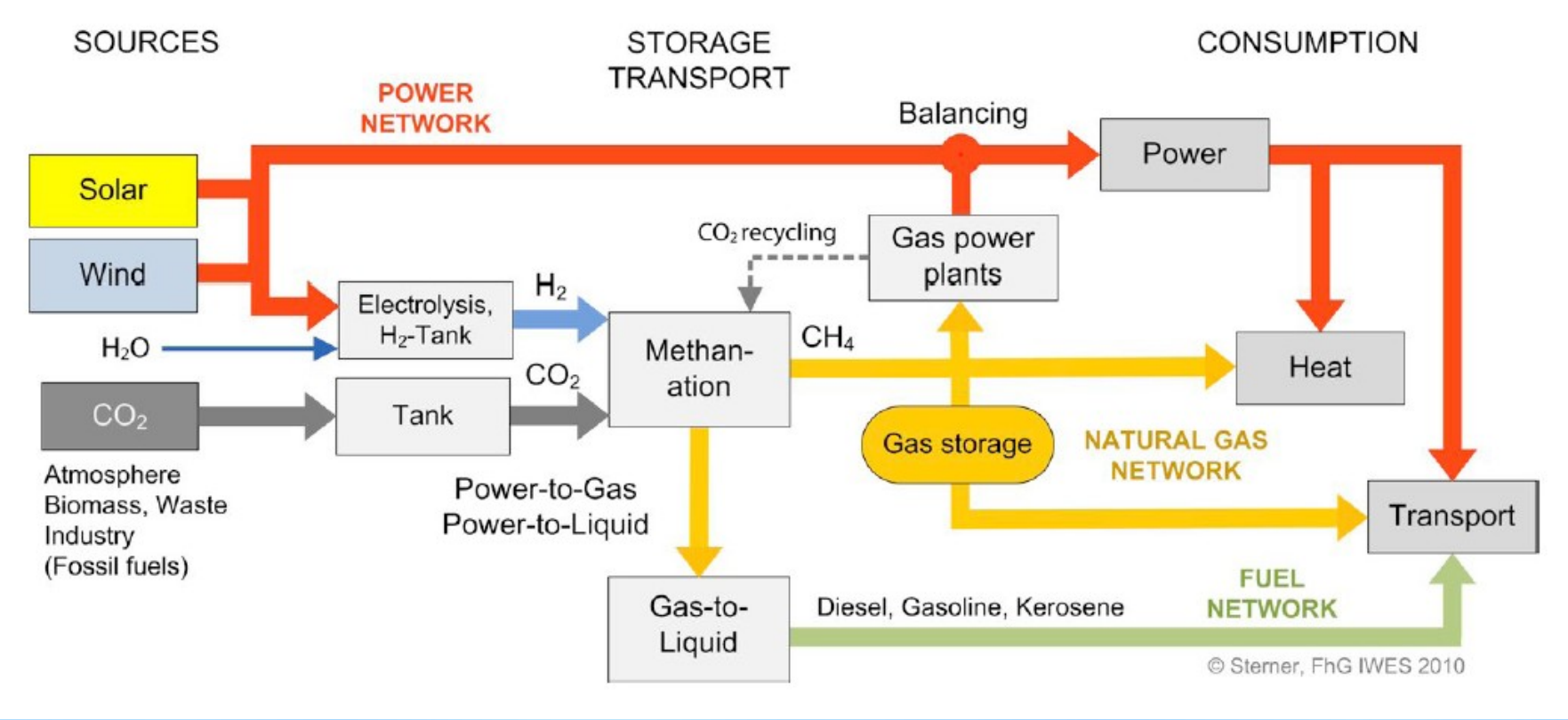
Stepless auto trans is standard and much appreciated in today's traffic conditions

Climate control AC is standard and fuel penalty is very small and well worth paying

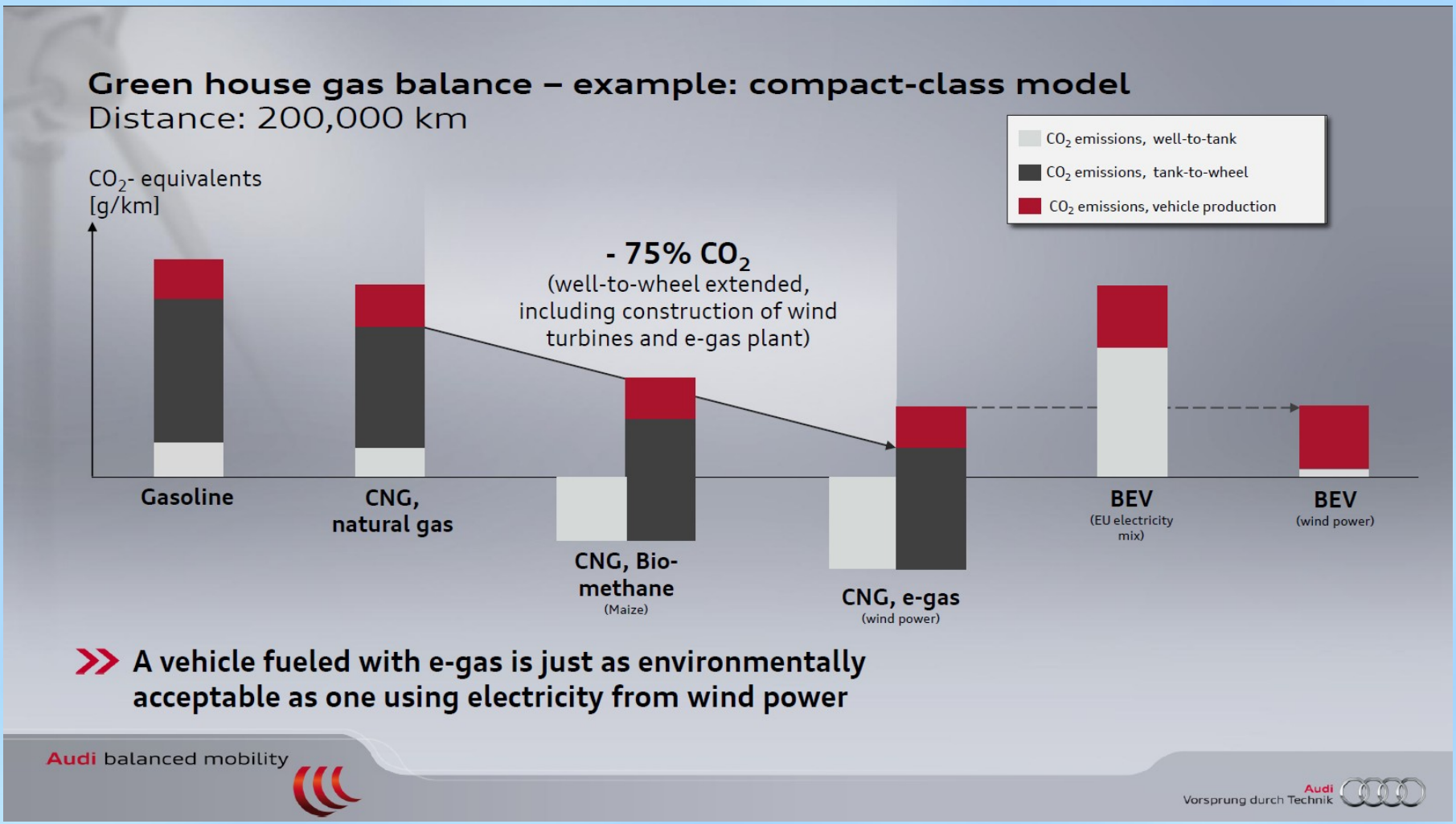
As petrol price rises, fuel economy is ever more important. 51 mpg, 5.5 l/100 km is still good.

Range between speedy fillups is at least 450 miles and cannot be matched by BEV

100% Renewables are Possible



Renewable Methane matches BEV



Overall Conclusions

HEVs (and ICEVs) continue to improve in fuel economy and CO2, but are limited by fossil fuels

Only solution for zero CO2 is renewable fuels

This meets vehicle needs, including range, and is compatible with engine and fuel infrastructures

Both are critically important to ease transition in all markets and especially so in developing countries

Thank you for your attention

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Several energy presentations are at:
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