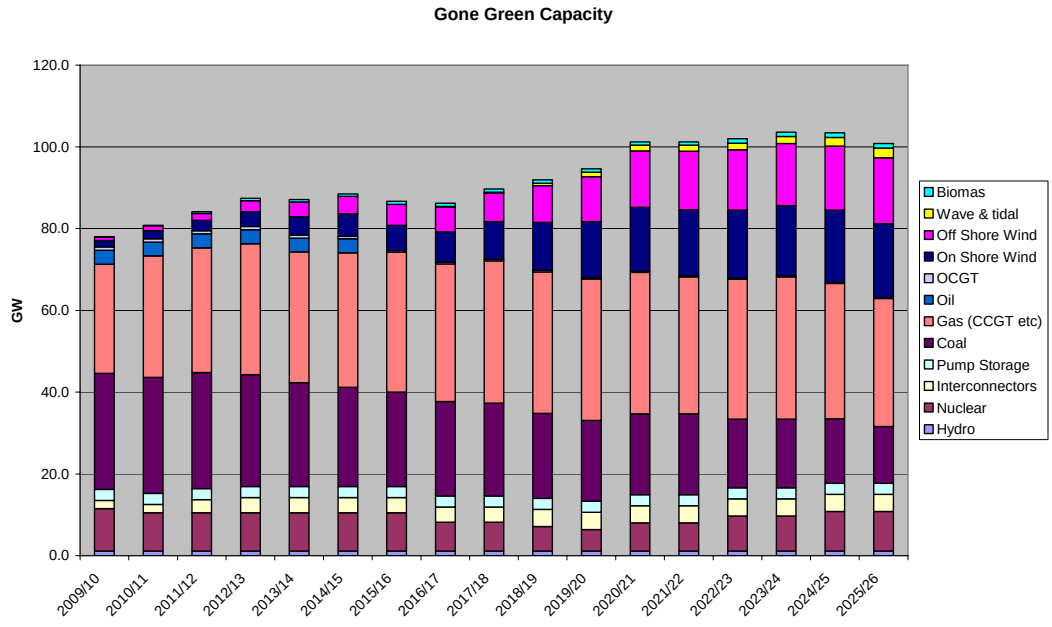
A nuclear-based Secure Energy Strategy (SES) compared with the Government's 2009 Green Strategy

Comparisons of the 50 GW nuclear programme (labelled **S**ecure **E**nergy **S**trategy) are made below with the National Grid's "**GONE GREEN**" (GG) strategy, which has been the subject of a recent consultation exercise (June to August 2009) to which Ref 1 is a contribution.

1 DETAILED COMPARISONS OF "GONE GREEN" AND THE SECURE ENERGY STRATEGY

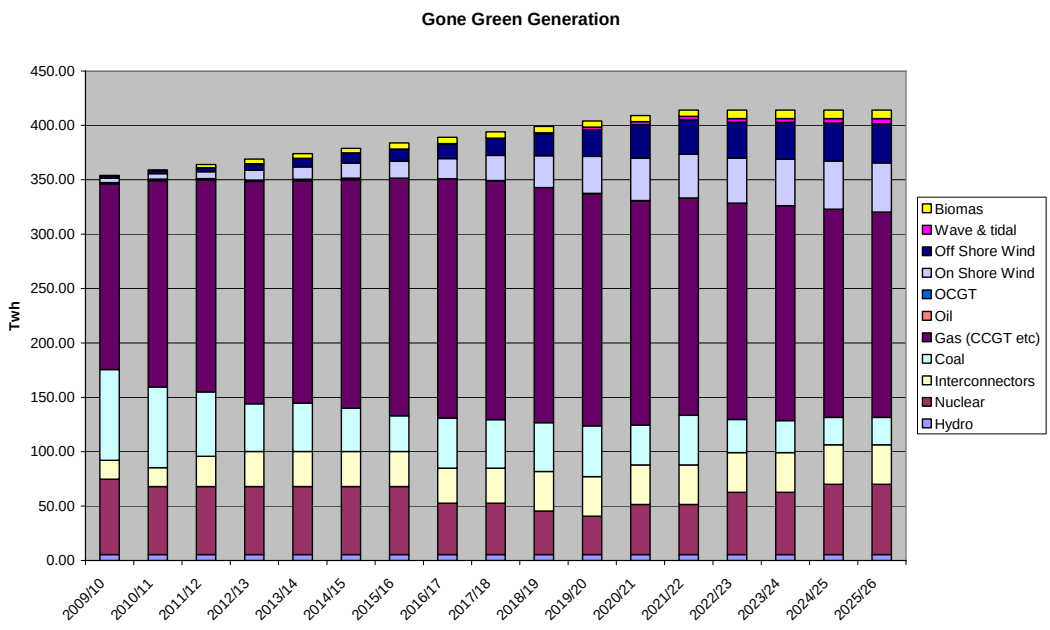
- Fourteen percent of peak winter demand will be taken out of operation by 2015 owing to closures under the EU Large Combustion Plant Directive. The proposed future capacity is shown in figure 1.

Figure 1: Nominal Generating Capacity envisaged by Gone Green



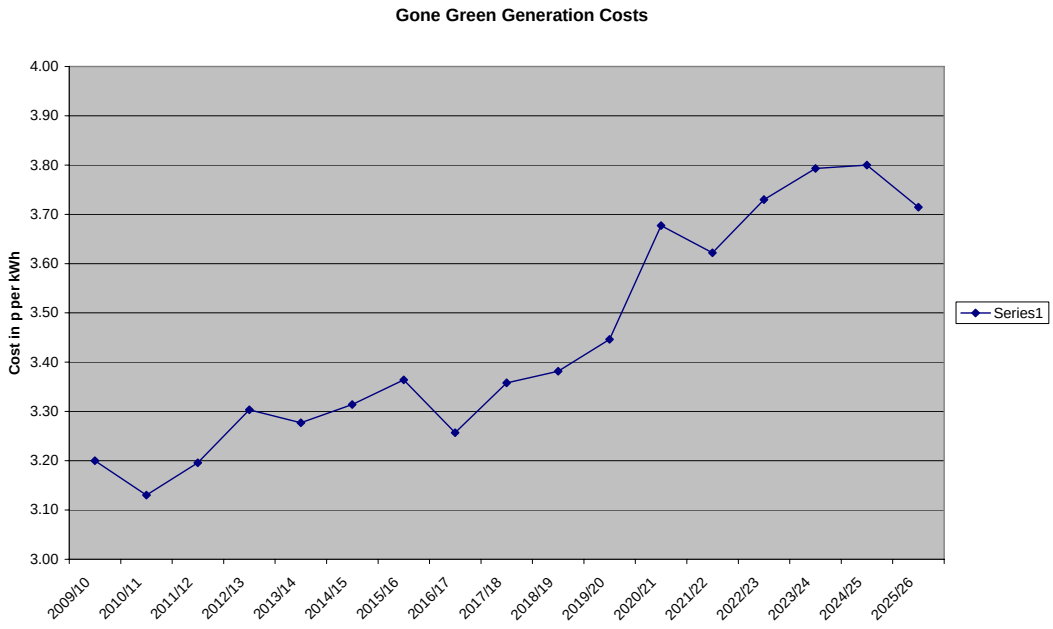
- Because the output from wind power (and all other "renewables" other than hydro electricity) is variable and intermittent so consequently require at least 95% back up generation capacity the actual power generated, shown in figure 2, is very different.

Figure 2: Total Generation by Type for the Gone Green Strategy



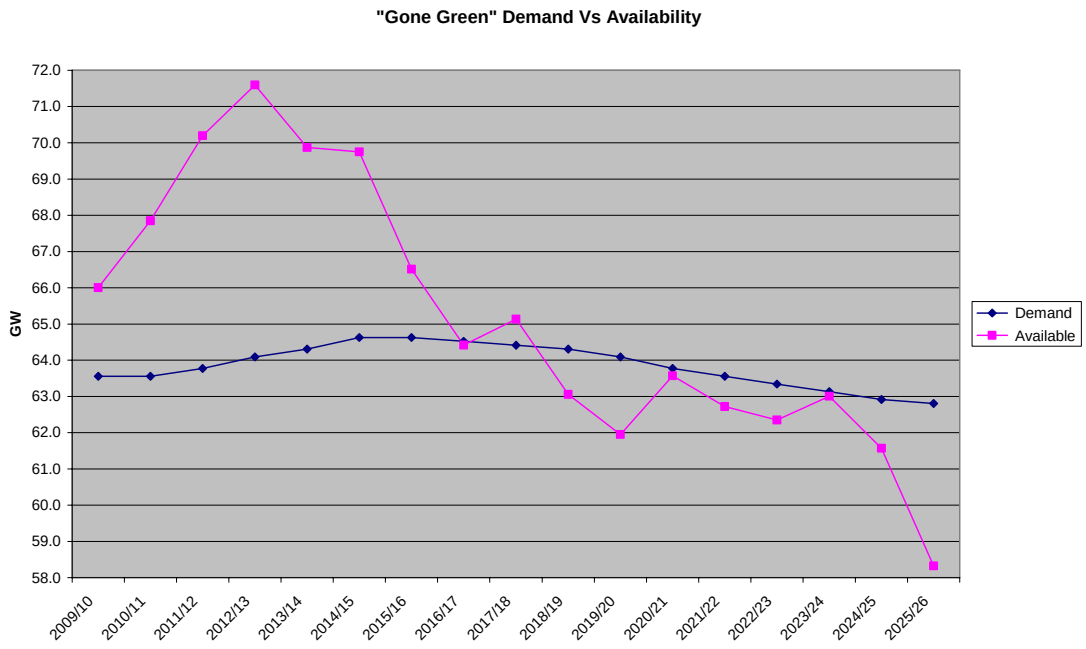
- The Gone Green Strategy will lead to greatly increased electricity costs for both the consumer and industry.

Figure 3: Cost of Generation in p per kWh for the Gone Green Strategy



- Also there will be power cuts from about 2016 with catastrophic power shortages from 2025, if not before see figure 4).

Figure 4: Worst Case Winter Demand Vs Available Supply for Gone Green



- Other problems with the Gone Green strategy for electrical generation concern the high capital and running costs of offshore wind turbines, the need for large scale and extensive modification to the electric grid (at a cost of at least £5Bn) to allow the wind farms to feed into the national supply network and the inherent loses and instability which would be a feature of such a grid. In the unlikely event that the government strategy could be implemented, the overall cost of to the year 2025 will be of the order of £100Bn and the result will be an unreliable, expensive and inadequate electricity supply system.

- Finally, other than by the encouragement of the increasing use of electric vehicles and the use of an improved metering/cost system to smooth the 24 hour electricity demand, plus some highly improbable targets for the increased use of biofuels and increased insulation and energy efficiency, the "Gone Green" strategy paper does not explain how the non electricity consumption of hydrocarbons is to be significantly reduced.

2 THE SECURE ENERGY STRATEGY

- The Secure Energy Strategy (SES) envisages a major expansion of nuclear power with construction starting in the next two years, the first new reactor coming into service in 2018, the second in 2020 and thereafter at the rate of 1 or 2 per year, replacing and supplementing the existing nuclear stations until the total nuclear power plant capacity reaches 50 GW in 2035 and 100 GW in 2050. At this point, nuclear power would provide approximately 90% of the total average electrical power generated in the UK and about 50% of total energy demand in the UK. About 10 GW coal fired capacity and a similar amount fired by natural gas will remain. The rest will be provided by

renewables, while pumped storage, the cross Channel link and improved start-up and shut-down techniques for the fleet of new nuclear stations will manage major demand variations.

- To ensure that there is not a shortage of power between 2015 and 2025, a derogation from the EU Large Combustion Plant Directive would be necessary and also new supercritical build coal plant of a further 10 GW would be required to be undertaken up to the year 2020. Wind power, both on and off shore, would not be subsidised more than nuclear beyond the capacity currently approved.

- Calculations for total capacity and annual generation until the year 2025 are shown in figures 5 and 6. The capacity and annual generation until the year 2050 is shown in figures 7 and 8. It may be seen from figures 8 and 9 that, by 2050, both the total capacity and power generated will have approximately doubled. This would allow at much of the energy currently supplied by hydrocarbons for transport, industrial uses and space heating to be replaced by virtually carbon free nuclear energy. The capital costs saved by the SES strategy compared with Gone Green would be of the order of £20Bn. For this and other reasons, the cost of electricity would be roughly flat, as shown in figure 10. As shown in figure 10, the risk of winter power cuts would have been mitigated for the years 2015 – 2012 and thereafter is most unlikely.

Figure 5: Nominal Generating Capacity to 2025 for the SES Scenario

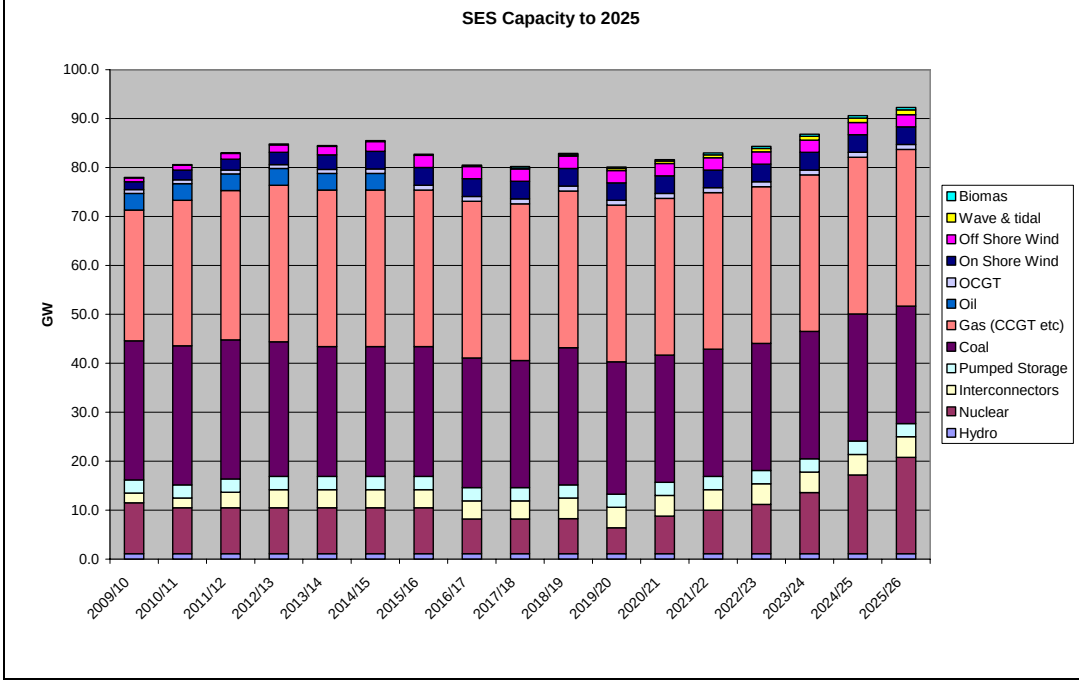


Figure 6: Total Generation by Type to 2025 for the SES Scenario

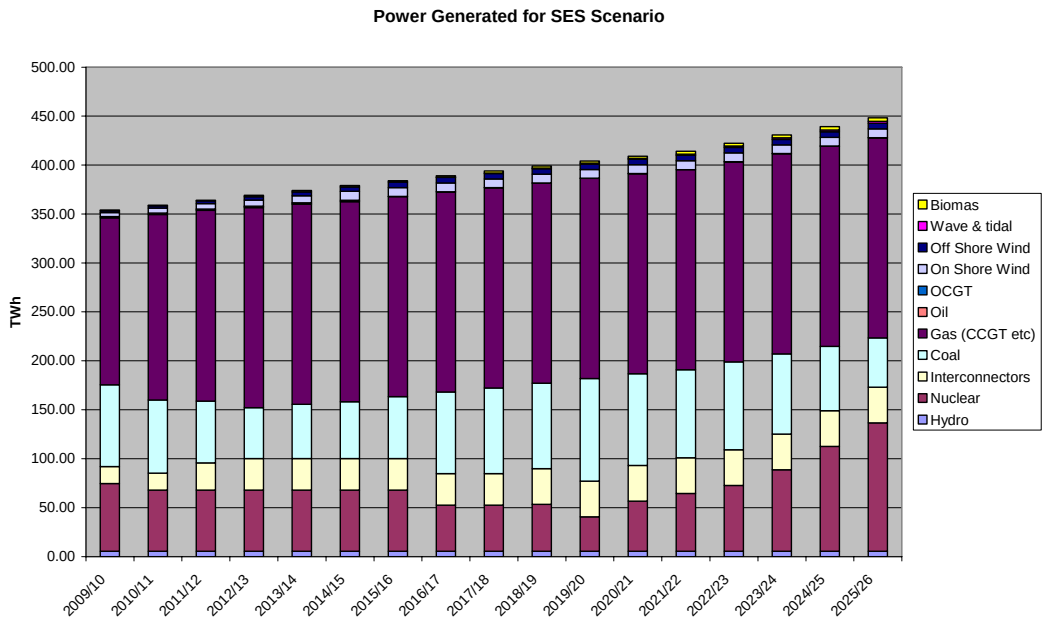


Figure 7: Nominal Generating Capacity to 2050 for the SES Scenario

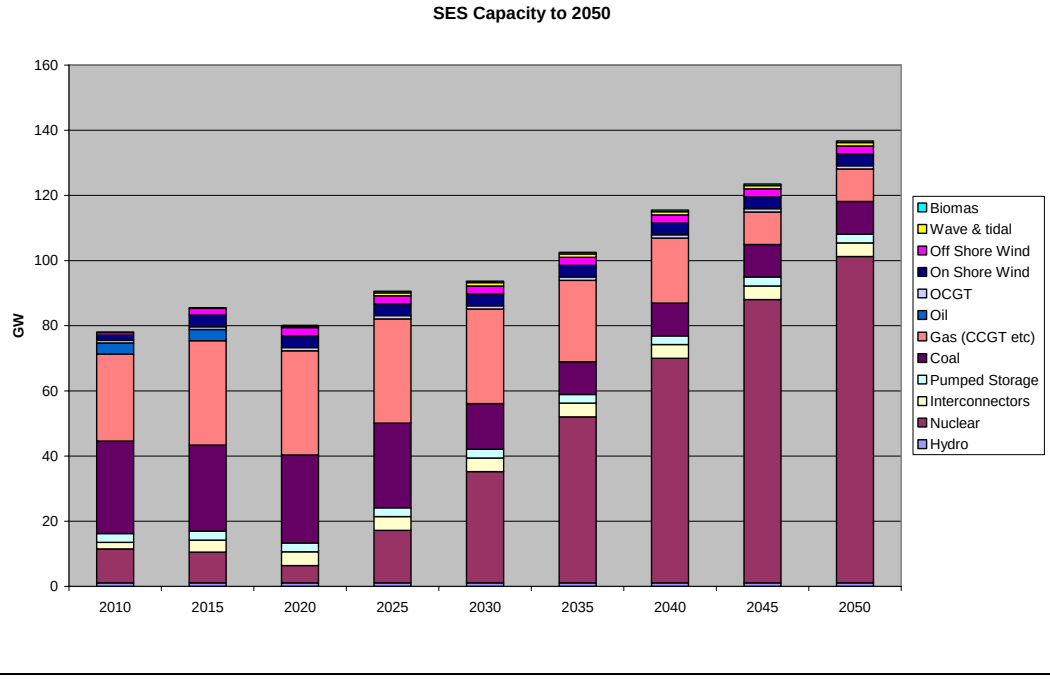


Figure 8: Total Generation by Type to 2050 for the SES Scenario

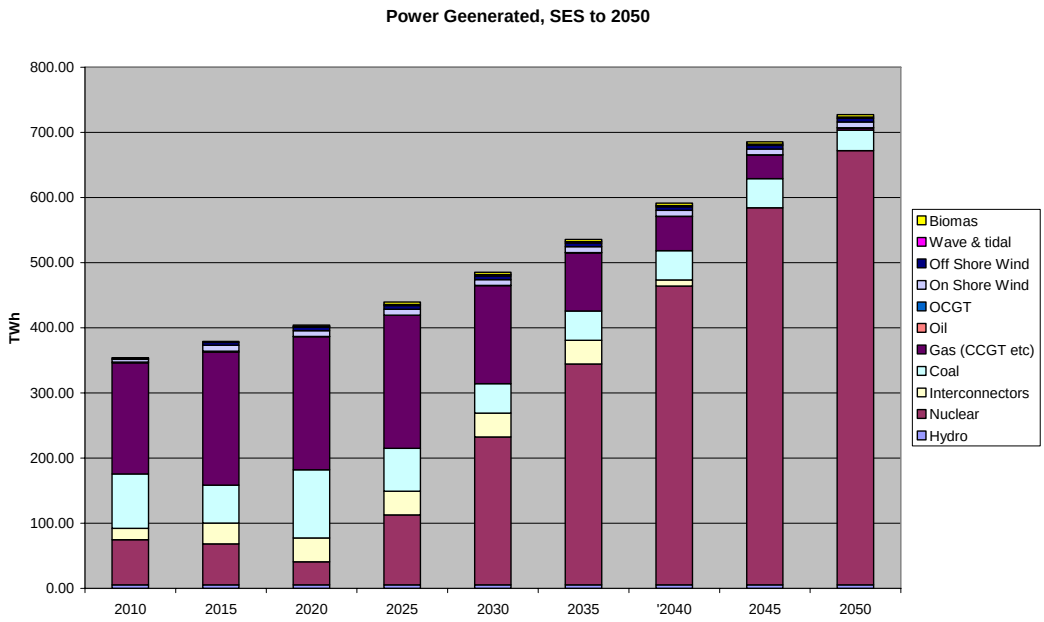


Figure 9: Cost of Generation in p per kWh, SES Vs Gone Green

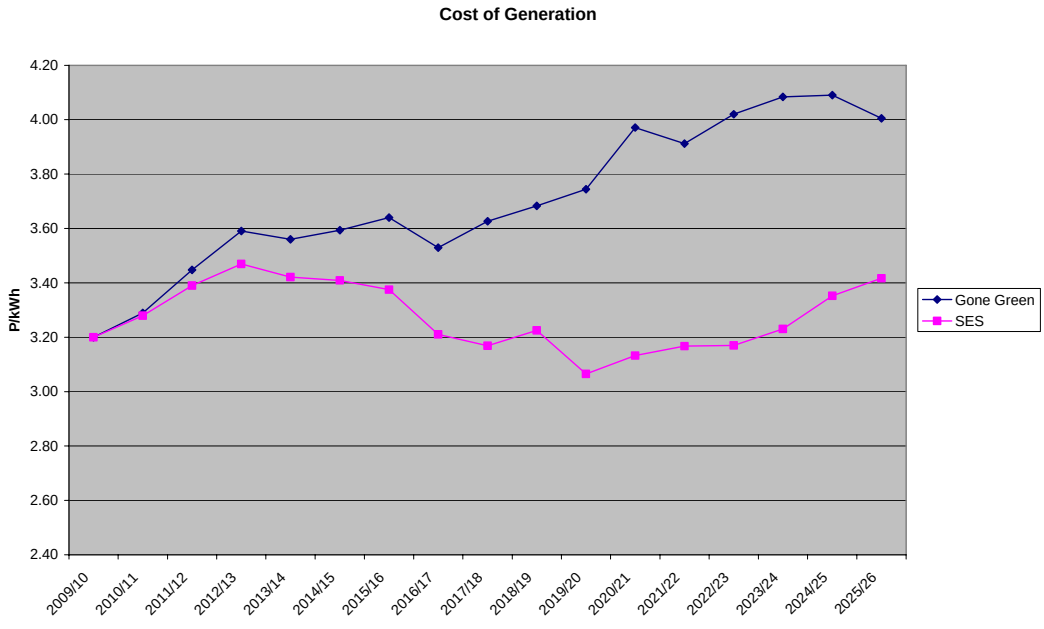
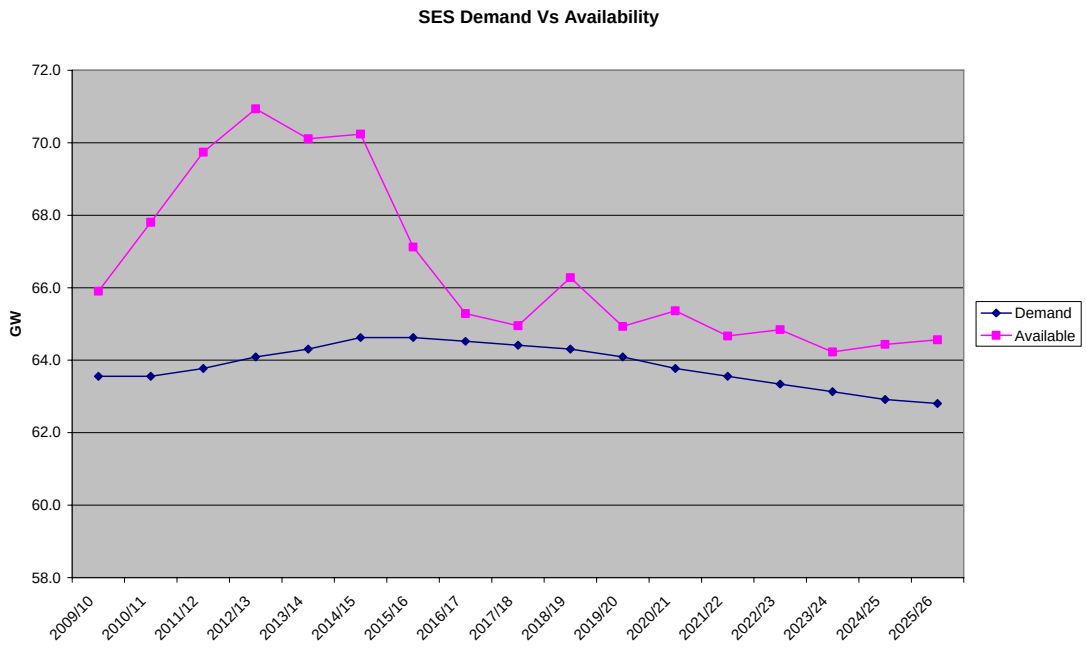


Figure 10: Worst Case Winter Demand Vs Available Supply for SES

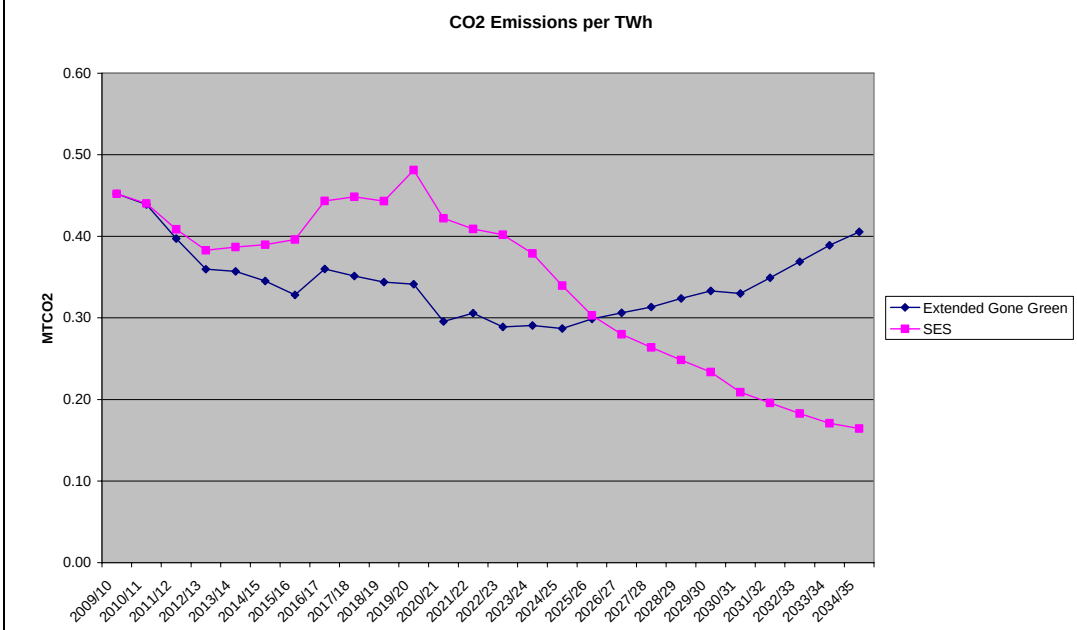


- So, from a security of supply point of view as well as cost, the SES plan is greatly superior to the "Gone Green" Scenario.

- As can be seen in figure 11 below the SES Scenario, which assumes that there is a derogation for the EU Large Combustion Plant Directive, initially results in a higher level of CO_2 emissions, but the two graphs converge at about the year 2025; by 2050, the CO_2 emissions for the SES scenario are less than half of those which would be emitted by the Gone Green scenario. This is because nuclear plant is nearly carbon neutral whereas wind turbines and other renewables require back up generation which, if it is not nuclear, must be fossil fuelled (as is assumed here).

- On all three key criteria**:** cost, security of supply, and CO_2 emissions reduction, the SES plan is greatly superior to "Gone Green".

Figure 11: CO_2 Emissions for Gone Green and SES



- By the year 2050, at which 80-90% of generation will come from nuclear capacity, the CO_2 emitted will have fallen to less than 0.1 million tonnes of CO_2 per TWh. However, the power generated will have doubled so the actual CO_2 emitted by electrical generation will have fallen from 160 million tonnes of CO_2 to about 70 million tonnes of CO_2.

- The additional supplies of electricity will facilitate significant reductions of CO_2 emission from requirements previously supplied by other fuels. Simple replacement would indicate that these other sources could be significantly reduced but, because of the more refined and controllable nature of electrical power and by the use of heat pumps for space heating, the reductions would be greater. Conservatively, a 40% efficiency gain has been is assumed where electric power is used in place of other sources of energy. This gives the results shown in Table 1.

Table 1: Energy Consumption and CO_2 Emissions for 2050 for the SES Plan

	Consumption (TWh)	**CO_2 (M tonnes)**
Electricity input (output)	1,860 (760)	71
Transport	530 {670 – 100 -40}	111{140 x 530/670}
Natural gas for space heating and industrial processes	620 {830 – 150 – 60}	124 {166 x 620/830}
Oil for space heating and industrial processes	226 {380 – 110 – 44}	48 {80 x 226/380}
Total	2,810	354

- Thus the total CO_2 emission will have been reduced from the 2007 total of 700 million tonnes to 350 million tonnes, a reduction of 35% from present levels which therefore achieves a 50% reduction from 1990 levels (see also Table 2 above).

- The SES would also stimulate the construction and high value engineering industries (particularly Rolls Royce, British Aerospace and associated companies together with the electronics and software engineering industries) in a way that would not be possible with the Gone Green Strategy.

Short Reference List
(Long list inside Refs 1 and 2 below)

1 S F Bush and D R MacDonald, Maintenance of United kingdom Electricity Supplies to the year 2020 and Proposals for a Secure Energy Strategy to 2050, © Prosyma Research Ltd, 12th August 2009.

2 Briefing Paper on the Nuclear Fuel Cycle, © Hill Path Projects Ltd, 28 August 2009.