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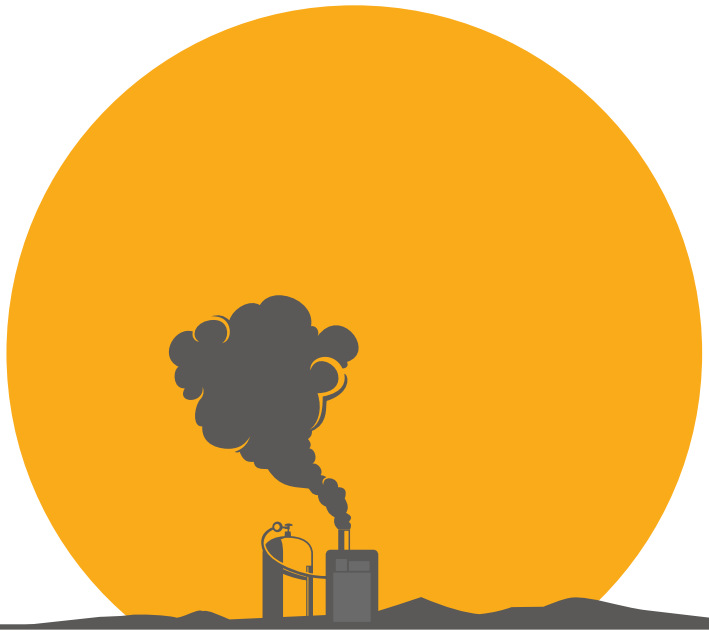

HOW NEW DIESEL GENERATORS ARE SECURING EXCESSIVE RETURNS AT BILLPAYERS' EXPENSE

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ABOUT THE AUTHOR

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IDEAS to
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Summary

Last year the government introduced a new energy policy which has awarded £109 million in subsidies, paid out of consumers' energy bills, to new diesel generators, which are the dirtiest form of energy generation available, worse even than coal. That subsidy will increase in a second auction to be held in early December, by up to £434 million. At the same time, the government is slashing subsidies for green energy: solar subsidies, for instance, are set to be reduced by 87 per cent.

Together with revenues from the energy market, this increasing subsidy is allowing the owners of small diesel generators to earn pre-tax returns of up to 23 per cent. And that estimate may be conservative, because many of the generators have been able to finance their projects through a tax relief scheme, which could increase returns by a further 10–15 percentage points. As a result, we are seeing a rapid proliferation of diesel generators, and this will continue unless new projects are prevented from accessing further subsidies.

This situation has developed because the government introduced a scheme (called the capacity market) to ensure there are enough power stations online to meet demand. Ed Davey, the energy minister who introduced the scheme, stated that it was never intended to support diesel generators. The role that diesel provides could be fulfilled by other means, using smart technologies to manage electricity demand more efficiently and without emitting CO_2 and air pollutants that are harmful to human health.

Therefore, we recommend that diesel gensets should be prevented from entering the capacity market, and that constraints should be placed on those that already exist or have secured capacity contracts.

To achieve this, the government should introduce an amendment to the Energy Bill – which will return for its second reading in the House of Commons in the new year – that prevents any generator with an instantaneous carbon intensity over 450gCO_2/kWh from accessing 15-year contracts. This change is technology-neutral but aligns the capacity market with the government's decarbonisation objectives.

Units that have already received 15-year contracts should be subject to the following:

- **a requirement to fit best-available technologies to mitigate air pollutants, in line with European standards for medium combustion plants (EC 2015)**
- **the emissions performance standard, as established in the Energy Act 2013. This should also be tightened over time for units over 450gCO_2/kWh to ensure that running hours are restricted.**

What are diesel gensets and what role do they play?

Diesel gensets are blocks of reciprocating diesel engines connected to an electric generator. They provide modular electric generating capacity and come in standardised sizes.

They have been most widely used in the UK to provide standby power generation for large industrial and commercial sites that cannot afford to lose power in the event of interruptions on the electricity network. Increasingly they are being built and connected to the network to provide generation when there is a sharp peak in electricity demand. They are able to switch on and reach full load very quickly (in roughly 10–15 seconds, although this can vary), which is very useful to National Grid in managing short-term fluctuations.

However, diesel gensets are not unique in providing this capacity: there are many other options available on both the demand and supply side of the system to

manage these fluctuations. Historically this role has been fulfilled by power stations running in spinning reserve, which can increase their output at short notice. Internationally and in the UK there is a growing number of companies providing load-shifting services: aggregating short-term shifts in demand from a number of large users, thereby managing fluctuations and reducing peaks. Included in this is frequency response, which can provide load-shifting within periods of less than one second. There is great potential to expand and optimise load-shifting, which would dramatically reduce the need for peaking units such as diesel gensets (Gottstein and Skillings 2012).

Why are they so attractive to investors?

Despite the availability of alternative technologies, diesel gensets are being rapidly deployed. We estimate that 375 megawatts (MW) of new gensets were successful in last year's capacity market auction and 1,500MW have prequalified this year. They are being deployed so quickly because the potential returns are extremely attractive to investors.

It is misleading to call the electricity market a market. In reality it is a complex set of platforms for selling services, influenced by subsidies, taxes, levies and tax breaks. Each of these platforms is constructed in such a way that it incentivises certain technologies and penalises others. Diesel gensets are attractive to investors because they are being incentivised in several areas of the market at the same time.

The capacity market

The capacity market is an annual auction designed to guarantee security of supply by providing additional payments to energy companies to ensure that they deliver energy or reduce demand when needed. The total amount of capacity that is required is set in advance of each auction by the secretary of state, and operators then bid to receive a contract. One-, three-, or 15-year contracts are available, all within the same market.

The 375MW of new diesel capacity in last year's auction was awarded 15-year contracts, which will provide them with a secure revenue stream of £19.40 per kW for the length of the contract. **For a 24MW diesel genset this equates to £6.98 million of subsidy over 15 years, which is added to consumer bills.**

Short Term Operating Reserve (STOR)

National Grid maintains this reserve in order to access extra power when required. Providers of generation or demand reduction can choose whether to be totally available for STOR, and therefore to sit outside of the electricity market, or they can provide partial availability. They receive a payment for being available and an additional payment when power is delivered.

Diesel gensets with capacity market contracts are only able to provide partial STOR availability. **For a 24MW unit we estimate that STOR revenues will equate to approximately £480,000 annually.**

Embedded benefits

Most generators on the network must pay a number of charges to National Grid for the use of the transmission network and for balancing services.[1] Diesel gensets are exempt from paying these charges because they are embedded on the distribution network and do not export to the national transmission network. This gives them an advantage over transmission-connected generators such as gas-fired power stations. In addition, they are able to reduce these charges for others on the system

1 This includes transmissions network use-of-system (TNUoS) charges, balancing services use of system (BSUoS) charges, and transmission losses charges.

by reducing peak load,[2] and they receive payments (known as TRIAD payments) from other users on the network for doing this.

We estimate that a 24MW unit can expect an additional £840,000 in TRIAD payments for reducing peak load.

Electricity market

Diesel gensets are able to sell their power through the electricity markets. This is almost always done through the balancing mechanism, which balances supply and demand in each half hour trading period of every day (for more detail, see Elexon 2015). The revenues a 24MW unit will receive could vary hugely according to the power price and when the operator chooses to dispatch.

We pull all of these figures together in an illustration of a business model for a standard 24MW diesel genset below.

How are they financed?

Until the option was removed in November's autumn statement, diesel gensets were eligible for finance through tax-relief schemes. Many of the units that were successful in last year's capacity market auction and those that have prequalified for this year's auction have been financed this way.

The Enterprise Investment Scheme (EIS) is designed to help smaller, higher-risk trading companies raise finance by offering a range of tax reliefs that includes:

- 30 per cent relief on income tax liability
- any gains free from capital gains tax
- any losses offset against income tax.

Effectively, gensets financed through EIS funds have access to investment capital at significantly reduced cost. These benefits are additional to both the 15-year contracts they are able to secure through the capacity market auctions and the additional revenue streams set out in the previous section.

In response, several EIS funds were launched to reap the rewards of the double subsidy available through tax breaks and the capacity market. One fund set out example investment returns of 57.1 per cent (Foresight 2015).

EIS funding was closed to 'reserve power', which includes diesel gensets, in the 2015 autumn statement (HMT 2015). However, many of the companies that were entered into the 2014 and 2015 auctions have already benefitted from these schemes because qualification for EIS is determined at the time the investment is made (HMRC 2015). Those units that have already been accepted into the capacity market will benefit from this double subsidy.

Depending on the investment profile, we calculate that EIS funding could increase the annualised rate of return by 10–15 percentage points.

A diesel genset business model

Table 1 provides a breakdown of the costs, revenues and returns available for a 24MW diesel genset.

2 These charges are calculated annually using the three half-hourly periods with highest system demand (known as triads). If system demand can be reduced then the triads will be lower and the charges will be reduced.

Table 1
A diesel genset business model

Revenue		
STOR	£/MW/yr	20,000
Capacity	£/MW/yr	19,400
TRIAD	£/MW/yr	35,000
Costs		
CAPEX	£/MW	150,090
Maintenance (assume 5% CAPEX)	£/MW/hr	11,259
OPEX	£/MWh	200
Power factor		0.9
Grid connection costs		500,000
Site rent		50,000
Profit	£/yr	782,046
Net present value	£	2,367,249
Returns		
Internal rate of return		18%
Return on investment		53%
Annualised rate of return (pre-tax)		23%

Source: Author's calculations
Note: We assume STOR runtime of 20 hours/year and TRIAD management runtime of 50 hours/year.

The 23 per cent annualised rate of return is based on an unlevered investment. Where debt is leveraged the returns would be even higher, and for schemes with EIS funding higher still, although this option is now closed.

What impact does diesel generation have on consumer bills?

Consumers pay for these subsidies through their bills, and returns of 23 per cent to diesel generators do not provide value for money. The government is currently reviewing the feed-in tariff scheme for small-scale renewables to ensure that costs are controlled and returns do not exceed 9 per cent; indeed, the consultation document for this review states that returns over 12 per cent would not be considered appropriate within EU state aid guidelines. It therefore seems inconsistent to support returns of 23 per cent for other forms of generation (DECC 2015, EC 2010).

A number of other recently announced changes to energy policy are aimed at saving costs to consumers. This includes the ending of subsidies to onshore wind; the closure of the renewables obligation to solar PV below 5MW from 2016; an end to the climate change levy exemption on renewable electricity; a reduction in ambition for the energy company obligation (ECO); and the removal of a £1 billion fund for carbon capture and storage (CCS). Again, there is an apparent contradiction between the 15-per-cent returns to diesel gensets and these other attempts to reduce short-term costs.

Providing subsidies to diesel through the capacity market introduces a new inefficiency into energy policy that drives up consumer bills. It is incentivising a form of generation that is penalised through another policy, the carbon price floor (CPF). The consumer pays for two separate policies that are working against each another. This issue of conflicting policies is even worse when applied to the larger fossil generators, such as coal and gas-fired power stations, because the scale is so much greater – but even at the smaller level, such as diesel, it provides very poor value for money to billpayers.

What impact does diesel generation have on decarbonisation targets and air pollution?

Using the government's greenhouse gas conversion factors, we calculate that diesel gensets have a carbon intensity of 1010gCO_2/kWh (Defra 2012). This is higher than the carbon intensity of unabated coal, at 930gCO_2/kWh, and far higher than that of combined cycle gas turbines (CCGTs), at 378gCO_2/kWh.

It is expected that the new diesel gensets will be 'peaking plant' – that is, they will run only when prices spike in the balancing mechanism. If the running hours of these units are very low then emissions will be limited. Nonetheless, diesel is still the most carbon-intensive way of providing peaking plant.

In reality, running hours will be determined by the diesel operators according to market conditions. If price spikes become more common – as may be the case as older power stations retire over the next 10–15 years and supply margins become tighter – they may decide to run more often than expected. However, there are few mechanisms currently in place to constrain the running of these units because they fall outside of the criteria for regulation.

- The Europe-wide emissions trading scheme does not apply to units under 20MW (SEPA et al 2013). All existing and planned diesel gensets in the UK fall under this threshold.
- The industrial emissions directive (IED) is a European directive that seeks to limit the emission of air pollutants (excluding CO_2). Reciprocating diesel engines are constrained by this directive if they run over 500 hours in a year (EC 2015). This equates to an 18 per cent load factor, which is far higher than these units are expected to run. This constraint is therefore very unlikely to be felt by diesel generators.
- All new power stations in the UK over 50MW are subject to an emissions performance standard (EPS) which limits their emissions to 450gCO_2/kWh, averaged over a year (HM Government 2015). The 50MW threshold is too high to capture diesel gensets, and even if they were captured, the ability for generators to average their emissions over a year means that gensets with a carbon intensity of 1010gCO_2/kWh could still run at a load factor of up to 45 per cent.

One constraint that does apply is the UK-only carbon price floor, which applies to units over 2MW.

With few constraints on the running hours of gensets, they could become a greater source of carbon emissions than expected. Table 2 below illustrates the potential emissions under a range of scenarios. It calculates emissions based on the total capacity of gensets in the capacity market (1,900MW), assuming that all prequalified capacity for the 2015 auction is successful. It also compares these emissions levels with the equivalent power generated by a CCGT.

Table 2
Potential impact of diesel gensets on emissions levels, compared with equivalent generation by combined cycle gas turbine

Capacity (MW)	Load factor (%)	Generation (TWh)	Annual carbon emissions from diesel (Mt)	Annual carbon emissions from a CCGT (Mt)
1,900	1	0.17	0.17	0.06
1,900	5	0.83	0.84	0.31
1,900	18*	3	3	1.13

Source: Author's calculations
*** EU industrial emissions directive threshold.**

Emissions from diesel gensets are not a major problem in terms of meeting carbon budgets *if* they run at a load factor of less than 5 per cent, reaching 0.84MtCO_2/year. However, by comparison, a CCGT running for the same period would emit approximately one-third of the emissions. And even better, load shifting could fulfil the same role without any emissions at all.

It is highly unlikely under current market conditions that gensets would run up to the IED threshold load factor of 18 per cent – but, as we explain above, there is no regulation to prevent this. Our view is that if less polluting options exist that can fill the same role as diesel generators then these should be prioritised.

In addition to the CO_2, diesel gensets emit other harmful air pollutants including oxides of nitrogen (NOx), which convert to nitrogen dioxide (NO_2) in the air, and particulate matter (PM). Long-term exposure to these air pollutants can be damaging to human health, reducing average life-expectancy by six months (BMA 2012). The UK Committee on the Medical Effects of Air Pollutants (COMEAP) has calculated that exposure to PM10[3] had an effect on mortality equivalent to 29,000 deaths in 2008 – more than the total number of deaths attributable to obesity and alcohol abuse combined (COMEAP 2010).

Air pollution also comes at a cost. The most recent UK estimate of the health cost is £16.285 billion a year (Defra 2010), and the most recent estimate of the total economic cost is £22.7 billion a year (both in 2012 prices) (COSU 2009).

Running at very low load factors, diesel gensets would not be a significant source of air pollution but, as we describe above, there is very little constraint on their use and they could therefore run for longer than expected. Our view is that direct public subsidies should not be awarded to technologies that could pose a threat to public health, particularly when there are less-polluting options easily available.

What impact does diesel generation have on security of supply?

The role that gensets play as peaking plant is important, as it helps National Grid to ensure secure supplies of power (although there are many other options available for providing the same service). However, the proliferation of diesel is affecting the dynamics of the capacity market such that longer-term security of supply may be harmed.

The low capital costs of gensets, coupled with the access to cheap investment capital through EIS funds, has meant that they are able to bid into the capacity market at low prices and thus bring down the price that the market clears at. This has contributed to a lower-than-expected clearing price, which in turn has meant that new-build CCGT has been priced out (Stokes and Spinks 2015). The government has made clear that they want to see investment in large amounts of gas capacity in order to ensure security of supply, but at present this is being undermined by an increasing amount of diesel capacity benefitting from the capacity market – the very mechanism designed to incentivise new CCGTs.

Removing diesel from the capacity market would mean the market clears at a higher price. Although this increase would fall on consumers, it would make it more likely that the government would be supporting the investment they want to see in new-build CCGT. It would also give providers of demand-side services a much better chance of securing capacity contracts (although they are additionally disadvantaged because they cannot access the 15-year contracts available to generators). In early 2016 IPPR will publish a report on the potential of demand-side resources and how that potential can be realised.

3 That is, particulate matter up to 10 micrometres in size.

Recommendations: how can the use and proliferation of diesel gensets be constrained?

This briefing seeks to highlight three significant concerns about the proliferation of diesel gensets.

- In terms of the cost to consumers, diesel gensets are not providing good value for money. Returns of 23 per cent are higher than those permitted in other parts of the sector, including for renewable technologies, which have recently seen tariffs cut or removed entirely. Although access to EIS funding has now been stopped, this has allowed a proliferation of double-subsidised gensets at the expense of the taxpayer and billpayer.
- In terms of decarbonisation, diesel does not pose a significant threat to carbon budgets if it runs at the levels that are currently expected, but there are few constraints in place to prevent that usage climbing in the future. There are alternatives available to National Grid to manage the fluctuations in supply and demand that would emit far less CO_2.
- In terms of security of supply, gensets are pricing out both the new CCGT generation that the government wants to see built and the demand-side load-shifting and load-reduction alternatives, which have great potential.

Our view is that the level of diesel generation being constructed in the UK and the returns that investors have been able to secure are having a negative impact in terms of the wider objectives of energy policy: affordability, decarbonisation and security. It is an unexpected development that results from the design of the capacity market and loopholes within tax relief schemes.

We recommend that diesel gensets should be prevented from entering the capacity market, and that constraints should be placed on those that already exist or have secured capacity contracts.

To achieve this, the government should introduce an amendment to the Energy Bill – which will return for its second reading in the House of Commons in the new year – that prevents any generator with an instantaneous carbon intensity over 450gCO_2/kWh from accessing 15-year contracts. This change is technology-neutral but aligns the capacity market with the government's decarbonisation objectives.

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- **the emissions performance standard, as established in the Energy Act 2013. This should also be tightened over time for units over 450gCO_2/kWh to ensure that running hours are restricted.**

Few people within the energy sector expected diesel capacity to increase at the rate that it has. By taking the steps above, government could prevent its further proliferation, limit the distorting effect it has on the capacity market, and protect billpayers from excessive costs.

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