Review of electricity market arrangements: what does it mean for Scotland?

Summary: This paper provides an overview of why the UK Government's Review of Electricity Market Arrangements (REMA) is important for Scotland. It describes some of the key areas of reform included in the review. It does not advocate for any one set of options; however, it does argue that reform of Britain's wholesale electricity market will have significant implications for a wide range of Scotland's energy and just transition ambitions, not just those directly related to electricity. These include the interim 2030 climate change targets, the vision for a Scottish hydrogen economy, and ambitions to decarbonise heat and transport. It also has the potential to impact on domestic, commercial and industrial consumers. The note also highlights the dependency of UK progress on what happens in Scotland: decisions through REMA will influence the ability of Scotland to support the UK in meeting its sixth carbon budget, its commitment to fully decarbonise the GB electricity system (subject to security of supply) by 2035, and to meet overall UK net zero targets.

What is REMA?

1. UK Government has instigated a major review of the wholesale electricity market along with many of the structures that sit alongside[1]. This review covers:
    - the way wholesale electricity is traded;
    - whether there should be locational price differences for wholesale electricity trading across Great Britain;
    - whether to 'split the market' and separate wholesale trading for different generators groups such as intermittent renewables and dispatchable power stations;
    - the potential for reform to low carbon support mechanisms, currently Contracts for Difference (CfD);
    - the capacity market or alternative support for 'capacity adequacy';
    - operability and ancillary services; and
    - the way in which flexibility is incentivised.

2. These reforms could have far reaching implications for Scotland. They will be critical to Scotland's ability to deliver on its statutory Climate Change targets, energy and just transition objectives and wider social and economic policy.

3. There is a particular need to understand the implications of several potential options of reform:

    - **The option of moving to zonal or nodal pricing for wholesale electricity:** these options would likely see the electricity prices received by generators and paid by consumers in Scotland fall substantially in comparison with current levels and in comparison with the rest of GB.

      Locational pricing would change the incentives on generation developers, influencing investment, location and operation. For example investment in Scottish generation is likely to be more challenging as expected returns will be lower and more uncertain.

      Although Scottish demand may benefit in the short term from prices that are lower, it is important to consider other areas that consumers may value such as price-stability, equality and fairness, and the successful delivery of net zero.

    - **Reform of low carbon support mechanisms:** The current CfD mechanism is expected to play a key role in supporting the growth of the Scottish renewables sector over the coming decade. The options under consideration have the potential to significantly change the degree of market risk that generators are exposed to.

    - **Capacity adequacy and security of supply:** the majority of Scotland's (and GB's) generation is expected to come from renewables. But it is important that the market framework can support dispatchable low carbon generators to be available and capable of generating when needed. This includes technologies like gas with carbon capture and storage (CCS), hydrogen power stations, and bioenergy with CCS (BECCS). Ensuring sufficient dispatchable generation is critical to security of electricity supply.

[1] https://www.gov.uk/government/consultations/review-of-electricity-market-arrangements

This note has been produced by Simon Gill as part of work exploring electricity market reform and commissioned and funded by Scottish Futures Trust. Author's contact: simon@energylandscape.co.uk.

- **Supporting flexibility:** energy storage, demand flexibility, international interconnection, and the potential to link Scotland's electricity system to a growing hydrogen economy through electrolysis are all expected to play an important part in managing the evolution of Scotland's electricity system. We need to understand the role that each will play and ensure that the market framework supports them.

4. Although REMA is important, it is important to note that key areas of reform fall outside of its scope. In particular, the framework for the **development of the electricity transmission network** and **retail market reform** are not part of REMA. Other areas outside its scope include development of one-off **'First of a Kind'** funding mechanisms such as the Dispatchable Power Agreement developed for CCS generators[2] and **carbon pricing arrangements** including development of the UK Emissions Trading Scheme (ETS). BEIS have highlighted that REMA will work closely with team developing policy in these areas.

Why is REMA important for Scotland?

5. Electricity market arrangements set the rules within which many of the targets and ambitions for the Scottish energy system will need to be delivered. Table 1 lists the full range of ambitions laid out by Scottish Government in its recent draft Energy Strategy and Just Transition Plan[3], and other recent policy documents.

6. There are obvious implications of REMA for Scotland's ambitions to grow its **renewable sector**. The build-out of Scotwind and onshore wind depends on wind developers having confidence in revenues that will come mainly from the wholesale electricity market itself and low carbon support mechanisms. Changes to these structures will impact on projects revenue streams, risk exposure and investment appetite.

7. Any demand-sector planning to decarbonise through electrification will also be affected including **heat and transport.** These sectors will succeed if REMA reforms ensure a market where electricity is affordable, there is reasonable confidence in ongoing costs, and the trajectory of the energy supplied through the electricity system remains on track to decarbonise quickly.

8. The development of a **green hydrogen sector** will be influenced significantly by the electricity market framework with which it needs to interact. There are different models for the link between electricity and hydrogen:
    - as an electricity demand-side technology (when connected stand alone to the network);
    - as part of a hybrid electricity-hydrogen business model (when connected behind a generator's electricity meter); or
    - operationally independent of the electricity system if built as part of a non-grid connected generator.

9. In the first two cases the operational costs of the electrolyser will be affected by decisions made under REMA, either by directly setting the market framework within which electricity must be purchased to run the electrolyser, or, in the case of the second model, through impact on the 'opportunity cost' of using electricity for hydrogen production instead of selling in the wholesale electricity market. Even in the third case, the impact of electricity market arrangements will be felt at the investment stage as developers compare technical designs and business models both for the electricity and hydrogen aspects of their project.

10. The development of **flexibility,** including **pumped storage hydro** and **grid scale battery storage,** is likely to be critical to integrating renewables onto the Scottish system. Flexibility business cases depend on a mixture of wholesale market trading (known as energy arbitrage), ancillary services and capacity market revenues.

11. In addition, Scotland's **security of electricity supply** depends on appropriate business cases for **biomass power stations, gas with CCS, BECCS,** and **hydrogen power stations.**

12. These reforms will also set the framework within which **power purchase agreements (PPAs)** and other trading mechanisms will evolve, this is important for all generators, including those under **community ownership.**

13. Lastly, the ability to deliver a **just transition** away from oil and gas depends on developing a **vigorous renewable industry** and a **clear conception of what constitutes fairness** for consumers.

[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1117566/ccus-dispatchable-power-agreement-business-model-summary.pdf
[3] https://www.gov.scot/publications/draft-energy-strategy-transition-plan/

Table 1: the importance of REMA to Key Scottish energy and just transition targets.

	Area of Interest	Target / Ambition	Why is electricity market reform important?
Overall climate targets	Climate Change targets	30% GHG reduction by 2030 + net zero by 2045	Electricity could meet **up to around 80% of Scotland's** energy demand by 2045 (up from 16% today).
	Electricity sector	An emissions reduction pathway which requires a zero carbon electricity system by 2030	In addition to generation, feasible **'flexibility' business cases** are needed for **energy storage** (including batteries and pumped storage) and other forms of flexibility.
	CCS and negative emissions	3.8 MT CO_2 of negative emissions by 2030 and 5.7 MT by 2032 under the current Climate Change Plan	**Direct air capture:** requires significant energy input to operate (Approx 2 TWh per MT CO_2). **NETS by CCS:** likely to be most feasible in the electricity generation sector.
Electricity supply targets	Offshore wind ambition	8 – 11 GW capacity in Scottish waters by 2030	Wholesale market structure sets the framework within which Scottish generators compete with those in the rest of GB. Locational pricing could significantly reduce the price received in Scotland. Most new renewable capacity is expected to require support mechanisms such as CfDs. Business models for dispatchable generators, needed for security of supply, will include ancillary services and capacity markets.
	Onshore wind ambition	20 GW capacity by 2030	
	CCS and negative emissions	3.6 MT CO_2 of negative emissions by 2030 and 4.7 MT by 2032 under the current Climate Change Plan	
Energy demand targets	Heat decarbonisation	Decarbonise at least 1 million homes by 2030 and equivalent non-domestic decarbonisation	Core option for decarbonisation of transport and heat (including heat network supply) is electricity. Wholesale market structure will impact the price paid by the electricity demand side. Locational market reforms could see electricity prices lower in Scotland than elsewhere. But there is significant uncertainty about the longer term impact and impact on ability to access zero carbon electricity.
	Heat network target	6 TWh of heat delivered through heat networks by 2032	
	Transport – cars and vans	Remove the need for petrol and diesel cars and vans by 2030	
	Transport – rail	Scotland's railways to reach net zero by 2035	
Hydrogen economy	Hydrogen production	5 GW installed renewable and low-carbon production capacity by 2030 and 25 GW by 2045	Green hydrogen production uses electricity and faces similar impacts as demand side sectors (above). Electricity market framework affects one side of the decision faced by renewables developers when balancing future electricity vs green hydrogen production.
Just transition ambitions and targets	Just transition outcomes	Including: ensure people have access to affordable, clean energy; ensure Scotland is supportive for private investment, home to a multi-skilled energy workforce, and competitive in domestic and international markets	The key '*transition to*' area for Oil and Gas jobs is the renewable electricity sector which therefore needs to be flourishing. Other areas including hydrogen production (green and blue) CCS etc. are also likely to depend heavily on the successful and fast decarbonisation of electricity.
	Oil and Gas sector	The fastest possible just transition for the Oil and Gas	
	Fuel poverty	Remove fuel poverty, as far as is reasonably possible, by 2040	Wholesale costs set around 29% of domestic electricity bills pre energy price crisis and significantly more today. Locational elements could see short term reductions in the cost of electricity in Scotland. But they also change the distribution of risk and uncertainty carried by consumers. Nodal pricing would also introduce significantly greater variation in costs across Scotland.
	Community ownership	2 GW of community owned energy by 2030	Market reform will influence the availability, length, and structure of PPAs for renewables including those suitable for community ownership.

The GB case for Change

14. The UK Government has committed to "fully decarbonising our power system by 2035, subject to security of supply"[4] and REMA identifies several areas where UK Government thinks radical change is needed to achieve this.

15. In the REMA 'case for change' BEIS list five key challenges:
    - the need to increase the pace and breadth of investment in generation capacity;
    - the importance of increasing system flexibility;
    - providing efficient locational signals to minimise system costs; and
    - ensuring the system remains operable.

16. National Grid ESO (NGESO) has led much of the early analysis informing the debate[5]. It has highlighted four problems that current market arrangements create for the delivery of net zero:
    - constraint costs are rising at a dramatic rate;
    - balancing the network is becoming more challenging and requires increasing levels of inefficient redispatch;
    - national pricing can sometimes send perverse incentives to flexible assets that worsen constraints; and
    - current market design does not unlock the full potential of flexibility from both supply and demand.

17. NGESO conclude that: "Our assessment found that real time, dynamic locational signals are needed to inform how both supply and demand assets dispatch in operational timescales. Neither national nor zonal pricing can deliver efficient locational signals as GB transitions to a net zero energy system."

18. There is widespread acceptance of several areas of the case for change. In particular, there is recognition of the scale of infrastructure investment that is needed including the importance of investment in all forms of low carbon generation, in networks and in flexibility if we are to deliver on net zero. There is also widespread acceptance that we need to change the way that the *costs* of electricity production feed through to the *prices* paid.

19. A key area for Scotland to engage with is the challenge posed by transmission network constraints both within Scotland and between Scotland and the rest of GB. Across 2020 and 2021 around 5.8 TWh of wind generation was curtailed across GB. Scottish wind farms accounted for 94% of that curtailment in 2020 and 80% in 2021[6]. Market reform is seen by many as a way of managing the costs associated with those constraints.

20. Despite the case for change put forward, there is no clear consensus as to the scale or type of reform that is needed. The options put forward in REMA range from relatively small adjustments to the status quo to very radical change that would substantially alter the format of the wholesale electricity market.

21. And whilst the case for change is compelling in some areas, there are others where it is less convincing. One of the important points for those engaging in this debate in Scotland (and elsewhere) is to consider each area of reform from both a principles and practicalities perspective; what is the value of change, and the potential of each option.

What Scotland is aiming for? How does that align with GB-wide ambitions?

22. Scotland's Climate Change Plan update[7] calls for a fully net zero electricity system by 2030 and, as well as continuing to scale renewable generation, it highlights the importance of other technologies in ensuring a secure and low carbon electricity system: pumped storage, battery technology, demand flexibility CCS, bioenergy, and hydrogen power stations.

23. This target lays the groundwork for decarbonising the wider energy system. It also supports the delivery of UK Government targets, including the ambition to fully decarbonised the GB-wide electricity system by 2035. Without significant effort from both GB and Scottish institutions to support delivery of Scotland's own targets, that GB target is likely to be unreachable.

24. NGESO's modelling for their annual Future Energy Scenarios (FES) recognises the importance of a thriving Scottish low carbon electricity sector. For example, in modelling for its 2022 FES[8], across the three scenarios which a

[4] https://www.gov.uk/government/publications/net-zero-strategy
[5] https://www.nationalgrideso.com/future-energy/projects/net-zero-market-reform
[6] https://www.drax.com/wp-content/uploads/2022/06/Drax-LCP-Renewable-curtailment-report-1.pdf
[7] https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/documents/
[8] https://www.nationalgrideso.com/future-energy/future-energy-scenarios

broadly consistent with UK net zero, **the quantity of wind in Scotland in 2035 ranges from 49 GW to 56 GW.** This is beyond even Scotland's own targets and the capacity suggested in the recently published Scottish whole energy system scenarios[9].

25. To illustrate the scale of the challenge Figure 1 shows a potential pathway up-to the middle of the 2030s that is broadly consistent with Scotland's declared ambitions, NGESO's 2022 FES scenarios, and the Scottish whole energy system scenarios. The three snapshots it shows are: today's existent generation capacity in Scotland; Scotland meeting its declared 2030 ambitions; and a continued increase in capacity to 2035 in line with the three net-zero compliant NGESO's FES.

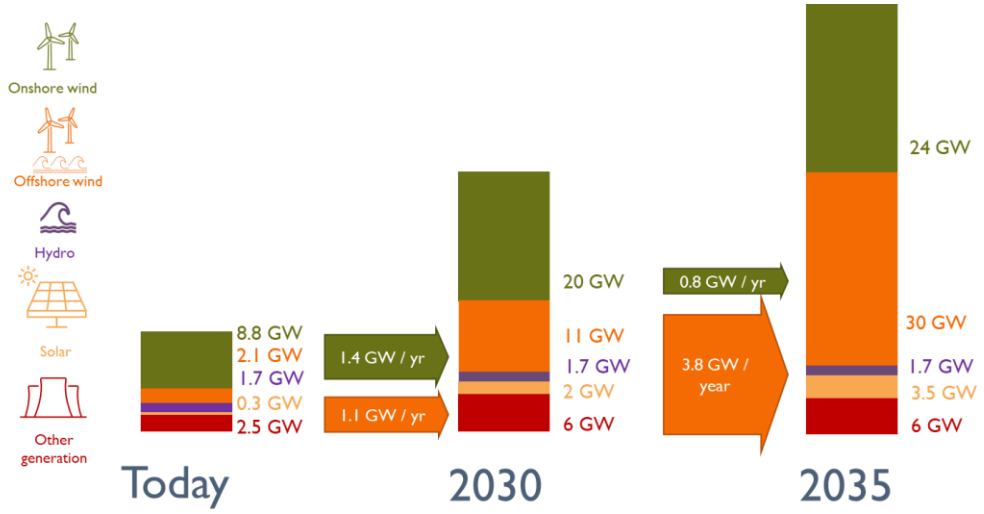

Figure 1: Illustrative pathway for Scottish generation capacity out to 2035 consistent with Scotland's declared ambitions in 2030, NGESO's net zero FES scenarios for 2035, and the Scottish whole energy system scenarios. It also highlights the annual build rates required for onshore and offshore wind to deliver this outcome.

27. Whilst there is a significant step in capacity between 2030 and 2035, it is important to compared the Scottish 2035 capacity with the total across GB. The range of GB wind capacity in the net-zero compliant FES scenarios is 100 GW to 115 GW showing that, even at the scale shown above, Scotland is only contributing around 50% of GB's overall wind capacity.

28. Figure 2 illustrates the potential evolution of annual electricity generation available and electricity demand. It shows that today, generation is around 50% higher than demand with renewable generation approximately equal to demand.

29. By 2030 there is an increase in demand reflecting three factors: a relatively small increase due to electrification of transport; a large increase due to electrification of heat; and a large increase due to the development of hydrogen electrolysis. At the same time available generation increases more than 2.5 times, reflecting the increase in on- and off-shore wind capacity.

30. Between 2030 and 2035 Scottish demand growth slows, but the increase in generation continues with generation in 2035 around 75% more than five years earlier. This means that, in this illustration, in 2035 annual generation is well over three times the level of demand.

31. There may be some opportunity for international interconnectors to connect directly into Scotland . However, The excess of electricity generation over demand, even after accounting for ambitious electrification of heat and transport, and the development of green hydrogen, represents an opportunity for Scottish renewables to meet wider GB electricity demand. Doing so requires a sufficient capacity of transmission network within Scotland and between Scotland and the rest of GB.

[9] https://www.climatexchange.org.uk/research/projects/scottish-whole-energy-system-scenarios/

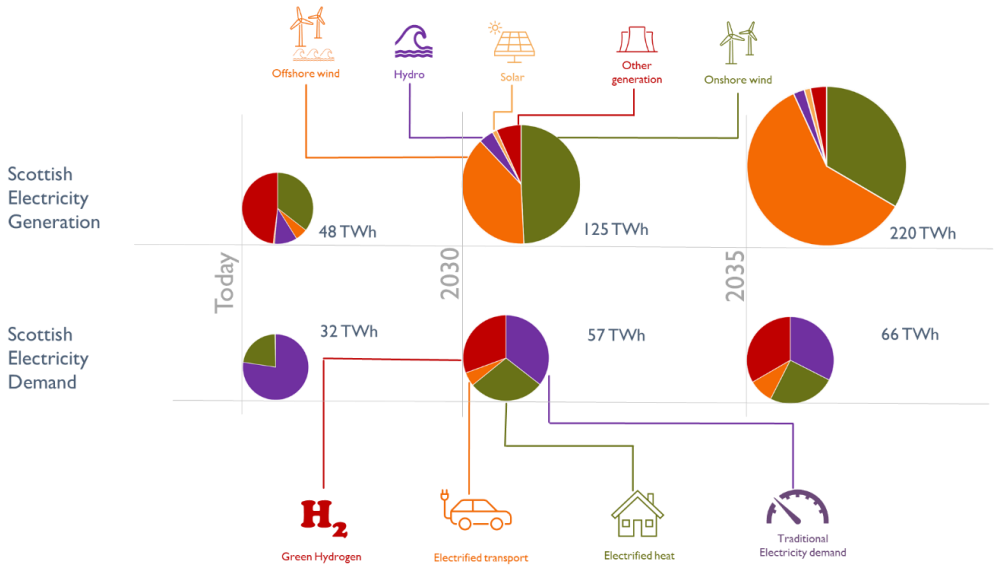

Figure 2: Illustration of annual electricity generation and demand in Scotland out to 2035. Values for today are based on current statistics, 2030 values are consistent with Scotland's declared ambitions (e.g. for the level of heat decarbonisation) and 2035 is broadly consistent with FES 2022 and the Scottish whole energy system scenarios.

32. Figure 3 highlights the difference in scale between renewable generation and underlying demand on a time-series basis. This figure should be treated as illustrative only, but it shows the scale of underlying electricity demand (not including hydrogen electrolysis) is an order of magnitude smaller than the scale of available renewable generation.

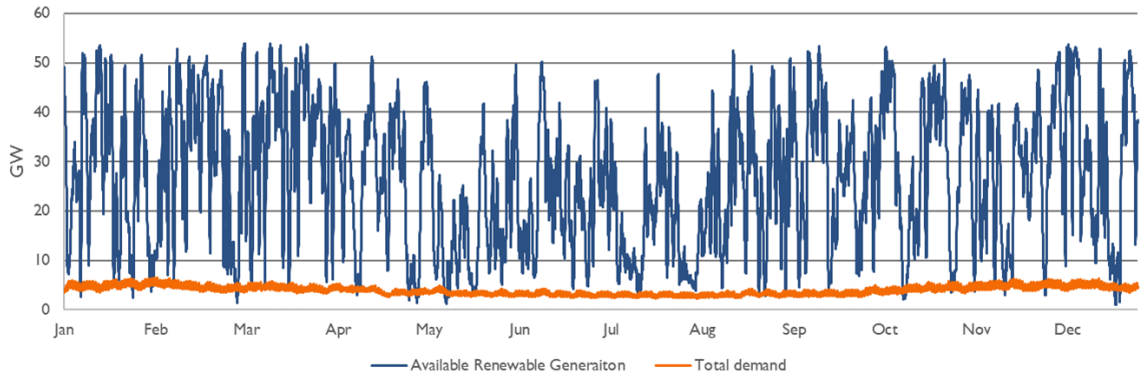

Figure 3: Illustration of renewable electricity generation available and demand (excluding hydrogen electrolysis) across a full year in 2035. This is based on capacities and annual demand in Figures 1 and 2.

33. Given the difference in scale between generation and demand in this example, it is important to ask: is this the right balance? In answering that question it is important to consider both the Scottish and the wider GB / UK implications of attempting to change that balance.

34. Getting sufficient renewable generation capacity built in GB is one of the key challenges to decarbonising the electricity system by 2035 and reaching net zero across the wider economy. Scotland has a project pipeline, a supply chain, and a planning and consenting framework which will be able to deliver wind capacity quickly. Without Scotland's contribution there could be significant risk to:
    - the UK meeting its sixth carbon budget and its commitment to a fully decarbonised electricity system in 2035;
    - decoupling GB electricity prices from the price of gas;
    - ensuring a thriving Scottish renewable industry capable of supporting a just transition from oil and gas; and
    - paving the way for economy-wide decarbonisation by 2045 (Scotland) and 2050 (UK).

REMA: the main areas under review

Wholesale electricity market

Wholesale market arrangements: the framework within which electricity is traded between generators, suppliers, and very large consumers.

Current arrangements involve:

- **Bilateral trading:** generators and suppliers (and other wholesale market participants e.g. 'non-physical traders') can strike deals between themselves with the terms largely up to them.
- **Self-dispatch:** generator owners choose which stations to run and only have to inform national grid close to delivery time.
- **National prices:** prices agreed through wholesale trading do not depend where in GB the generator or consumer is located.
- **Firm financial system access:** most market participants have a firm financial right of access to the wholesale market. This means if the system cannot *physically* accommodate their generation they will be compensated (e.g. through the Balancing Mechanism. In relation to wind farms this is often referred to as 'curtailment payments').

What is being considered:

- The potential to move to a **centrally traded and dispatched** market where the System Operator receives bids and offers from generators, consumers and flexibility and directs which assets should operate and at what level.
- Whether to combine central dispatch with either **zonal** or **nodal** pricing where the zonal or nodal price will tend to reflect the cost of meeting demand in that zone or at that specific location. Note that zonal and nodal options are likely to require central dispatch.
- A move to a locational market would also likely imply **a loss of firm financial access right** to the system with market participants only gaining the right to access when dispatched by the System Operator. Note that nodal pricing implies a loss of firm financial access rights for market participants, and zonal pricing implies a loss of firm access except within the zone.
- A separate reform option is whether to **split the market** which could mean 'as available' generation including wind, solar and nuclear being moved into a separate market from 'on demand' generation such as gas, biomass and future hydrogen power stations.

Particular areas of importance for Scotland:

- Insufficient transmission capacity means that curtailment of renewable generation is a major feature of the Scottish electricity system and is likely to continue to be so for the foreseeable future.
- Locational price models – zonal or nodal – are likely to see the electricity price in Scotland fall to zero for large parts of the year (at least for a period of years) when transmission constraints are binding.
- Under current arrangements, Scottish generators, once connected, are financially insulated from the lack of network capacity through their firm access rights. Reform options, such as zonal or nodal pricing, which are likely to include a loss of those access rights could have a significant impact on revenues and risks; especially where that is combined with regular zero or negative prices.
- Low prices could reduce electricity costs paid by Scottish consumers at least in the short term. However, this depends on many factors including the continued acceleration of a GB-national transition to renewable generation.
- Consumers will only benefit in the long term if market arrangements support the required investment in renewable and other low carbon generation.
- Market arrangements need to support fair and equal outcomes both between different groups of consumers and between different parts of the country. They will also interact with other elements of the 'end user bill' such as network costs which drive existing regional variation in retail prices.

Low Carbon support

Low carbon support: the set of mechanisms used to provide subsidies, price-stabilisation, or other support to renewable and nuclear generation.

Current arrangements involve:

- **Contracts for Difference:** where generators are effectively guaranteed a fixed 'Strike price' for their generation through a combination of wholesale market revenues and top-up / pay-back mechanisms. The system assumes that generators receive the 'reference price' through their PPA or alternative trading mechanisms and the CfD pays a top up when the reference price is less than the strike price (or claws back additional revenue when the reference price is greater than the strike price). Consumers ultimately cover the cost of the CfD mechanism or receive the benefit of payback. See Figure 4 below.)
- **Renewable Obligation Certificates and Feed in Tariffs (ROCs and FiTs):** legacy arrangements for renewable generators which provide a revenue uplift largely independent of the wholesale market price.

What is being considered:

- **Adjusting the current CfD arrangements:** so that future generators are exposed to more market risk. For example, this could be through shorter contracts or limits to the quantity of power covered by the CfD.
- **Deemed CfD arrangements:** where renewable generators are paid for their *potential* to generate and export, regardless of whether they generate or not. This allows support to operate when the generator is not dispatched in the market, if they choose to provide ancillary services instead, or if they choose to use their output 'behind the meter' e.g. to charge storage. In these cases the CfD support would cover what they *could* have exported to the system.
- **Revenue Cap and Floor:** where the cap and floor cover all revenue streams available (wholesale market revenue, ancillary services, capacity market etc.).
- **Supplier obligation:** direct support is removed, and suppliers are obliged to purchase a fraction of their demand from zero-carbon sources with the fraction ratcheting up over time. The size of penalties imposed on suppliers' who fail to meet their obligation set the additional value that they are willing to pay for zero carbon power.

Particular areas of importance for Scotland:

- Scotland expects CfDs, or alternative support mechanisms to be a central part in delivering on renewable capacity ambitions and to ensure a booming Sottish renewable sector to support a just transition.
- The risk faced by renewable developers depends heavily on the interaction between the support mechanism and the wholesale market design. For example, current rules in CfD contracts which mean that generators do not receive a top-up when the reference price is negative could, in combination with locational pricing, significantly erode the revenue-security that CfDs provide.
- It may also be important to consider the degree to which Scottish consumers benefit or suffer from the way in which support mechanisms are paid for and the equality and fairness implications across the country.

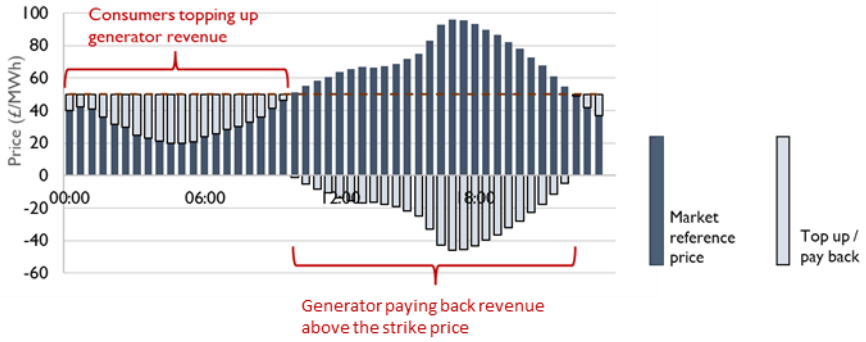

Figure 4: Illustration of how CfDs work to deliver a guaranteed strike price to generators

Capacity Adequacy

Capacity Adequacy: market, policy and regulatory mechanisms used to make sure that GB can meet its peak demand.

Current arrangements involve:

- **Capacity Market (CM):** The CM aims to procure sufficient capacity to meet the expected peak demand. Capacity providers are paid an annual fee, set by an auction, in return for being available to generate or to reduce demand during a period where there could be a shortage. Consumers cover the costs of the CM through their bills.

What is being considered:

- **Optimising current CM arrangements:** for example to give an advantage to low carbon providers of capacity and avoid reliance on unabated gas power into the 2030s.
- **Reliability options:** Based on the concept of a 'call contract' a reliability option gives the buyer – likely to be the System Operator – the right to buy electricity at a pre-defined price and penalises the counterparty if they are unable to deliver when called. The penalty is equal to the difference between the real-time wholesale market price and an agreed reliability strike price, so the penalty increases as the system margin reduces and wholesale prices rise.
- **Strategic reserve:** where back-up capacity is kept available but outside the wholesale market. The System Operator or UK Government would pay the costs of maintaining the plant 'operationally ready' but the station would only be allowed to generate when other options were exhausted. A similar approach was used in the mid 2010s with a unit at Peterhead was made available under a 'supplementary balancing reserve' contract.

Particular areas of importance for Scotland:

- Scotland's security of electricity supply is ultimately linked to that of GB as a whole – if GB suffers a shortage of supply it would affect Scotland no matter where the generation of flexibility is located.
- Supporting a sustainable business case for low-carbon dispatchable generation is critical to making sure that demand can be met when the wind isn't blowing.
- Well designed capacity adequacy mechanisms will support the development of new battery and pumped storage capacity in Scotland as well as proposals such as SSE's new gas with CCS station at Peterhead.
- It will also support flexible demand which can provide capacity adequacy by switching off when margins are tight.

Flexibility and operability

Flexibility and operability: flexible technologies include energy storage, generators that can start up or vary their output quickly, flexibility from the demand side and international interconnectors. Operability means ensuring that the system has access to the wider services needed to ensure that it can keep operation and respond to unexpected events such as faults and failures. Operability services include frequency response and reserve, voltage support, fault current, inertia and black start restoration.

Significant development of flexibility and operability are both considered crucial to move to a net zero electricity system.

Current arrangements involve:

- Flexibility business models tend to be flexible, often relying on multiple revenue streams derived from wholesale and ancillary service markets and 'behind-the-meter' arrangements, for their business case.
- Operability is delivered through a combination of ancillary service markets run by NGESO (e.g. Dynamic Containment Reserve) and regulatory requirements on market participants (e.g. Mandatory reactive power requirements set in the Grid Code).

What is being considered?

- A number of adjustments to existing market frameworks which would increase rewards for flexibility providers. For example the CM could reward capacity providers capable of responding more quickly.
- A cap and floor mechanism for some flexibility assets, although this is likely to be limited to particular types of flexibility such as pumped storage.
- The supplier obligation mentioned above can support flexibility as flex can align supply and demand more closely and support the supplier in meeting more of its demand from low carbon sources.
- For operability, if the wholesale market moves to centralised dispatch many of the current ancillary services could be procured directly alongside energy as is done in markets elsewhere in the world.
- There are also options to move this to a more localised procurement of ancillary services and adjust other mechanisms, such as the CfD, to encourage greater participation in ancillary service markets by existing generators.

Particular areas of importance for Scotland:

- Heavily constrained electricity networks within Scotland and between Scotland and the rest of GB mean that flexible technologies are likely to have a particularly important role in Scotland. Getting the market framework right to support them will be important for decarbonisation overall.
- Scotland has potential for growth in pumped storage hydro which could play an important part in providing long-duration energy storage. The investment case for this technology is particularly challenging given the multi-decade pay-back time. Therefore it is important the market framework considers the value that pumped storage can bring and the revenues streams and risk sharing measures needed.
- Scotland's ambition to develop a hydrogen economy can provide significant demand side flexibility for the electricity system. The wholesale market itself (which sets the price of the energy input to electrolysis either directly, or through 'opportunity cost' of using generation to run an electrolyser rather than for export) and the frameworks for flexibility services have the potential to support the development of that hydrogen system, if reformed in the right way.
- Other forms of flexibility including battery storage and demand flexibility will play a growing part in supporting the network.
- Scotland will also have particular challenges associated with other 'operability issues' including the need to ensure technical services. These will need to be delivered from a very different mix of providers. That transition is already underway, ensuring the market framework for ancillary services adapts will be an important part of maintaining reliability.