

# **SHE TRANSMISSION OPERATIONS STAKEHOLDER WORKSHOP**

**MARCH 2019**



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## INTRODUCTION

On 5 March 2019, SHE Transmission hosted a stakeholder workshop, aimed at gathering feedback from its stakeholders on its approach to network resilience and reliability for the RIIO-T2 plan.

The workshop took place at the Edinburgh International Conference Centre (EICC). The workshop covered four topics: intelligent network control; managing and storing our materials; our asset replacement programme; and black start and network resilience.

The room was set up with four different 'stands', each manned by SHE Transmissions personnel. After the introductory presentation, stakeholders were invited to listen to presentations given at each stand before returning to their seats for a round-table discussion.

SHE Transmission instructed EQ Communications, a specialist stakeholder engagement consultancy, to independently facilitate the workshops and take notes of the comments made by stakeholders.

Every effort has been made to faithfully record the feedback given. In order to encourage candour and open debate, comments have not been ascribed to individuals. Instead, notes have been assigned to the type of organisation that each stakeholder represents.



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## EXECUTIVE SUMMARY

The workshop began with an introductory presentation from Dave McKay, Director of Transmission Operations, and Andy Adams, Head of Operational Performance at SHE Transmission at SHE Transmission. The presentation gave stakeholders an overview of the business and explained the key issues pertinent to the reliability and resilience of the transmission network in the north of Scotland.

Following the presentation and introductions, the workshop began. Stakeholders worked their way around the four different 'stands' over the course of the morning, listening to a presentation from a SHE Transmission representative at each one. The topics covered at the four 'stands' were: intelligent network control; managing and storing our materials; our asset replacement programme; and black start and network resilience.

Each topic focused on providing stakeholders with options for the RIIO-T2 Business Plan. In general, there were three options presented that required increasing levels of investment: 'minimum standard', 'responsible operator' and 'progressive network enabler'. However, not all topics had three options.

At the end of each presentation given at the stands, stakeholders reconvened for a round-table discussion and a voting exercise (exercise 1) where they were asked to identify their preferred option for the RIIO-T2 Business plan, without an awareness of the costs. At the end of the workshop, once stakeholders had visited and discussed all four topics, they were asked to complete another voting exercise (exercise 2), this time with knowledge of the cost implications. A summary of the feedback given at the workshop, and the outcomes of the 'voting', can be found below.

### INTELLIGENT NETWORK CONTROL

Angus Coutie, Transmission Control Room Manager, and Kenny Henderson, Head of Technical Services at SHE Transmission, presented this session. The key points raised by stakeholders are shown below:

- Stakeholders told us that they would like to see SHE Transmission adopt the 'responsible operator' option for control centres. This remained their position once they had been made aware of the cost implications of each option. They recognised the importance of a stand-by facility to help manage major network faults and offset the cost of a new facility against the cost of long outages. However, they wanted to see

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increased sharing of facilities with other network companies.

- Stakeholders also chose ‘responsible operator’ for control systems (note: there was no third option here). This is because it was felt that SHE Transmission must keep up with evolving technology in this area.
- For protection, stakeholders wanted SHE Transmission to go even further, supporting the ‘progressive network enabler’ option on average. Once costs were revealed, the average score increased, demonstrating that stakeholders thought it was good value for money. Protection received the highest score across the options in all categories across both exercises. Like control systems, stakeholders felt it was important that SHE Transmission was adopting the latest technologies and recognised the potential for money saving over time.
- On average, stakeholders opted for ‘progressive network enabler’ for communications – overall scoring second highest across the options in all categories across both exercises. As with the options above, stakeholders wanted SHE Transmission to adopt the latest technologies. However, some expressed concern at the scale of what needed to be delivered and questioned whether it needed to be phased over several control periods.
- For all aspects of intelligent network control, stakeholders expressed concern that any move towards IP connected, digital equipment was accompanied by a robust approach to cyber security.

## **MANAGING AND STORING OUR MATERIALS**

Sandy Gourlay, Logistics Manager at SHE Transmission, presented this session. The key points raised by stakeholders are shown below:

- On average, stakeholders wanted to see the ‘responsible operator’ approach to warehousing. However, once the cost of these options had been revealed, the average score decreased significantly – the largest decrease in exercise 2 across any of the options – demonstrating that stakeholders were surprised by the leap in cost between the options.
- Stakeholders supported investment in warehousing because they recognised that it had the potential to reduce the length of outages and minimise the cost associated with them. However, there was a desire to see greater collaboration between network companies when it came to spares.
- Stakeholders wanted SHE Transmission to go further with regard to on-site security: on average, they voted for ‘progressive network enabler’ and this didn’t change when

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costs were involved. It was felt that no price could be put on people's safety. The use of CCTV was strongly supported, although opinions were divided over the value for money of helicopters.

## **OUR ASSET REPLACEMENT PROGRAMME**

Euan Philips, Asset Engineering Manager at SHE Transmission, presented this session. The key points raised by stakeholders are shown below:

- Stakeholders wanted to see SHE Transmission choose the 'responsible operator' option for its asset replacement programme and their decision did not alter perceptibly even when they were made aware of the cost implications of this.
- Stakeholders were very much of the view that SF6 should be replaced wherever possible, given its impact on the environment. It was felt that the company should look to use less harmful alternatives, wherever possible, whilst being mindful of cost.
- When stakeholders were asked to consider the merits of bringing forward investment in civil enabling works and asset replacement, more generally from T2 to T3, there was a good deal of support for this. Many were of the view that front-loading investment would make the network more resilient and would save money in the long run. It was, however, felt that works should be considered on a case-by-case basis and that cost-benefit analysis should be carried out wherever possible.
- Stakeholders also saw the benefits of safeguarding land close to SHE Transmission's assets, as it was felt that this land would increase in value in the future and could always be sold on at a profit.

## **BLACK START AND NETWORK RESILIENCE**

Ian Brown, Substation Engineer at SHE Transmission, presented this session. The key points raised by stakeholders are shown below:

- On average, stakeholders wanted to see SHE Transmission go for the 'responsible operator' option for black start in order to include investment in autonomy and restoration times. However, in both exercises, the score was at the lower end and when stakeholders were made aware of the cost, the average score dropped by 0.17, making it even more marginal and thus implying a lack of consensus among stakeholders on this.
- Whilst stakeholders recognised the need for a back-up system, concerns were expressed about the use of diesel generators and batteries, particularly with regard to

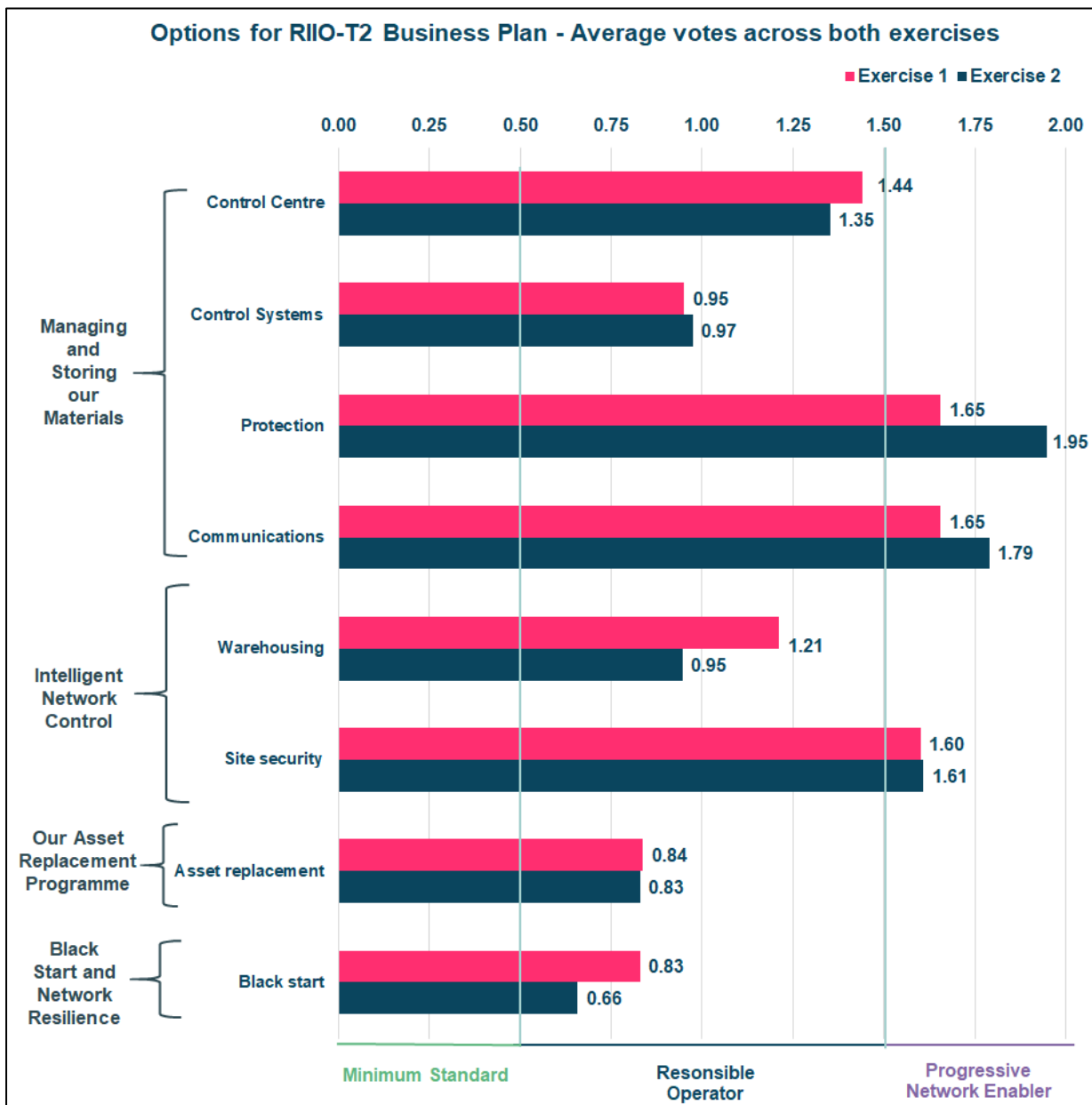
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their environmental impact. Stakeholders wanted to see SHE Transmission explore newer technologies instead, including distributed sources as a more progressive way of backing up the grid.

- There was some support expressed for the adoption of network tools to stabilise the grid, particularly given the scale of renewables coming online. However, concern was raised as regards the high cost of this option, and a middle ground was suggested whereby there would be some investment in that area, albeit not as much as proposed.
- There was consensus that SHE Transmission should be investing in additional equipment to ensure network resilience rather than developing emergency response plans. It was generally felt that SHE Transmission should take a risk-based approach to this investment, although some felt that serving areas of high population should be prioritised.

## EXERCISES 1 AND 2: RESULTS

During the voting exercises, stakeholders were asked to review SHE Transmission’s options for its RIIO-T2 Business Plan and decide whether the company should adopt the ‘minimum standard’, ‘responsible operator’ or ‘progressive network enabler’ approach. In exercise 1, stakeholders were provided with the un-costed options in order to understand their general views on the principle. In exercise 2, the costs of each option were revealed to ascertain what stakeholders felt was value for money. A summary of the results of the voting exercises can be found in the graph below.



When summarising the results of these exercises, ‘minimum standard’ was treated as a ‘0’, ‘responsible operator’ as a ‘1’, and ‘progressive network enabler’ as a ‘2’. Therefore, if the



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average score was between 0.5 to 1.5, we have treated this as a vote for 'responsible operator' as any figure within this range is closest to '1'. The average figures are displayed in the graph below, which collates all eight options across the four topic areas in both exercises 1 and 2.

## **WRITTEN FEEDBACK**

After the workshop, stakeholders were asked to complete a short feedback form about the event. Some of the key findings are shown below:

- 56% of attendees reported that they found the workshop 'very interesting', with 36% opting for 'interesting'.
- 94% 'agreed' or 'strongly agreed' that they had the opportunity to make their points and ask questions.
- 81% 'agreed' or 'strongly agreed' that the right topics were covered for them on the day.
- 62% thought EQ Communications' facilitation was 'very good', with 38% opting for 'good'.
- 93% of stakeholders wanted to receive SHE Transmission's post-event report and invites to similar events in the future.

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## ATTENDEES

A total of 46 stakeholders attended the workshop, representing 31 organisations. The organisations represented on the day are shown below:

ABB	LS Transmission Consultancy
Babcock Networks	Marine Scotland
Balfour Beatty	Morgan Sindall Group
Bellway Homes	National Grid
Coriolis Energy	Nexans
Corrie Construction Ltd	NorPower Ltd
Cyberhawk Innovations	Omexom
EDF	Power System Partners
Energy Technology Partnership	Qmulus Solutions
Energyline	RJ McLeod
European Marine Energy Centre	Scottish Government
Forsa Energy	SP Energy Networks
Fred. Olsen Renewables	SSE Renewables
GE	University of Edinburgh
Heriot-Watt University	Wood
iPower	

## INTELLIGENT NETWORK CONTROL

### SUMMARY

This topic was presented by Angus Coutie, Transmission Control Room Manager, and Kenny Henderson, Head of Technical Services at SHE Transmission. Angus began the presentation, talking stakeholders through the different options for upgrading the company's control rooms in RIIO-T2.

Kenny then provided an explanation of three key areas in relation to intelligent network control: control systems; protection (SCADA); and communications, which involves replacing existing earth wire with optical ground wire to enable a faster speed of communications. A summary of all of the options in relation to managing and storing our materials can be found in the table below.

		Minimum Standard	Responsible Operator	Progressive Network Enabler
Intelligent Network Control	Control Centre	A new control centre - and replicating our facilities in another location, bringing equipment out of storage	A new control centre - and establishment of control centre support team at a suitable location already having pre-prepared facilities, but displacement of incumbent staff using the site	A new control centre - and full standby facility ready and waiting to be used in the event of the loss of the control centre
		£1m*	£5m*	£17m*
	Control Systems	Replace specific identified list of hardware which is obsolete / time expired on a like-for-like basis, utilising spares	Minimum Standard, plus replacement of existing hardware with Internet Protocol (IP) connected, digital, compliant equipment including cyber security measures	
		£6m	£8.7m	
	Protection	Replace existing obsolete / time-expired on a bay-by-bay basis with modern equivalents, updating both main and auxiliary relays	Minimum Standard, but includes replacement of full-bay protection scheme including bay control units - and the addition of system monitoring	Responsible Operator, but also initiate programme for full deployment of digital substations
		£20m	£23.5m	£24.5m
	Communications	Only carry out earthwire to optical groundwire replacement when other projects are taking place	Continue with the programme of works to complete fibre optic communications to all substations	Responsible Operator, plus installation of secure Internet Protocol (IP) network connections at all substations to enable enhanced system monitoring and further IT capabilities
		£1m	£7m	£9m

\*This cost is the additional cost on top of building the new control centre, which SHE Transmission is committed to doing.

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## CONTROL CENTRE

In both exercise 1 and exercise 2, stakeholders wanted to see SHE Transmission choose the 'responsible operator' option for control centres: **“a new control centre - and establishment of control centre support team at a suitable location already having pre-prepared facilities, but displacement of incumbent staff using the site”**. However, this was marginal, as the average score, particularly in exercise 1, was close to being ranked as 'progressive network enabler'. In exercise 2, whilst the average score decreased slightly it was only by 0.09 / 2, thus only just remaining as the 'responsible operator' option.

In the discussions at the tables, whilst a number of stakeholders did feel that 'minimum standard' was sufficient as this was what the regulator stipulated, most wanted to see SHE Transmission go further, with one commenting that if a new standby facility were to become the 'minimum standard' option in twenty years' time, the company should build it in T2.

However, stakeholders recognised that ultimately it was down to cost and so, whilst in an ideal world they would choose 'progressive network enabler' to increase the resilience of the network, the significant increase in cost ruled out the 'progressive network enabler' option.

In order to help establish which option to go for, stakeholders were of the view that if the standby facility was needed frequently then it would be more appropriate to go for the most expensive option. However, it was recognised that 'frequently' could mean once in ten years. Stakeholders also made the point that when it came to cost, it was not just a question of capital expenditure and that the cost to SHE Transmission, and to customers of a long delays should also be taken into account when making a decision on the best approach.

The most common suggestion with regard to control centres was for SHE Transmission to find a way to share a standby facility with other network companies, such as SP Energy Networks and National Grid. Stakeholders asked several times whether the standby facility even needed to be in Scotland or whether there could be one located elsewhere. Nonetheless, it was noted that politically it was probably more appropriately placed in Scotland.

## CONTROL SYSTEMS

In both exercise 1 and exercise 2, stakeholders wanted to see SHE Transmission choose the 'responsible operator' option for control systems: **“replace specific identified list of hardware which is obsolete / time expired on a like-for-like basis, plus replacement of existing hardware with Internet Protocol (IP) connected, digital, compliant equipment – including cyber security measures”**. The average score hardly changed once stakeholders were made aware of the costs

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(increase of 0.02 / 2). It is important to note that there was no 'progressive network enabler' option for control systems, which means that stakeholders ranked it as highly as they were able to.

In the discussions, stakeholders unanimously agreed that the only real option was 'responsible operator' as it was critical that SHE Transmission kept up with the evolving technology in this area. In fact, several stakeholders were surprised that the company was still working with old systems. However, this decision was given with the caveat that the implications of IP connected equipment for cyber security had been duly considered.

It was felt by some stakeholders that SHE Transmission should prioritise the weakest areas of the network and start to upgrade from there in order to roll it out over the course of RIIO-T2. It was understood by some that, until there was a critical mass of IP connected, digital equipment, SHE Transmission wouldn't see the benefits of a digital network.

Stakeholders were aware that the upgrade of this network would have an impact on resilience, particularly during the upgrade process as circuits would need to be taken out in order to install IP connected, digital equipment.

Stakeholders flagged the importance of factoring in data management, as SHE Transmission needed to be able to handle all the new information coming from a digital control system. They were also keen to stress that there still needed to be ways of operating any future system manually, as there may be times when they would need to override a digital system.

## PROTECTION

In exercise 1, stakeholders generally voted for 'progressive network enabler' for protection: **“replace existing obsolete / time-expired protection equipment on a bay-by-bay basis with modern equivalents, replacement of full-bay protection scheme including bay control units, system monitoring and initiate programme for full deployment of digital substations”**. This was, again, marginal though, as it was only 0.15 / 2 above 'responsible operator'. However, once stakeholders had been made aware of how much the options cost in exercise 2, they supported SHE Transmission to go even further in this area – still voting for 'progressive network enabler', but by a clear margin. This received the highest score of all of the options presented in all four areas of the workshop. This point was made in the table discussions, where stakeholders felt the cost increase was so negligible in comparison that it was worth going for 'progressive network enabler'.

Stakeholders supported SHE Transmission taking the most ambitious approach when it came to protection for several reasons. Firstly, they recognised that existing technology was outdated (with

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some assets being 50 years old). It was felt that technology was moving so quickly in this area that, as with control systems, SHE Transmission needed to invest in order to keep up.

Secondly, stakeholders felt that whole-life cost should be considered when deciding which option to go for. Several stakeholders made the point that the latest technologies would save SHE Transmission money on protection and that a lower cost option may be more costly over time, particularly if that option still required 'boots on the ground'. One stakeholder asked whether the existing regulatory framework just encouraged investment in the lowest cost option and questioned whether this needed reforming. Another stakeholder agreed with this, feeling that five-year control periods encouraged short-term thinking. Finally, it was pointed out that there were health and safety benefits attached to digitising protections.

There were, however, some caveats put forward by stakeholders as part of these discussions. This included the concern that, as with control systems, the cyber security implications of digitising the protection system ought to be duly considered as part of this process. One stakeholder also warned of progressing too quickly, as SHE Transmission could end up installing equipment that was obsolete quite quickly given the rate at which technology was developing in this area. SHE Transmission was urged to consider the impact of the digitisation of protection on the interface between the transmission and distribution networks. There was, once again, a call for standardisation in this area.

## COMMUNICATIONS

In exercises 1 and 2, on average stakeholders voted for 'progressive network enabler' for communications: **"programme of works to complete fibre optic communications to all substations, plus installation of secure Internet Protocol (IP) network connections at all substations to enable enhanced system monitoring and further IT capabilities"**. As with protection, this was only marginal in exercise 1 (0.15 / 2 above 'responsible operator') but once stakeholders were made aware of the costs, there was resounding agreement that 'progressive network enabler' was the right option in this area.

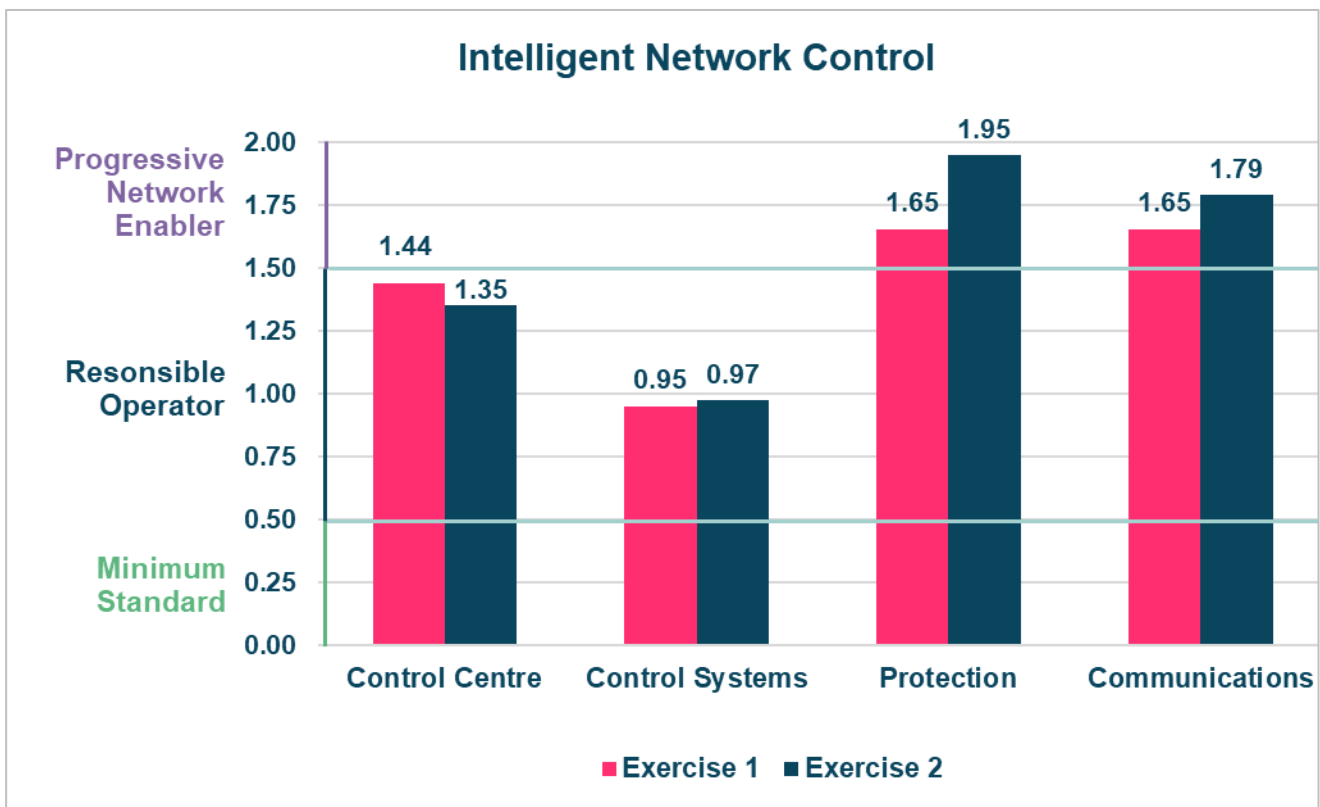
During the table discussions, it was generally agreed that SHE Transmission should take the 'progressive network enabler' approach to communications. As with control systems and protection, stakeholders felt that it was important for SHE Transmission to use the latest technologies. There was a feeling that it was right to invest now in order to have a better performing network in future – and that there would be a financial benefit to doing so, even if it was hard to quantify. It was noted that performance in this area impacted on the delivery of other areas, for example CCTV would require an upgrade of the communications system and that should be taken into account.

However, several stakeholders did express concern as regards the required scale of the progressive approach and questioned whether it was feasible to achieve this in RIIO-T2. Stakeholders urged SHE Transmission to carefully consider where to start with these upgrades, prioritising key substations at the expense of those where there wouldn't be as much benefit. Some stakeholders felt that SHE Transmission shouldn't rush into upgrading the whole network and should take a scalable approach to ensure it worked on a small scale first.

Concern was also expressed that upgrading the control system, protections and communications in parallel could put the network at risk. However, another saw the benefit in rolling everything out at the same time in order to keep costs down.

Finally, as with control systems and protection, the issue of cyber resilience was raised again as it was felt that unless it was done properly, it would make the network more exposed to cyberattacks.

The graph below summarises the results of the voting exercises (exercise 1 and 2).



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## CONTROL CENTRE

### 1) Which option do you think is best, and why?

- “The back-up facility is just that: a back-up. Unless the primary site has been completely obliterated, the plan B facility doesn’t need the same level of resources.” Connections representative
- “I would be inclined to go more towards the ‘minimum standard’ given the big difference in cost.” Energy / utilities representative
- “I don’t see why you can’t share that cost with Scottish Power.” Business representative
- “Do you have to be in Scotland to run your control centre?” Business representative
- “You can tie it in with warehousing. If you build two new warehouses, could you tie them together with control centres for economies of scale?” Infrastructure / engineering representative
- “Are we really this far behind? Try selling this to a bill payer and this would be eye-watering.” Connections representative
- “If another £12 million will secure against a day’s loss to the Scottish economy, then that’s worth it if that additional capability enables the reduction of that time by hours. It’s not a straightforward choice.” Energy / utilities representative
- “Is there a benefit to having a split site that can manage the whole system – like National Grid? Do you require your control engineers to live really close to the centre?” Infrastructure / engineering representative
- “I want to suggest another option: you’ve already got another couple of control centres in the UK. You could use one of those. Also, you could work with other energy companies like EDF.” Infrastructure / engineering representative
- “I think your back-up facility should be shared with others. It doesn’t even have to be in the UK.” Infrastructure / engineering representative
- “You’d want them in Scotland, politically.” Infrastructure / engineering representative
- “The fact that you would have to relocate staff sounds like a fairly inefficient system.” Energy / utilities representative
- “It slightly depends on how often you would need to use them. Once in hundred years, once in ten years?” Infrastructure / engineering representative
- “If something goes wrong there would be trouble.” Infrastructure / engineering representative
- “If ‘minimum standard’ is deemed as the industry standard then that should be the way to go.” Energy / utilities representative
- “You need to have additional disaster recovery.” Infrastructure / engineering representative
- “With a lot of these options it just comes down to economics. Naturally you need to go for the best option you can get but it all comes down to the economics.” Government representative



- “I asked about what the regulator requires, and the response was the ‘responsible operator’ option. So, I’d lean towards that.” Infrastructure / engineering representative
- “I have a view that a responsible operator would be the progressive network standard anyway, so why are you aiming low? The only con is the cost, so is that really a reason not to do so? Will you need to put it in place anyway in 20 years’ time, if it becomes the minimum standard in 20 years’ time? In which case you might as well do it now.” Infrastructure / engineering representative
- “The costs of a 4-week delay would be really high.” Infrastructure / engineering representative
- “My question is what the risk of this crisis happening actually is.” Academic
- “I think you need to be progressive but doubt it will cost £17 million. My issue is I feel you should be at the progressive stage already, in other words you shouldn’t need to be investing more money.” Connections representative
- “I think that ‘responsible operator’ is best because you’re not going to suddenly switch to air-insulated switchgears and so you’ll need someone to physically go over to check that the connection is closed. This cannot be done remotely. Operational restrictions play a role in whether this needs to happen and has a bearing on my decision.” Connections representative
- “A new control room is a must, irrespective of which option you choose.” Connections representative
- “Do SP Energy Networks and National Grid have backups? Could you share them?” Infrastructure / engineering representative
- “If there is a fire, how would your network operate? Could you operate from another control room?” Infrastructure / engineering representative

## CONTROL SYSTEMS

### 2) Which option do you think is best, and why?

- “For me, the only viable option here is ‘responsible operator’.” Infrastructure / engineering representative
- “What about the cyber security implications of having more IP connected devices? You are increasing your risk in that area.” Energy / utilities representative
- “You have to go digital.” Infrastructure / engineering representative
- “That technology has been out for a while. I’m surprised you’re still working with Microsoft.” Connections representative
- “Minimum standard is a non-option.” Energy / utilities representative
- “You need to avoid a constant cycle of replacement.” Infrastructure / engineering representative

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- “You have to pick your weakest link and bring that up to date because it’s a network, so it’s a case of prioritising.” Infrastructure / engineering representative
  - “This domain is rapidly changing. It’s moving over to digital substations, and if you’re not careful, if you don’t move forward, you’ll be effectively going on smoke signals compared with the current technology, so you need to go to the ‘responsible operator’ option just to keep up with the times.” Infrastructure / engineering representative
  - “It’s the future, so perhaps you should do it on a scheme-by-scheme basis with a five-year plan to see how it will work. You could also scheme-manage it.” Infrastructure / engineering representative
  - “This also feeds into resilience because if you have to take out a circuit to do work, you’re taking out infrastructure and creating a wider risk.” Infrastructure / engineering representative
  - “I thought that, without the critical mass, you wouldn’t see the benefits of a digital network.” Infrastructure / engineering representative
  - “Assuming the IP upgrade is inevitable, all this is about is investing now or later, though there is a risk of the system being obsolete by the time it is installed.” Academic
  - “Digitalisation is the way forward, but it needs to be possible to operate the systems manually too. You need to strike a balance.” Academic
  - “You need to factor data management into this. If you have too much, it can be a hindrance for you. There’s so much to wade through.” Connections representative
  - “We rely on systems to analyse everything and take care of any issues, but we need to have some human controls in place to ensure that we don’t miss anything. If you lose control of the system, can you send out a human team to deal with it?” Academic

## PROTECTION

### 3) Which option do you think is best, and why?

- “IEC 61850 is the way the world is going. If we all adopt it then it will drive down the costs of providing protection.” Energy / utilities representative
- “I appreciate that all this isn’t about bringing in digital technology for technology’s sake. It’s because you’re going to save huge costs, so I can see why you’re doing this.” Infrastructure / engineering representative
- “Yes, but you can future proof things now and then by the time it gets to the future it’s obsolete. I think there’s a happy medium between ‘responsible operator’ and ‘progressive network enabler’.” Business representative
- “I chose ‘responsible operator’ initially, but now I’ve seen that it’s only an incremental price increase to ‘progressive network enabler’ I have changed my mind. The caveat being that the

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cyber security related risks of having more IP connections needs to be considered.”

Infrastructure / engineering representative

- “It is all about the whole-life cost versus manned life cost. You have to reduce your costs with fewer boots on the ground.” Infrastructure / engineering representative
- “The protective relay in the black box is nearly 50 years old. Whatever is available today, do it.” Infrastructure / engineering representative
- “How much of this decision-making about technology is made in consideration of the interface between transmission and distribution?” Infrastructure / engineering representative
- “There are health and safety benefits to digitalising the network.” Connections representative
- “There could be an issue with relying on various systems from different companies. For example, when the tsunami hit Japan, there were some instances where they couldn’t get the parts they needed.” Infrastructure / engineering representative
- “Given the small difference in cost of £1 million between ‘responsible operator’ and ‘progressive network enabler’, I would upgrade to progressive.” Infrastructure / engineering representative
- “It’s a rapidly moving domain and there’s so much that can be done so it would be foolish not to go down the ‘responsible operator’ route.” Infrastructure / engineering representative
- “You have to improve your protection if you are going to have your bay units. It’s the best time to enhance the entire system. It also makes sense from a cost perspective.” Connections representative
- “SSE is bringing its protection systems into the modern world, but National Grid is still sitting in the 1970s when it comes to protection.” Connections representative
- “You are incentivised by the regulator to take the lowest cost option, rather than consider the whole-life cost. Do you feel the mechanisms are good enough? Do you just pick what is low cost now as a priority?” Government representative
- “I think one of the issues here is Ofgem’s price control period. It limits long-term thinking if you’re always having to think in terms of five-year periods.” Infrastructure / engineering representative

## COMMUNICATIONS

### 4) Which option do you think is best, and why?

- “CCTV requires bandwidth, so if you’re going to increase the amount of CCTV in order to monitor sites, you need to increase connectivity.” Business representative
- “From my side of things, National Grid has dipped in and out of communications but historically we always struggled with balancing two different licenses.” Energy / utilities representative
- “Looking at the costs, I say take the hit now and make the network perform better in future.” Infrastructure / engineering representative

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- “Is there a plan to combine new tech and old tech? Are they compatible?” Academic
  - “To not do it is stupid. Go for it.” Infrastructure / engineering representative
  - “Take a scalable approach. Avoid stranded investments. Rather than a one-off purchase of a massive system for long period of time, start small and engage with the supply chain. Don’t buy something you can’t then join up or requires you to do everything at once or an end-to-end investment.” Infrastructure / engineering representative
  - “There’s no fully digital substation in the UK.” Infrastructure / engineering representative
  - “My observation is you don’t have a mix and match option here. There will be some wee substations where there won’t be as much benefit.” Infrastructure / engineering representative
  - “Pick where we get the most benefit.” Infrastructure / engineering representative
  - “Is your strategy ‘we’ll do them all’ or ‘we’ll do the key ones’?” Infrastructure / engineering representative
  - “I think under ‘responsible operator’, where to start would be the challenge to do that in five years.” Energy / utilities representative
  - “It might take two or three price control periods.” Energy / utilities representative
  - “The actual implementation is a very risky time, if you’re doing all these things in parallel. If you have a high level of upgrades taking place on your network at the same time – is it practical?” Infrastructure / engineering representative
  - “The cost of doing stand-alone work here is disproportionately higher than if you do the work while you’re there.” Infrastructure / engineering representative
  - “All of these activities could have a financial benefit that’s tough to quantify.” Academic
  - “Communication seems to be critical to a lot of this smart grid system. So, it feels like there needs to be a focus, and [it] needs to be brought up to modern standards ASAP.” Government representative
  - “You don’t want to expose your system to external cyber security attacks.” Connections representative
  - “The more that we move into real time, the more exposed we are. People can find a back door and operate our equipment without our permission.” Academic

## MANAGING AND STORING OUR MATERIALS

### SUMMARY

This topic was presented by Sandy Gourlay, Logistics Manager at SHE Transmission. Sandy's presentation was split into two parts. The first was about 'warehousing' and SHE Transmission's approach to storing their materials. Three options were given, ranging from having one standard warehouse to having two sets of twin warehouses, plus a full operations centre. The second part of the presentation covered SHE Transmission's proposals for their site security for RIIO-T2. Again, Sandy discussed a range of options. A summary of all the options in relation to managing and storing our materials can be found in the table below.

		Minimum Standard	Responsible Operator	Progressive Network Enabler
Managing and Storing our Materials	Warehousing	Standard single-warehouse	Two sets of twin-warehouses (bundled and non-bundled) - one north and one south	Responsible Operator, plus a full operations centre adjacent to main warehouse
		£12m	£36m	£38m
	Site Security	Comply with current procedures: 2-yearly substation risk inspections and 4-yearly inspection of overhead line towers. Replacement of ageing CCTVs	Minimum Standard, plus upgrading all remaining substations to palisade fencing	Responsible Operator, plus full CCTV and building alarm systems - and on-going helicopter inspections to monitor overhead lines
		£5m	£8m	£12.5m

### WAREHOUSING

In both exercise 1 and exercise 2, on average stakeholders wanted to see SHE Transmission choose the 'responsible operator' option for warehousing: **“two sets of twin warehouses (bundled and non-bundled) – one north and one south”**. In exercise 2, once stakeholders had been made aware of the costs, the average score decreased and whilst it remained at 'responsible operator', it went down by 0.26 / 2, which was the largest decrease across any options at the workshop.

This was borne out in the table discussions, where stakeholders generally supported SHE Transmission going further than the 'minimum standard'. To help inform their decision, stakeholders wanted to understand the main driver for holding spares – whether it was to facilitate regular maintenance of assets or to respond to emergencies.

There was recognition that having spares close by was important in emergencies as it reduced the length of outages by accelerating SHE Transmission's response time. Stakeholders were therefore

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generally supportive of having two warehouses – one in the north and one in the south. In terms of locations, one stakeholder did urge SHE Transmission to consider the weather as storms could make a warehouse inaccessible.

Another reason that stakeholders wanted to see SHE Transmission go beyond ‘minimum standard’ was because there was a financial cost associated with outages, which helped offset the capital investment required to build new facilities. They also recognised that the current approach, which relied heavily on third parties to supply spares as needed, also came at a cost which should be considered against the cost required to build new warehouses.

It was, however, pointed out that the increase in cost between ‘minimum standard’ (one warehouse) and ‘responsible operator’ (two sets of twin warehouses) was significant. This may account for the sizeable decrease in overall score when the costs were made known to stakeholders, as some may have opted to reduce their choice to ‘minimum standard’, bringing down the overall score.

Whilst the consensus therefore appeared to be ‘responsible operator’ for warehousing, several stakeholders did comment that rather than just building new warehouses, there also needed to be a focus on having good records and properly documenting the spares that were being held.

A common theme raised by many of the stakeholders was the need to consider a ‘spares club’, coordinating the sharing of spare assets with others in the industry (such as National Grid or Scottish Power) or even, according to one stakeholder, further afield with the oil and gas sector. In order to make this possible, several stakeholders pushed for standardisation across the industry. SHE Transmission was urged to look to National Grid for best practice, as it was felt they were leading the way on spares management. The suggestion was also made to look at examples from abroad, particularly from France.

One supply chain representative asked SHE Transmission to ensure that they engaged early with third parties, stating that if they better understood their strategy and requirements in relation to spares then the supply chain would be able to deliver better value.

Stakeholders wanted to see SHE Transmission take an innovative approach to the storage of spares, for example by looking at mobile transformers. The pace of technological change in the industry was noted by several of them, who said that any new warehouses would need to be able to store all the new equipment that was emerging.

There were several specific comments made in relation to the storage of transformers. The question as to whether transformers needed to be stored inside at all was raised.

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Whilst there weren't many comments about 'progressive network enabler', one stakeholder did say that they didn't feel a full operations centre needed to be adjacent to a warehouse, as having logistics experts alongside the people that worked in the operations centre wouldn't necessarily drive any efficiencies. This may explain why the score was not higher overall despite a relatively small increase in cost between 'responsible operator' and 'progressive network enabler'.

## **SITE SECURITY**

In both exercise 1 and exercise 2, on average stakeholders were marginally in favour of SHE Transmission choosing the 'progressive network enabler' option for site security: **"comply with current procedures, upgrade all remaining substations to palisade fencing, plus full CCTV and building alarm systems – and on-going helicopter inspections to monitor overhead lines"**. In exercise 2, once stakeholders were made aware of the costs, the average score stayed almost the same (increased by 0.01 / 2).

The reason given by stakeholders for choosing the most ambitious option was that no price could be put on people's safety and the SHE Transmission should be doing all they could to protect it. There was also a recognition that poor site security led to a higher risk of network failure, which could lead to extended outages and high costs for the end consumer. To help them decide, stakeholders were interested in understanding how often break-ins took place and whether they were mainly in urban or rural locations.

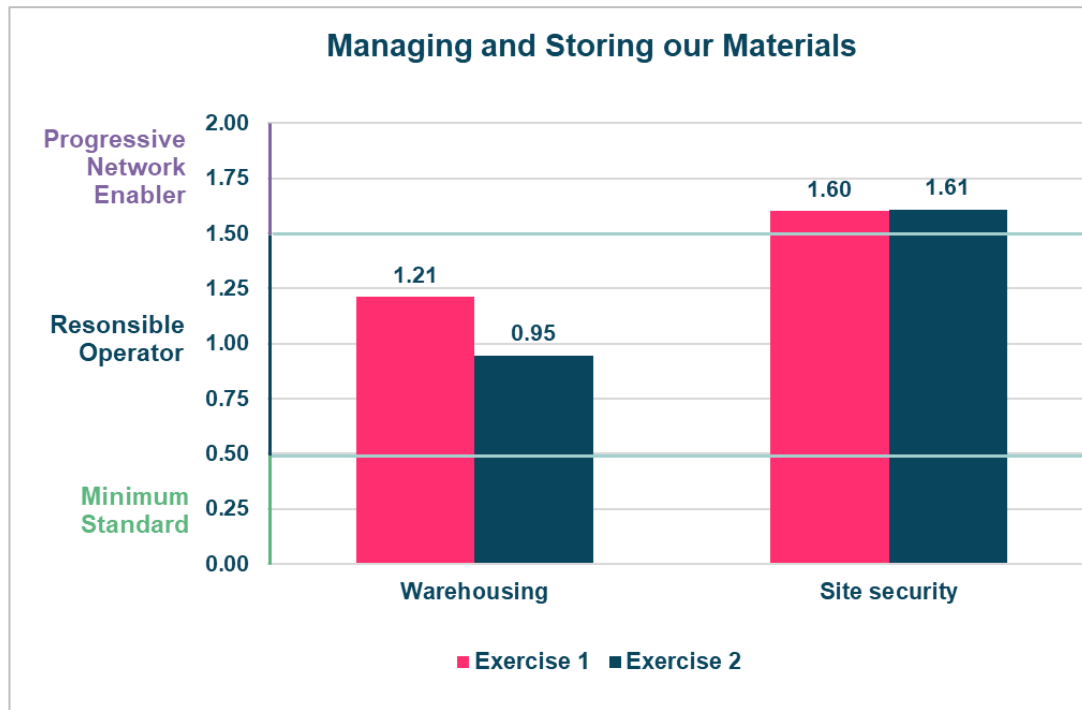
It was generally felt that just upgrading the fencing was not enough, as people would still be able to get in. Instead, there was consensus that the company should invest in CCTV at all of its substations, although one stakeholder questioned whether this was contingent upon having upgraded communications as well. Another stakeholder noted that installing CCTV, which is light sensitive, may lessen the need – and minimise the cost – of running floodlights.

There was less consensus on the role of helicopters in site security. Some stakeholders felt it was essential, particularly given the vast geographic area that SHE Transmission must monitor, and it was felt that drones could only monitor one overhead line at a time. However, others urged SHE Transmission to use drones to monitor overhead lines as it was felt that this was far more cost efficient and that money could be better spent elsewhere, for example having patrols at substations.

It was suggested that perhaps a hybrid option was sensible in which higher risk substations received more security investment than those that posed a lower risk. Other comments included the need for SHE Transmission to look to influence asset policy, for example specifying certain materials to be used

in assets that were less attractive to thieves. Stakeholders also urged SHE Transmission to get involved in preventing the sale of stolen material, as that would help reduce the number of break-ins.

The graph below summarises the results of the voting exercises (exercise 1 and 2).



## WAREHOUSING

### 1) Which option do you think is best, and why?

- “I think that mitigating the risk of suffering catastrophic failures far outweighs these operational costs.” Infrastructure / engineering representative
- “I would argue that the minimum standard isn’t working as things stand. SHE Transmission acquired an old hydroelectric network and there aren’t adequate assets to deal with outages, so it takes too long.” Infrastructure / engineering representative
- “I struggle to see why there isn’t coherence across the industry regarding storage and how things operate. Cable storage is sometimes shared but what about transformers? If it’s an extra £24 million for a storage facility, why wouldn’t you talk to your neighbour?” Business representative
- “You’ve been ‘begging, stealing and borrowing’, as the presenter said, to make things work. There’s a cost attached to that. Is there a bigger cost attached to the alternative?” Connections representative
- “It is important for the supply chain to hear about your strategic spares, what that looks like, who wants what. If there’s a failure and we’ve not had this conversation it is damaging, as we



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can be supplying the customer and might not have the spares that you need. Coordinating with SPEN and National Grid would be a good way to work. By having early engagement, it's easy for us to give best value rather than getting a last-minute call to get something over from Sweden tomorrow." Infrastructure / engineering representative

- "I would encourage TOs to adopt an innovative approach to the storage of spares. There are mobile transformers available now for transmission and distribution, rather than just only the standard stock." Infrastructure / engineering representative
- "Would you prefer one central point? You would want half a dozen insulators and conductors closer to hand potentially. It isn't just a quick drive to everywhere." Business representative
- "My first comment would be that we're moving into a new world of assets. The storage of spares is going to require certain environmental conditions, etc." Energy / utilities representative
- "Do you really need cable readily available? My point about the cable is: does it need to be in your territory?" Infrastructure / engineering representative
- "From a layman's perspective, it seems like you're hitting all your targets so it's a question of: is it really broken, and therefore do you need to fix it?" Connections representative
- "Why are you putting transformers that generally sit outside inside?" Infrastructure / engineering representative
- "It's important to consider weather, too: what if you can't get to one?" Infrastructure / engineering representative
- "Have you looked at tying up with Scottish power? There's a spares club, isn't there? I understand you need something in Scotland, but it could still be coordinated." Infrastructure / engineering representative
- "The challenge is that National Grid have standards, SSE have standards, and they're not aligned, so it's difficult to form alliances. It's a fine balance." Infrastructure / engineering representative
- "Have you looked at oil and gas, because they get spares, and they are very good at the logistics of moving spares very quickly between locations. The specs are different, but it's about managing the logistics." Infrastructure / engineering representative
- "It's interesting to look at what the French industry are doing." Connections representative
- "What do you think the main driver is? Do you have spares on hand for regular maintenance, or is it mainly focused on emergencies?" Infrastructure / engineering representative
- "You can't put everything in one location because that's impractical." Infrastructure / engineering representative
- "It seems the minimum requirement is not fit for purpose, so it automatically needs upgrading." Academic

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- “Documentation and control is vital, and so is standardisation, so I’d be curious to know what your plans are here.” Infrastructure / engineering representative
  - “I’m on the fence here because it might not even be necessary to put your transformers inside.” Energy / utilities representative
  - “Does the same branch deal with distribution spares?” Infrastructure / engineering representative
  - “There is a surprising leap in cost between the minimum requirement and being responsible.” Infrastructure / engineering representative
  - “I would say that National Grid are moving the goal posts when it comes to asset storage.” Infrastructure / engineering representative
  - “By having them north and south of the patch, it helps SHE Transmission’s reaction times in the event of power outages.” Academic
  - “Technological change has sped up unbelievably in the last five years and these warehouses must be fit for use with all the new equipment that is emerging.” Connections representative
  - “SHE Transmission needs to make greater efforts to store its assets as best as it can, rather than building new warehouses.” Infrastructure / engineering representative
  - “There needs to be standardisation.” Infrastructure / engineering representative
  - “Are your standards close enough, so yours are relatable to another TO’s?” Connections representative
  - “From a cable point of view, if you’re talking about saving, the SSE designs for cables are more conservative than others.” Infrastructure / engineering representative
  - “I am not sure about the efficiency of putting the operations centre adjacent to the main warehouse. You have people who are experts in logistics working alongside other experts, which just isn’t conducive to efficiency.” Infrastructure / engineering representative

## SECURITY

### 2) Which option do you think is best, and why?

- “Speaking from a personal point of view, SHE Transmission should be doing all it can to protect the people of our nation.” Energy / utilities representative
- “I think they should do helicopter video surveys of the topography so that they have photo evidence of the issue in question. That’d be much better than flying over the line and inspecting it. They could repeat it every 10 years and when a new contract is commissioned, SHE Transmission can hand over that data.” Infrastructure / engineering representative
- “In terms of CCTV, modern equipment is much more light sensitive. Installing more CCTV would reduce the costs of running floodlights.” Business representative

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- “How often do you get security threats, people breaking in?” Academic
  - “Are the forced entries mainly in urban or rural areas? It sounds like it’s more planned break-ins rather than the general public wandering in. Is a secure site really possible to properly protect against a burglary?” Business representative
  - “I’m for the third option [‘progressive network enabler’] to chime with the recent Cabinet Office report. The risk of network failure [is] not just due to copper theft, but people wrecking the substation. It probably will never happen, but if someone decides to destroy a transformer in a northern site it could be power off for extended time and cost for consumers, when for a small cost, you could align yourself to the UK-wide risk appetite.” Infrastructure / engineering representative
  - “Can drones not do the same as helicopters?” Connections representative
  - “The nature of the more remote locations is that the chance of there being a security breach is lower.” Energy / utilities representative
  - “There are opportunities here for drone technology, as they hugely reduce inspection times and costs.” Energy / utilities representative
  - “Is the CCTV contingent upon having updated communications to the substations?” Infrastructure / engineering representative
  - “You need influence asset policy, so specifying, for example, less attractive materials to steal.” Infrastructure / engineering representative
  - “I do question the cost of using helicopters over people and wonder if having people patrolling your facilities is a better alternative.” Infrastructure / engineering representative
  - “If you’re not careful, you could end up with a potential threat to life. Cameras give a good digital record and protect the business because they demonstrate your duty of care.” Infrastructure / engineering representative
  - “The fact is a fence is a fence, so people could easily get in.” Connections representative
  - “Palisade fencing must be the minimum requirement. Beauty has chain-link fencing, and that seems archaic.” Infrastructure / engineering representative
  - “I would get rid of the helicopters personally.” Connections representative
  - “If there was a cost-saving option somewhere, maybe a hybrid option would be best? Obviously, security is highly important, but it’s not equally critical across all areas. A phased approach might be the most desirable.” Government representative
  - “With helicopters, you’re using your range more efficiently. You can only travel along one line at a time with a drone. Until drones are made more efficient in their movements, helicopters are without a doubt the best way to go.” Connections representative
  - “Palisade fencing is not enough. SHE Transmission needs CCTV as well.” Connections representative

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- “The helicopters are the only option for Scotland, due to its large area. The drones are worth exploring though.” Connections representative
  - “If you feel you ought to go beyond the standard, are you arguing that the minimum standard ought to be raised?” Government representative
  - “How long does it take to access some of your remote substations if there has been a security breach?” Infrastructure / engineering representative
  - “Is there any work on stopping the sale of stolen material?” Infrastructure / engineering representative
  - “I think from our point of view, there’s no such thing as too much money on security. If that security could prevent one person being killed, how much is that worth?” Business representative
  - “If I had to choose between spending that money on warehousing or security, I'd definitely hands down choose security.” Infrastructure / engineering representative

## OUR ASSET REPLACEMENT PROGRAMME

### SUMMARY

This topic was presented by Euan Philips, Asset Engineering Manager at SHE Transmission. Euan started his presentation with an overview of the proposed asset replacement programme for RIIO-T2. He then spoke through three case studies of instances where SHE Transmission could consider bringing forward investment from T3 into T2 in order to: replace SF6 in switchgear; front-load civil works to minimise future disruption in sensitive locations; and safeguard land for future expansion of operations. Whilst the table discussion focused on these case studies, the option that stakeholders were asked to vote on in exercises 1 and 2 was the overall principle of bringing forward investment into T2. The option for the asset replacement programme can be found in the table below.

		Minimum Standard	Responsible Operator	Progressive Network Enabler
Our Asset Replacement Programme	Asset Replacement	Replace or refurbish assets forecast to fail during T2, bringing them up to current specifications	Bring T3 enabling works forward when carrying out T2 works	
		£638m	£749m - £949m	

In both exercise 1 and exercise 2, on average stakeholders wanted SHE Transmission to choose the 'responsible operator' option for its asset replacement programme: **"Bring T3 enabling works forward when carrying out T2 works"**. In exercise 2, once stakeholders had been informed of the cost of this, this average score decreased, albeit by an almost imperceptible margin. Stakeholders did, however, comment that there was a big leap between the costs in the minimum standard option and those for responsible operator, adding that certain works should be looked at on a case-by-case basis.

### REPLACING SF6

When stakeholders were asked to consider whether the company should replace SF6 where appropriate, irrespective of the cost, the general feeling was that they should. Whilst it was acknowledged that the gas was very good at what it does, it was felt that its impact on the environment, as a gas 23,000 times more potent than CO2 and which lasts in the atmosphere for over 36,000 years, meant that it should be avoided and replaced wherever possible. It was, however, commented by some that Government policy should dictate the company's approach and that SHE Transmission should therefore seek to use the most cost-effective option.

Given the cost implications, stakeholders were keen to discuss the pros and cons of the alternatives to SF6, along with their viability and impact on the environment. It was widely felt that if these

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alternatives were better for the environment, equally as reliable and not prohibitively expensive, they should be used wherever possible.

### **CONSTRUCTION IMPACT AND ENABLING WORKS**

When stakeholders were asked whether they agreed with the idea of bringing civil enabling works forward from T3 to T2, there was broad support for the view that this was a good idea. Most thought that the best approach should be to front-load investment for a number of reasons. Aside from issues relating to improving resilience, it was also felt that investing now may be more cost efficient in the long term, given the potential for increases in costs due to inflation. It was, however, cautioned that improvements in technology may mean that it would be more astute to delay spending money on certain works as costs may decrease in the future. It was, however, commented that, wherever possible, speculative spending should be avoided until the company was in a position to base its decisions on robust analysis.

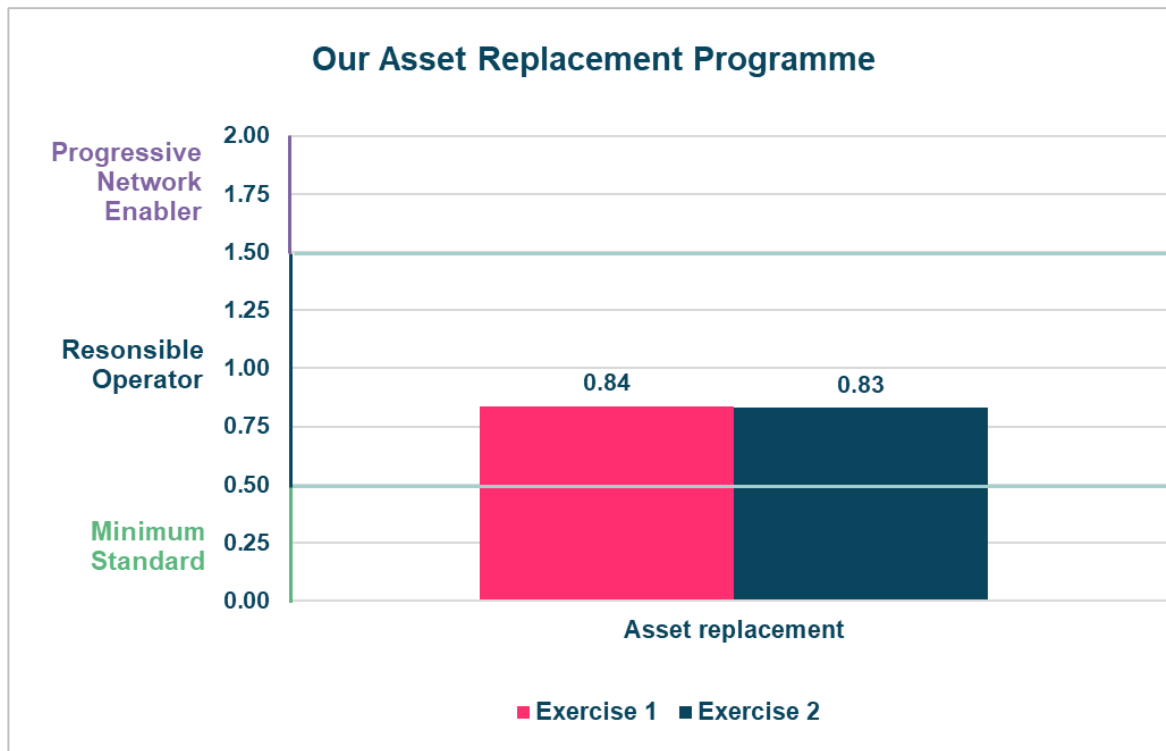
When asked whether SHE Transmission should go a step further and replace all its actual assets in T2 rather than T3, stakeholders made many of the same points. They tended to feel that early investment was the best approach. However, it was widely commented that this need not be a binary decision and that asset replacement ought to be considered on a case-by-case basis, as some assets, although older, may not necessarily be nearing the end of their lives. It was also noted that certain newer assets may have built-in obsolescence, so may not last as long as certain older assets.

### **SAFEGUARDING LAND FOR FUTURE GROWTH**

Stakeholders were generally of the view that SHE Transmission should purchase land now if there was a chance that this land would be needed in the future. It was commented that land prices tended to always rise in value so, if this land was not needed, it could always be sold, and at a profit. It was acknowledged that, although there may be situations where the company was able to compulsorily purchase land, this was often expensive, so the best approach should be through option agreements negotiated with landowners.

In general discussions on the merits of replacing assets in T2 rather than T3, stakeholders were in favour of the principle but thought that, where possible, monitoring should be improved to ensure that assets were not replaced needlessly or too soon. It was added that recent advances in technology would ensure that this could be done in a way that was not too costly for the company.

The graph below summarises the results of the voting exercises (exercise 1 and 2).



## REPLACING SF6

### 1) Should SHE Transmission replace SF6 where appropriate despite the cost on the basis it is the sustainable thing to do?

- “You could argue that SF6 was the best thing ever invented but clearly it’s awful for environment when it leaks.” Infrastructure / engineering representative
- “As a technology provider, this is a journey we’re currently on. There are huge regulatory and environmental pressures, so we recognise that it is coming and we’re looking to the future as to how we can prepare for that.” Infrastructure / engineering representative
- “My company has a pilot installation which has been going for a few years. What we need is something commercially viable for the market.” Infrastructure / engineering representative
- “It would be interesting to hear about the carbon footprint of actually replacing them, for instance isolating the gas. I personally have no idea of the cost of doing that. We need to make sure that the carbon footprint is being evaluated and we need to be presented with a fact rather than a bouncing fact.” Business representative
- “I don’t know a lot about the alternatives. How safe are they? What are they? Are they only slightly less dangerous?” Academic
- “Different manufacturers have all taken a different approach as the game is changing. It’s fairly mixed at the moment.” Infrastructure / engineering representative

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- “Ofgem are tasked with incorporating sustainability into their plans but I haven’t seen them do that yet. How would SHE Transmission make that case to Ofgem and how would it be evaluated?” Business representative
  - “You can’t ignore SF6 and the harm it does to the environment. There are other options there. Are there new innovations being looked at?” Infrastructure / engineering representative
  - “Regardless of what we think, are you not under pressure from the Government to do something about it?” Connections representative
  - “This is an industry problem, not an SSE problem.” Infrastructure / engineering representative
  - “The question is, should you do it irrespective of the cost?” Infrastructure / engineering representative
  - “There’s a parallel with plastics. In the 70s and 80s everything was plastic, and they said it was better because we weren’t burning wood, but now we know plastics are harmful.” Infrastructure / engineering representative
  - “SF6 is a horrendous gas, it lasts in the atmosphere for 3,600 years.” Infrastructure / engineering representative
  - “South Korea has already banned SF6, so it’s a matter of time.” Infrastructure / engineering representative
  - “We use a gas called GQ that’s 99% less risky than SF6. We’ve got some in Scotland too.” Infrastructure / engineering representative
  - “There is still a procurement discussion to be had about this from SSE’s point of view, and so there is a commercial issue as to who will actually deal with this.” Infrastructure / engineering representative
  - “The case study suggests that it’s a no brainer, but it’s not black and white. You need to think about reliability, which can be affected by the works. SHE Transmission needs to find a way to enable the substations to continue their good work.” Academic
  - “The legislation will come in place to force us to make this change as part of the process for hitting carbon reduction targets.” Academic
  - “Enforcement of environment policies for us contractors is huge. [With] legislation, we need to not disturb the communities. It would make sense to replace assets, especially when you know it’s a problem. Is there a way to replace the current SF6s with different gasses, so [that there is] a compromise position?” Connections representative



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## CONSTRUCTION IMPACT AND ENABLING WORKS

### 2) What do you think about the principle of bringing forward civil enabling works into T2 from T3?

- “I think it’s a good idea. You might as well take the hit at the beginning. If you know you’re going to have to do it, get everything up and running and prepare for the future. I’m really not in favour of a piecemeal approach. Also, Ofgem should reward that kind of forward thinking. You should get brownie points for thinking ahead and investing in the future.” Infrastructure / engineering representative
- “There’s economies of scale and inflation over a five-year period. Why not do it now? You’ll have to do it in T3 anyway.” Infrastructure / engineering representative
- “It’s a case of planning ahead so that you’ve got the strategy now, then the future design is ready so you can just press the button.” Infrastructure / engineering representative
- “Why run two substations when you could decommission one?” Infrastructure / engineering representative
- “It is efficient to intervene before the asset has completely gone.” Energy / utilities representative
- “You are better off spending the money now rather than spending more later.” Infrastructure / engineering representative
- “If you know you’re spending it anyway, that’s fine, but I would avoid speculative spending. I assume you are acting based on what you can see coming.” Energy / utilities representative
- “If you try to remove costs, is SHE Transmission sure that it can replace the last two within five years or will technology have overtaken its system and force it to invest further in yet more new technology?” Infrastructure / engineering representative
- “Waiting can also be an opportunity for SHE Transmission to invest in new technology.” Infrastructure / engineering representative
- “You said they were quite close, if there is two with concerns and one goes off, it’d have an impact on the next one. You’d have lost a whole area.” Connections representative

### 3) Should SHE Transmission go a step further and just complete all the works i.e. replace the actual assets in T2 rather than T3?

- “If you can demonstrate that you’re making it more efficient then you should.” Energy / utilities representative
- “There’s a real issue with the gap going from ‘minimum’ to ‘responsible operator’ for replacing assets. It feels like a big leap.” Infrastructure / engineering representative

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- “You've got to look at risk, cost, and get biggest bang for buck. There will be some sites where it's worth it and some where it might be nice but it's not essential.” Infrastructure / engineering representative
  - “With long-term planning, there's a big risk that your technology can be scrapped.” Connections representative
  - “Regarding the proposal to acquire additional land next to the Hydroelectric Plant in Sloy, I think it's a no-brainer. SHE Transmission can buy it and then there's always the option of selling it on.” Business representative
  - “I'd go right down the middle and replace assets on a case-by-case basis.” Infrastructure / engineering representative
  - “I agree. It shouldn't have to be a binary choice. There will be things that you can bring forward while you're working on something.” Energy / utilities representative
  - “Has the assessment been done already? If you started this in T2, by [the time] T3 comes you wouldn't be breaking ground for some years afterwards.” Business representative
  - “Ofgem need to realise it's all going to have to be replaced at some point. It's important to set this out. For willingness to pay by the consumer, it would be interesting for us to understand how many assets are like that and can we bring works forward whilst looking at the monetised risk?” Infrastructure / engineering representative
  - “It's a case of minimising costs and maximising efficiencies now.” Energy / utilities representative
  - “I'm sure there are cases where it makes sense to do it in T2, but doing it across the board probably isn't practical.” Infrastructure / engineering representative
  - “The lifespan is supposed to be 40 years and some of them are 50 years old. There are problems with leaking, things like that.” Infrastructure / engineering representative
  - “There's a problem with planned obsolescence these days, which means it's sometimes better to leave an old asset in place that's working fine rather than replace it with a new asset that won't last as long.” Infrastructure / engineering representative
  - “From a practical point of view, I understand you might not replace an asset with five or six years left in it. However, the process for having civils in place must be included in the first build. Otherwise, additional civils will be costly. It will also look like a more managed process.” Infrastructure / engineering representative
  - “If there's a 70% chance of a project going ahead, I'd say yes. Below 40%, I would say no.” Infrastructure / engineering representative

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## SAFEGUARDING LAND FOR FUTURE GROWTH

### 4) Future expansion is possible but not certain. During T2 work, should SHE Transmission safeguard land possibly at a lesser cost despite not having certainty they will need it?

- “Absolutely, every time.” Infrastructure / engineering representative
- “Regarding the proposal to acquire additional land next to the Hydroelectric Plant in Sloy, I think it’s a no-brainer. SHE Transmission can buy it and then there’s always the option of selling it on.” Business representative
- “Yes, because if someone comes along and builds a house or road where you’d planned to put a substation, then you’re scuppered.” Infrastructure / engineering representative
- “I would say you’ve got to have a strong, mature plan before you agree to do that future-proofing, otherwise you end up using land as a temporary storage site if there’s no plan in place.” Infrastructure / engineering representative
- “Some kind of negotiated sale whereby land is purchased but not used immediately could be an option.” Infrastructure / engineering representative
- “There are certain parts of the system where that land becomes quite valuable. Things are changing so quickly.” Energy / utilities representative
- “You should buy the land while it’s cheaper and monitor the deterioration, condition, criticality of it.” Infrastructure / engineering representative
- “The land isn’t valuable until someone wants it.” Infrastructure / engineering representative
- “You won’t get any more bargains as the farmers will see you coming.” Energy / utilities representative
- “The first time the farmer sells land, he may be happy, but the next time, he will want more because he will have been told he could get more.” Energy / utilities representative
- “It would depend upon the cost of the land being safeguarded.” Infrastructure / engineering representative
- “Potential deals on land will drive up the price exponentially.” Infrastructure / engineering representative
- “The time that it takes for the deal on an energy project to go through will leave time for the price to skyrocket.” Infrastructure / engineering representative

## OVERALL

### 5) Should SHE Transmission bring forward investment in T2 rather than waiting until T3?

- “Yes, it makes sense.” Infrastructure / engineering representative “

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- Looking at asset replacement, that's where the debate is. You're only talking about £80-90 million across the rest of the others. If you can deliver this one for just over £700 then you'll save enough money to do all of the rest too." Infrastructure / engineering representative
  - "We were working in the east coast before this, at the time we were converting, that was planned over a period of two years. As a contractor, it is impossible, the changes everywhere, it's hard with all these populations. It's more digital." Infrastructure / engineering representative
  - "Going back to a progressive network, you need to consider what you can do to be progressive. It's about fully understanding the condition of your assets, and I don't think anyone does at the moment. So, you should be spending on intelligence to know with certainty that you've spent this much on this asset and how long it's going to last. There's clever stuff out there that's not necessarily costly, that you can use to monitor your assets. Because you're basing your decisions on what you know at the moment, which might not necessarily reflect reality. There's space for being cleverer about what your assets are doing. Avoid spending money where you don't need to. It closes the circle." Infrastructure / engineering representative
  - "Your comment about manufactured obsolescence is very valid." Infrastructure / engineering representative
  - "If you've got an asset that's coming up to 10 years, I'd start monitoring it, including looking at safety for the public, passers-by, if it's critical to the network, so it should be more like gas monitoring." Infrastructure / engineering representative
  - "If it enables work for buying land and digging up roads for cables to go ahead, I would be in favour of it, as it doesn't cost much and will provide instant results. I would be more concerned about when SHE Transmission intends to spend more on its asset, but you don't know how much you would get out of it." Infrastructure / engineering representative

## BLACK START AND NETWORK RESILIENCE

### SUMMARY

Ian Brown, Substation Engineer at SHE Transmission, presented this session. It was split into two parts. This first part covered the investment options the company is considering to prepare for a black start situation on the network. This included a discussion of both the autonomy and restoration standards. The second part of the presentation covered some of the ways in which SHE Transmission could improve network resilience, largely by installing switchgear. The table exercises only voted on the options for black start in this session, as there weren't specific costed options for network resilience.

		Minimum Standard	Responsible Operator	Progressive Network Enabler
Black Start and Network Resilience	Black Start	Upgrade generators and batteries across the network to meet 72-hour autonomy standard	Minimum Standard, plus network tools to support system stability so that restoration time is improved	
		£50m	£250m	

### BLACK START

In exercises 1 and 2, on average stakeholders wanted to see SHE Transmission go for the 'responsible operator' option for black start: **“upgrade generators and batteries across the network to meet 72-hour autonomy standard, plus network tools to support system stability so that restoration time is improved”**. However, in both exercises, the average score was at the lower end of 'responsible operator' and when stakeholders were made aware of the cost, the average score went down by 0.17 making it even more marginal. It should be noted that there was no 'progressive network enabler' option for black start.

Overall, stakeholders wanted to understand more about the likelihood of a black start situation and the length of time it would take for the network to be restored. They were aware, however, that the risk of a black start was increasing and that there was a need to be prepared. They recognised that the major cost implications of a black start situation, including the economic cost, needed to be taken into consideration when planning the level of investment in this area. Several stakeholders wanted to see greater collaboration on black start contingency planning with the other TOs.

In terms of the proposed 'minimum standard' approach, whilst they recognised the need for a back-up system, stakeholders expressed concern about the use of diesel generators and batteries. Firstly, this was because of the impact of this equipment on the environment. They were also concerned about the safety implications of batteries, as well as the amount of space they take up. Many of the comments

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focused on the need to adopt newer technologies in this area to avoid having to rely on old generators and batteries. This included considering alternative means of generation, including distributed sources as a more progressive way to back-up the grid.

In general, stakeholders supported SHE Transmission's proposed prioritisation for the rollout of the battery / generator upgrade. One stakeholder urged the company to prioritise parts of the network that support major urban centres in Scotland.

There were mixed views about the 'responsible operator' option, with some disagreement over the need to invest in network tools to help respond to black start. Some felt it was very important – not just for black start but in order to support system stability as more and more renewables came online.

However, others felt that 'minimum standard' was fine as it ensured compliance. Some stakeholders commented that the cost for 'responsible operator' was high, with one requesting a cost-benefit analysis of these network tools. Several said that only having two options for black start wasn't right, and that there must be a 'halfway house' whereby SHE Transmission didn't do everything but did some of the more important things when it came to network tools.

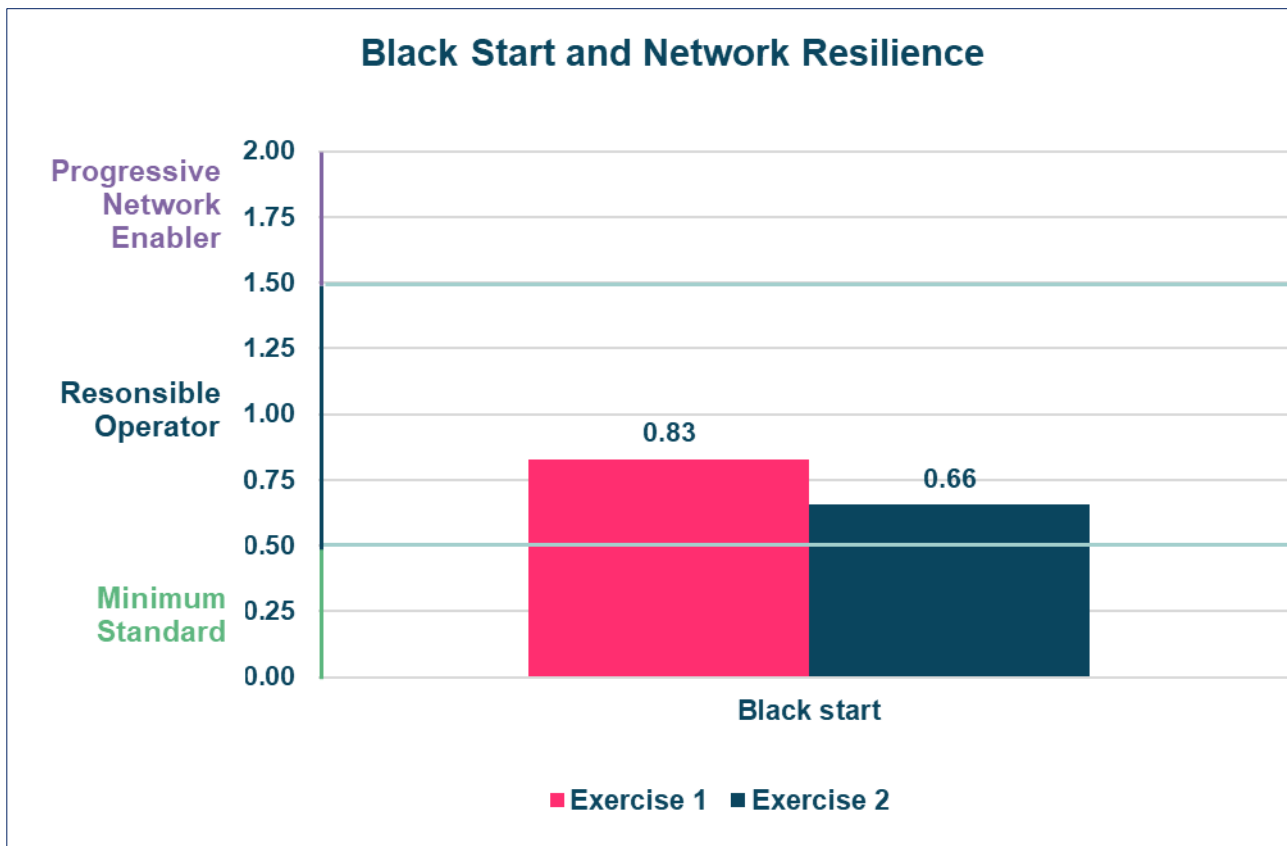
## **NETWORK RESILIENCE**

There were no costed options for network resilience, so stakeholders did not vote on it as part of the table exercises.

For the most part, there was consensus that SHE Transmission should invest in additional equipment rather than emergency response plans. Stakeholders felt that it was better to invest upfront rather than pick up the cost associated with outages when the network failed. That said, one stakeholder felt that if the network was compliant in the eyes of the regulator then there was no need to invest in more equipment. Another stakeholder didn't feel that switchgear would be enough to solve single circuit issues.

In terms of how to prioritise this investment, stakeholders generally felt that SHE Transmission should take a risk-based approach. If not, then the feeling was that areas of high population should be prioritised as it affected more people. Other suggestions included critical substations and windfarm connections. Stakeholders overwhelmingly supported the approach of integrating the installation of new network equipment into existing upgrade works. A generator pointed out that whenever the network was down for upgrade works, it cost them money, so supported a combined approach. However, it was felt that where there were critical sites that required new equipment, these should be done as stand-alone projects.

The graph below summarises the results of the voting exercises (exercise 1 and 2).



## BLACK START

### General comments

- “I think it feels like a no-brainer in terms of resilience, with the cost implication being so small overall. I think it’s about being clear about the likelihood of these events.” Energy / utilities representative
- “Consideration should be given to the wider economic benefit to Scotland.” Infrastructure / engineering representative
- “I don’t think people really understand the implications of black start. The additional costs are definitely justifiable if you think of the potential catastrophic effects of a black start situation.” Business representative
- “If a total disaster happens, how long would it take to get all the systems back?” Infrastructure / engineering representative
- “The Government recommends that we should be prepared for seven days.” Government representative

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- “If the difference is three days, it’s worth it. If it is five hours, not so much.” Connections representative
  - “Here there’s a case for consistency across the three TNOs. It has to be consistent.” Infrastructure / engineering representative
  - “I think you need to work with other operators to make the process more effective and cost-efficient.” Academic
  - “Is the planning nationwide? Presumably you consult with National Grid and Scottish Power.” Infrastructure / engineering representative
  - “You need to be operable on a black start day, in other words you must have the facilities to allow for it. It’s not going above and beyond. You can’t guarantee there won’t be a mess, and you have a duty to put things back together.” Energy / utilities representative
  - “The network is becoming less stable. The prospect of black start is getting more real. It would take a total blackout for people to sit up and start realising that.” Energy / utilities representative
  - “The probability of black start is low, but the likelihood is increasing.” Infrastructure / engineering representative

**1) Do you agree with SHE Transmission’s proposed ‘minimum standard’ approach in terms of 72-hour generator / 12-hour batteries?**

- “In terms of battery technology, wet cells pose a fire risk if you’re putting them next to diesel-fuelled tanks. The safety implications have to be considered.” Infrastructure / engineering representative
- “How does wet battery square with being an environmentally friendly company?” Business representative
- “Why are renewables not reliable during a black start situation? There’s nothing inherent about them, is there?” Infrastructure / engineering representative
- “Batteries are huge. For example, it can be 7 tonnes for 4 square metres.” Connections representative
- “In terms of batteries, you need to think about your carbon footprint and the giant rooms required for storing them.” Connections representative
- “You would need to run generators once a month too as a maintenance procedure, which is bad for the environment.” Connections representative
- “Could SHE Transmission not look into alternative technologies? They are smaller and require fewer civil works.” Academic



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- “We’re looking at it from the top-down but you can also look at it from the ground up. I wonder if [with] a shift to renewables you can establish a stronger, quicker response to black start.” Infrastructure / engineering representative
  - “Are you going to cover the opportunities for generators for providing black start?” Infrastructure / engineering representative
  - “We’re all about recovery. In the system that we’re trying to set up, a back-up system is essential. If money is no object, it’s an absolute no-brainer. The network is becoming more fragile and people need to be prepared.” Academic
  - “There is a project funded by Ofgem, looking at distributed sources for black start.” Government representative
  - “What are the advantages and disadvantages of more dispersed storage going into the network?” Business representative
  - “We have to be mindful of the fact that battery technology is improving all the time. Similarly, with the diesel generators, it’s quite a polluting technology. We have to be mindful of the developments in these technologies.” Energy / utilities representative
  - “Plastering the roofs of the substations with solar panels could certainly be an option.” Infrastructure / engineering representative
  - “You will dispatch that black start generation. I’m confused as to why all of this sits on your books.” Infrastructure / engineering representative
  - “This is an area where the numbers don’t tell the whole story. Black start is a joint operation with other TOs, and if you didn’t spend this there would be ways to have National Grid pick up the costs.” Government representative

## **2) What do you think of SHE Transmission’s proposed prioritisation for the rollout of our battery / generator upgrade?**

- “Seems pretty sensible.” Infrastructure / engineering representative
- “Seems logical.” Infrastructure / engineering representative
- “You’d need all of these, not some. You’re playing catch-up, I feel.” Energy / utilities representative
- “It is vital you keep Aberdeen and Inverness safe because they are major centres.” Infrastructure / engineering representative

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### 3) How important do you think it is that SHE Transmission invests in network tools to improve the restoration time?

- “It’s critical, especially with the increase in renewables. If any of the TOs want to decarbonise the energy network, you have to have the flexibility and resilience this would bring. You have to future proof in T2.” Infrastructure / engineering representative
- “Didn't you say improved restoration standards are coming anyway?” Infrastructure / engineering representative
- “Is the main driver for a synchronised compensator black start, or is it something else?” Infrastructure / engineering representative
- “It is vital to have additional circuit breakers on the lines. These are easier to operate, and easier to restore from black start.” Infrastructure / engineering representative
- “Is it possible to ascertain the cost benefit of the circuit breakers?” Academic
- “Being forward-looking, SHE Transmission is now part of a changing network with changing demand, so it absolutely needs network tools.” Connections representative
- “Do you have the point of wave switching on top of the battery? Do you need that to meet the standard or are you compliant already?” Connections representative
- “From a recovery perspective, it is key because it retains the stability of the network during an emergency.” Connections representative
- “You need to invest in the tools on your network to establish a sense of stability.” Connections representative
- “For black start, two choices are too coarse. I know synchronised condensers are expensive, but there's more of a choice than presented here.” Infrastructure / engineering representative
- “I was torn. Because it’s hard, is there a kind of halfway house?” Business representative
- “My view has changed. I’m ‘minimum standard’ on that one. The incremental is massive.” Infrastructure / engineering representative

## NETWORK RESILIENCE

### 1) Should SHE Transmission invest in additional equipment, or should they focus on putting in place emergency response plans?

- “The networks were designed when circuit breakers were the most expensive item. Now that’s no longer the case: they are much cheaper and more reliable. If you can deploy the technology, then it’s a no-brainer.” Infrastructure / engineering representative
- “Urban centres need to be prioritised, that is, they need to be brought back quickly onto the network as they are more crucial.” Business representative
- “Prevention is better than cure.” Infrastructure / engineering representative

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- “Do you have the same approach for generation – do you put an extra circuit breaker in or are you making these investments purely for load?” Infrastructure / engineering representative
  - “Investing in infrastructure in the first place should in theory avoid the need to rely on people to implement the emergency response.” Energy / utilities representative
  - “That’s clearly an economic decision. If you’ve got weaknesses in your system you need to look at your whole system.” Infrastructure / engineering representative
  - “The switch gear will only make a wee impact. I don’t imagine it’s not going to deal with the single circuit risk.” Infrastructure / engineering representative
  - “A combination of both, usually; there needs to be a balance.” Infrastructure / engineering representative
  - “Your resilience to known risk factors is important.” Infrastructure / engineering representative
  - “Is your network compliant? If I was the regulator, I’d ask why add more cost when you are already compliant with this?” Connections representative
  - “If it’s a huge improvement then why not. You would only have to spend more money in a fault situation.” Connections representative

## 2) If so, how should SHE Transmission prioritise this investment?

- “It has to be risk-based. Ofgem is talking about monetising risk to failure. Everyone can understand that. Then look at social vulnerability.” Infrastructure / engineering representative
- “It’s going to be a risk-based approach. There’s a reputation element there.” Infrastructure / engineering representative
- “Prioritising areas with bigger populations is most important because any problems there would affect the greatest number of people. The rural areas have sparser populations and are therefore less important.” Connections representative
- “Start with the critical substations and work forward from there.” Connections representative
- “Have a plan and stage a prioritised recovery. SHE Transmission needs to know that each critical part is secure before it opens up new parts of the network.” Academic
- “Windfarm operators are a good port of call.” Infrastructure / engineering representative
- “I would prefer where there are the most people, others, they have plans in place anyway.” Infrastructure / engineering representative
- “If you have Ofgem driving all this, it has to be a national, reliable, consistent system.” Infrastructure / engineering representative
- “If you grade things on monetised risk, you know the monetised impact to failure, you can do something forward-looking and innovative. The challenge will be having that transparency of information. At the moment there is information, but I would encourage the TOs to be more

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transparent. If you did that, you would get that risk-based approach to improvements and wide support that Ofgem couldn't refute." Infrastructure / engineering representative

### **3) Should SHE Transmission be installing new equipment as stand-alone work, or integrate it into existing upgrade works?**

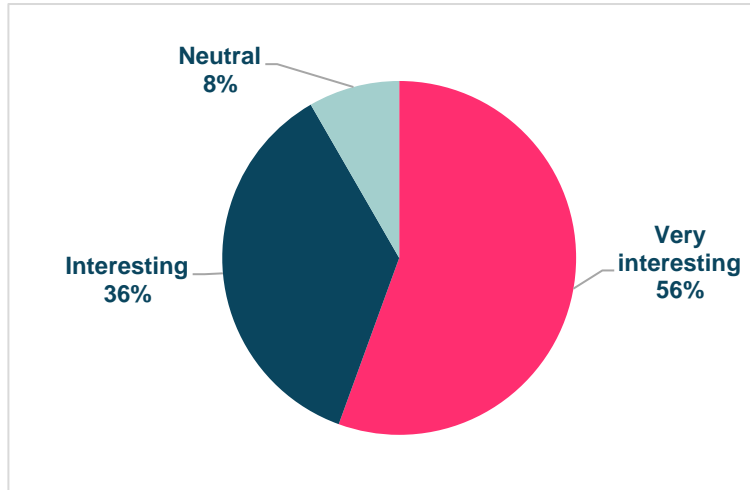
- "A hybrid is the best. If you go on to the site to do specific work, as part of that package you could do other upgrade work." Infrastructure / engineering representative
- "It makes sense to be doing it at same time as other upgrades. Again, it's [about] a case-by-case basis and timescales." Energy / utilities representative
- "I think from generation, from our perspective, for every minute we're offline it's ultimately going to cost us. Somebody has ultimately got to pay for it." Energy / utilities representative
- "When there is some work to be done in existing upgrade works, integration is a good idea. A critical site would have to be a stand-alone project, however." Connections representative
- "It's all about ranking the priorities and moving forward from there." Academic

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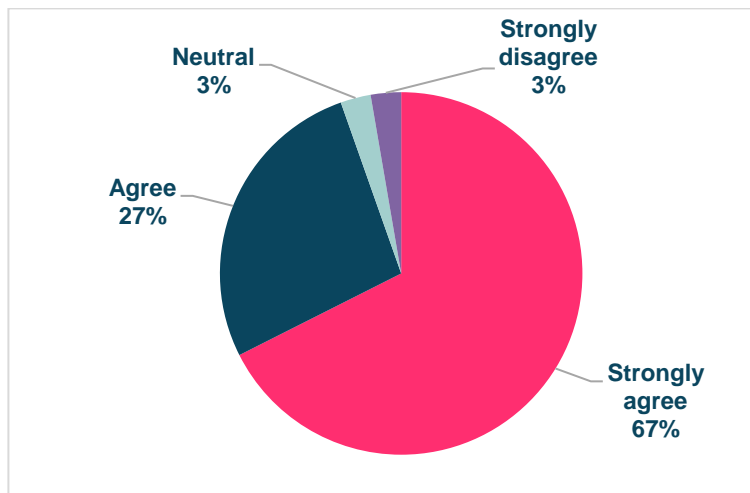
## EVENT FEEDBACK

After the workshop, stakeholders were asked to complete a short feedback form about the event. The feedback was as follows:

### 1. Overall, did you find this workshop to be:



### 2. Did you feel that you had the opportunity to make your points and ask questions?



### Comments:

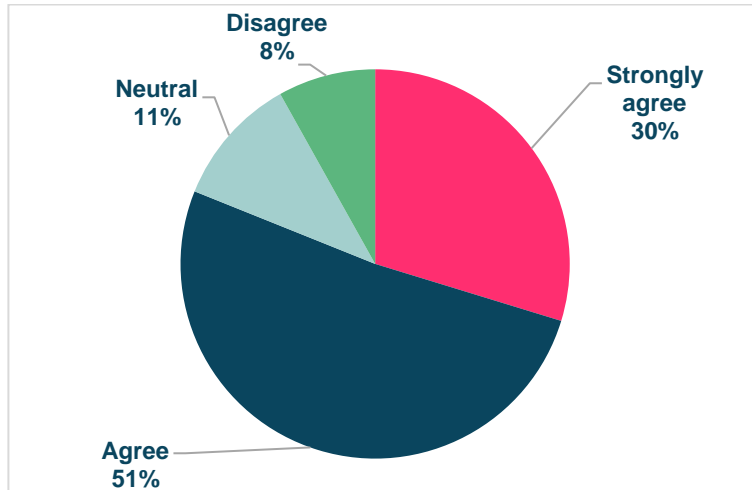
“Booth sessions followed by a table discussion was an excellent format.”

“It was a great opportunity to discuss issues at the table and speak to the SSE experts.”

“[The workshop] was very high-level and it provided an opportunity to give my points.”

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### 3. Did we cover the right topics for you on the day?



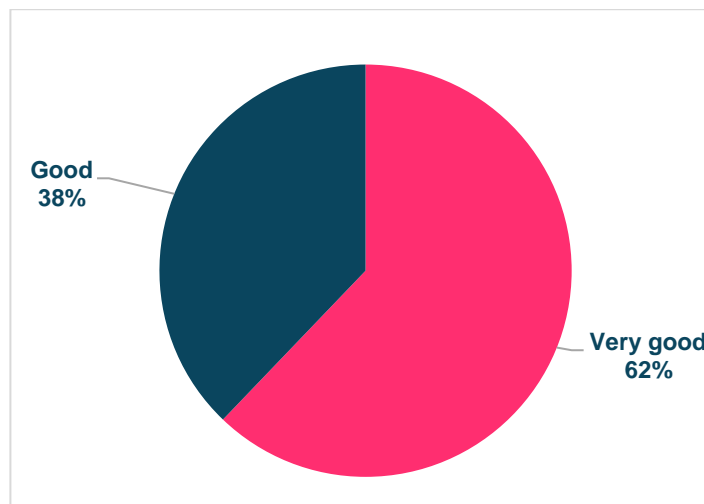
#### Comments:

“Cyber security, decarbonisation and climate change are a big driver in decision making.”

“There was a good selection of topics.”

“[There could have been] opportunities to explore resilience and reliability by embracing technology innovation.”

### 4. What did you think of the way the workshop was chaired by your facilitator?



#### Comments:

“[The facilitators had] good control of discussion and level of knowledge.”

“There was smooth running of each section. They kept the delegates engaged.”

“It was well managed – clear and concise.”

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## 5. Any other comments?

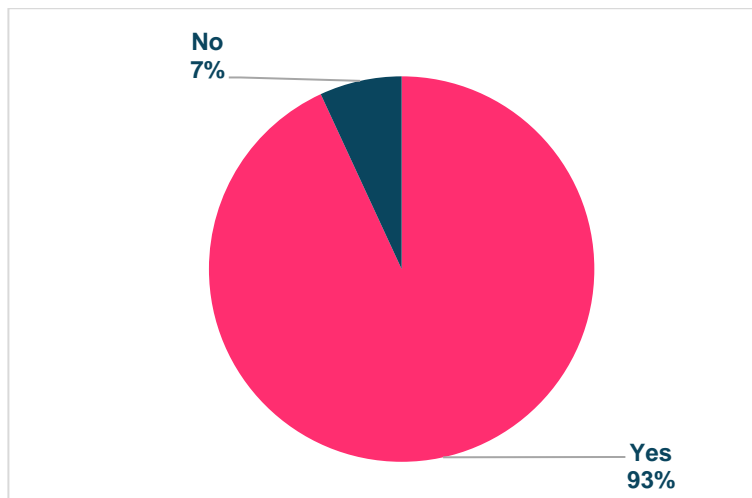
### Comments:

“Willingness to pay was interesting but doesn't give the whole picture on future bill impact.”

“[It would have been useful to have] whole-life costing of assets not just capital expenditure.”

“It was a very good event. Many thanks to SHE Transmission and EQ Communications.”

## 6. Would you like to receive our post-event report, and invites to similar events in the future?





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