



Scottish Hydro Electric Transmission
Stakeholder Views on a New Suite of Transmission
Structures (NeSTS)

FINAL

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Executive Summary

In March 2016, Scottish Hydro Electric Transmission (SHE Transmission) appointed Social Market Research (SMR) to develop and facilitate a stakeholder engagement event on a New Suite of Transmission Structures or NeSTS. This report presents an overview of the findings from a stakeholder engagement event hosted by SHE Transmission in Inverness on 19 May 2016.

Overall Message: Strong Support for SHE Transmission's Transparent and Detailed Assessment Approach

The research findings clearly indicate a strong level of support for the 510 Series Overhead Transmission Line Design Concept with polymeric insulators.

Support was gained from stakeholders across a number of key business areas including the following:

- **Reasonable sensitivity of the design to various natural landscapes** i.e. support for the 510 series was not so much gained by it being 'natural looking' or less perceptible, rather that this Series is the least intrusive to the contours of expansive, natural landmasses native to Scotland and elsewhere in Britain;
- **Potential to have modular design and assembly** i.e. reducing impact on the environment, reducing social disturbance and road traffic as well as noise pollution; and,
- **Less invasive construction techniques and potential for reduced access provision** i.e. that access to overhead transmission line construction sites could be minimised via using the 510 Series and that transport and storage, assembly and erection could be minimised over the site area and that the lighter construction materials used in the 510 Series could allow for 'floating road and/or plastic trackway' to be used. This would reduce further the environmental impact when compared to invasive excavation.

Transparency of Assessment Approach

It is clear that stakeholders attending the NeSTS event welcomed the open approach and full explanations given by SHE Transmission. This view was expressed in numerous ways and culminated in a plentiful exchange of questions from stakeholders throughout the day, from design concepts right through to the environmental impact and SHE Transmission's scoring assessment matrix (SAM) (used to compare and contrast each design against the next design concept). The following exchange is used to highlight this point.

In relation to the plenary session following the background briefing given by SHE Transmission about the NeSTS project the following exchange occurred:

- External Stakeholder Question: "Why are some of the weightings (on the scoring spreadsheets) so high?"

- SHE Transmission answer: A: "The weights are the opinion of the experts who looked at it in the first place. So those are the opinions of the experts from Energyline and SSE and some of the weightings reflect items that are quite a big contributor to costs".

Detailed Assessment Approach

In addition to the transparency of SHE Transmission's approach, it is clear that stakeholders attending the NeSTS event appreciated the detailed approach and full-some explanations given by SHE Transmission and Energyline (supplier to SHE Transmission) speakers. This view was expressed in numerous ways regarding the scoring assessment matrix (SAM) used to compare and contrast each design that had been developed and taken by SHE Transmission.

An example is cited below:

In relation to the plenary after the presentation regarding environmental impact, the following exchange was recorded:

- *External Stakeholder Question: "I am just curious as to whether these designs are all so robust that they could be put on top of 'the passes' as well as down at the coastal estuary?"*
- *SHE Transmission Answer: "One of the features of the bid was that we have to design structures that will be suitable for use at altitude in the north of Scotland and so forth with the wind loadings and other loadings that are involved in those geographies. It is a practical reality that what the project will do is apply these structures to a line and quite how much of the remaining design envelope we end up filling out with medium or light duty structures, we don't actually know yet, it will depend on what project we design for"*

Attendees

Both external and internal stakeholders were invited by SSE to attend the deliberative event. Among external stakeholders in attendance were:

- The Scottish Government, Planning Consents Department
- Scottish Natural Heritage
- Aberdeenshire Council
- Environment Scotland
- Highland Council

Among internal stakeholders within SSE Group in attendance were:

- SHE Transmission stakeholder engagement team
- SSE Group Accountant for Sustainability
- Energyline

Stakeholder feedback summary

Overall sentiment regarding the NeSTS project

Overall, external stakeholders appreciated the ambitions of the NeSTS project together with SHE Transmission's transparent approach to scope the NeSTS project in consultation with external and internal stakeholders. Equally, stakeholders appreciated the background briefing materials issued to respondents before the event that could be used to gather internal views from colleagues from each organisation.

An example was the ‘pre-read’ pack which was issued by SHE Transmission ahead of the event to support stakeholders to make decisions about the NeSTS project during the event. Many stakeholders commented on its helpfulness to act as an aide-memoir, *“When I talked about the pack’s contents with my colleagues back at Scottish Government, we pretty much all thought the same thing. There was some diversity of opinion, but I am hoping to bring their views here with me today”*.

Additional comments received regarding the overall NeSTS project related to the weightings and how these had been calculated by SHE Transmission for landscaping / expanse of natural land as well as the visual appeal (or not) of insulators (that are not separated).

Internal stakeholders viewed the event as an opportunity to share project development aspects internally as well as stakeholder engagement best practice. However, some concerns and questions were posed by internal stakeholders from a customer perspective. Feedback in this regard included:

“The presentation looks at span and height differentials. So my question is: if I am paying for a wind farm trying to connect to the network and I have a contribution to pay towards that section of line. Understandably, I want to go for the least cost option and if the old option was a wee bit cheaper, would I be able to influence that decision [like these larger organisations]?”

The environmental impact of overhead transmission lines (OHLs)

Concerns high on the agenda for external stakeholders in relation to the environmental impact regarding NeSTS related to the following:

- Routing;
- Access;
- Altitude;
- Geographical conditions;
- Destruction of natural animal and plant habitats;
- Safety and electrocution of birds;
- Preservation of landscape;
- Visual appeal / imperceptibility; and,
- Durability of designs in bad weather conditions.

Comments from external stakeholders included: *“I am just curious as to whether these designs are all so robust that they could be put on top of ‘the passes’ as well as down at the coastal estuary?”*

“In different landscapes there are different climatic conditions. Do you, from a standards point of view, treat everything to the same standard, because we can all be hit by a hurricane, we can all be hit by ‘different types of snow’. Is there an effect of climate that you can take into account in the standards that you apply [to the OHL design]?”

Commentary from internal stakeholders regarding discussions about environmental impact was more about the framing of the topic in question, *“It does depend on how you draw a line around the definition of environmental impact. Do you just want to talk about one tower design versus another? If so, as someone who is more interested in wider environmental policy you would have a much harder argument to convince you of everything”*.

The design concepts (long-list of concepts and the short-list of concept designs)

Discussions regarding the different design concepts largely centred upon how they:

- Impact the environment visually;
- Could reduce access and construction requirements and impacts;
- Influence the type of foundations needed and land required to support the structures; and,
- Define the corridor widths of overhead lines.

Illustrative examples are given below:

- EG1. External Stakeholder Question: *“Are you looking to take forward just one design at the end of the day or might there be advantages in having two alternative designs that fit different landscapes better and is it the intention that, whatever the winning design is, it would eventually replace the existing lattice towers?”*.
- SHE Transmission Answer: *“The current proposal is to take the design that has scored most highly and take it forward to a stage where it could be deployed. If we develop two types, then that is twice the design effort. However, we did look at the 540 series as well as the 510, so once we have the 510 up and running there is scope to have a low height variant”*.
- EG2. External Stakeholder Question *“The long-listed designs are all for 275Kv. Is there scope to go up to 400Kv or down to 132Kv to improve future capacity/align to need?”*.
- SHE Transmission Answer: *“You could change the design to suit the other voltages, but it would be a different design to that for the 275”*.

Span and height

Span and height was a prioritised topic during the event deliberations with a 30-minute discussion allocated to this during the group. During discussions regarding span and height, a number of issues were believed to be important, including:

- Flexibility of structure series that is implemented to be able to adapt to differing environments such as passes, forest, coastal pathways, traversing rivers and so on;
- Visual aspects of towers in relation to landscape settings;
- Materials used for construction and their impact on the environment as well as mitigating such environmental factors;
- Mitigation of environmental impacts for people near housing developments/and or existing dwellings;
- Topography;
- Size or 'bulk' of designs in built up areas and/or rural areas;
- Modular design potential;
- Stability of towers to withstand weather events; and,

- The differences between foundations needed for larger/taller structures as opposed to wider ones.

External Stakeholder comment during discussion group: *“Well I think I agree with the horses for courses argument and completely concur that we’d like to see wriggle room because what’s so important to us is the siting of these things and how they’re positioned so as and often it can be a degree, a question of micro siting. So there can be a degree of meters in terms of impact on key [landscape] views. We want to see a bit of wriggle room and flexibility in terms of the design and what comes forward. I can see a benefit in having fewer actual interventions in the landscape spaced further apart. Having said that, maybe shorter structure and more of them look better in different landscape types so it depends really. I think in terms of where we’re looking, sometimes we look at key views and impacts on those and sometimes it might be more beneficial to have smaller structures so then they’re not as strong in interfering with key views. But really it’s a question of horses for courses”.*

Overall, the key concern was the ability of the 510 series or the highest scored structure at the end of the consultation exercise to have flexibility in differing landscapes and land uses.

Internal stakeholders commented from the perspectives of the developers and cost, with one stakeholder noting:

“As a developer, what will be my cheapest option? More towers and less span or less towers and more span. It was noted that the cost of the new towers could not be more expensive than the cost of existing structures being used. I suppose that is something”.

Insulator configuration

The discussion group amongst external stakeholders regarding insulator configuration yielded a consensus regarding the configuration, and it also generated an opportunity to explore more fully other aspects of customer and environmental pollution that neither SHE Transmission or Energyline had believed important to date.

There was consensus on the configuration of insulators, with the 510 horizontal Vs made using polymeric insulators favoured by external stakeholders.

However, during the course of this discussion two concerns arose in the external stakeholder group discussion.

The first concern was the potential noise pollution that might be incurred because of differing stack formation/configurations and how these related to tower structure designs. Experts from Energyline were asked to comment on this matter but could not recall scientific research being undertaken into whether certain structures create noise, disturbing wildlife habitats and the tranquility of natural landscapes. SHE Transmission therefore promised to investigate further and feedback to the stakeholder group regarding any data around noise pollution in relation to the 510 Series and horizontal V insulator configurations.

- Expert from Energyline said: *“Just listening to the question now, and thinking about it on the spot. I can’t think of any reason why the insulators that we’re planning to use would cause any greater noise than what we’ve got on the line now. But we can do some research into that and see whether that’s a factor or not”.*

The second concern was the colour of the insulators themselves. Because clear glass and sky-blue coloured insulators could be used/adapted to the landscape they are placed within, it was certainly seen as a concern if these had the potential to be changed to “red” or “yellow”.

Discussions with internal stakeholders also focused on the aesthetics of insulators and a need to be sensitive to the environment in which they are deployed. There were also additional questions raised which could be factored into future engagement presentations. Comments from internal stakeholders included the following:

- *“In terms of insulator configuration are we viewing this from an aesthetic view point. Is this about getting it through planning [council approval]?”*
- *“I’m sure aesthetic is a consideration but it’s also about maintenance and how much pressure you’re putting on your cross arm. Are we going to be stressing the towers more because of some major configuration design criteria [that we score highly]?”*

There was also discussion among the internal stakeholders regarding the effect of insulators on bird life. One internal stakeholder commented:

- *“Do we want insulation to be more visible to prevent birds from flying into them or less visible so they blend into the environment more?”*

Reducing the environmental impact of construction

A number of ideas and opportunities were considered by the external stakeholder group concerning lowering the environmental impact of construction within the NeSTS project. Overall, these fell into two areas and included:

- Potential reductions of access and construction requirements via fewer components being taken to site and lighter plant requirements.
- Lower land use for shorter construction times and smaller as-built footprints.

However, the external stakeholder group all agreed that being involved at the strategic level and at the initial conceptual design level as progress is made towards a decision is almost of equal importance.

One of the external stakeholders made the following comment in relation to routing:

“Routing is a key stage and SHE Transmission, I feel, are good at engaging with us at an early stage in the project to let us examine this. Before it goes to public consultation, for example. So you might see options that are never taken further in terms of public consultation. Yes, routing is a key stage but in terms of the different designs there are potential options and benefits from the potential designs. But probably more important is getting the routing right to start with. I’d say that’s 75% mitigating the impacts and the remaining 25% or whatever is very detailed design of how the route and design of the structures. But we’re not looking at the 75% today, we’re looking at the 25%”.

Another external stakeholder commented on the weight and bulk of any one design was:

“Typically, you will have a suspension support, a D10 or a D30 support, and that is for maximum loading. What we talked about was having two grades of suspension support, for instance the heavy duty one would be suited to the extreme altitudes in the north and maybe a lighter variant for down south. The geometry would be the same or likely to be very similar, but in terms of the weight of the materials there may be some efficiencies to be gained”.

SHE Transmission's Scoring Assessment Matrix (SAM)

External stakeholders were generally positive about the SAM tool, with four out of five finding the tool helpful in assessing the design features of OHT lines. However, stakeholders did take the opportunity to highlight some areas where they believe SHE Transmission needs to focus and reflect on. For example, some commented on the lack of aesthetic / visual impact being represented separately on the score card and also, the fact that SHE Transmission's scores were also represented on participant scoring cards.

“[The score card] under-represents the visual impact [of insulators] and considerations around this. It would have been clearer today if they had been a different colour”.

In relation to the scoring assessment matrix (SAM) exercise, where stakeholders were invited to put forward their own scores for each design concept (19 in total) in an individual booklet, a number of comments were made about the inclusion and/or decision to omit a visual impact criterion from the SAM, including:

“Just an observation [but] that there wasn't an aspect weighting for visual impact. It's got insulator visual impact but not overall visual impact so I stuck additional weighting on design aesthetics to compensate for that. I'm not sure if that was terribly appropriate and I did feel a bit rushed in considering the design aspect weightings and I don't have an awful lot of confidence in the scores that I've given them. Not quick enough at arithmetic either to make sure the total adds up to roughly the right number. So a bit of doubt about the weightings that I've given the aspects.”

Another comment received from an external stakeholder was:

“Yeah, we're back to that consistency of look [visual impact]. There is a need for appropriateness to the environment”.

Composite transmission structures (composite poles)

Feedback from stakeholders in regard to composite poles was specific and raised a great deal of interest amongst the group, in particular regarding the increased structure heights required to provide clearance from ground to conductors at wider-spans.

Discussions with external stakeholders focused on the following benefits of composite poles, including:

- Composite pole load bearing comparisons with wooden poles; and,
- Air delivery by helicopter to remote places could be safer, easier and more cost effective.

Feedback from stakeholders was overall positive with many clarification questions being asked, including the following exchange that occurred in plenary:

- *External Stakeholder Question: "So the clearance to ground has been increased?"*
- *SHE Transmission Answer: "Yes."*
- *Internal Stakeholder Follow-up Question: "From what?"*
- *SHE Transmission Answer: "Our remit was to clear the minimum ground clearance of 6.7 meters for the 132kV. That gave us a structure height, we had face to face clearance heights of roughly 19 meters now they've increased that to 22 meters just now. We've had to do that for the OPPC. We could just add another module on and that would give us additional ground clearance".*
- *Stakeholder Follow-up Question: "Is the clearance between the conductors and the ground still 6.7?"*
- *SHE Transmission Answer: "Yes. It's been an issue for some land owners where they've asked for additional ground clearance so what we'll give them is an increased structure height but those will be one offs if you like".*

Internal stakeholders also commented on the use of composite poles, in particular to the lifecycle factors and costs.

"Is there any impact we can think of in terms of wider lifecycle costs of a mono pole design versus the steel lattice design?"

"If you're thinking about the environmental impact of your line, you can't just think about the immediate impact you need to think about how this plays out going right the way through from creation to disposal. Transport and so on".

"Perhaps this is where we need to think about putting in the infrastructure for the greater good rather than for the cost of one type of tower over another. Otherwise, you're not looking at the best value solution you're just looking at the best entering solution"

Undergrounding in relation to SHE Transmission's 'VISTA' project

Following a video presentation and talk by SHE Transmission's lead for stakeholder engagement about undergrounding much interest was generated about how stakeholders could apply to the scheme and nominate a local area for undergrounding. In addition, contact details for the scheme were written down by attendees for future reference.

A question was asked by one participant:

"When does the distribution window for nominating schemes for undergrounding distribution, when does that close?"

Answer by SHE Transmission: "It doesn't close. We'll keep going until we've used up the pot of money. So if you have any in mind the best thing to do is get them in and we'll start assessing them".

Digital Voting During the Event

The principal motivations for external stakeholders to attend the event were to represent issues important to their organization, and to contribute to the design on OHT lines.

The key findings from the digital voting included:

- *All stakeholders (both internal and external) found helpful SHE Transmission's explanation of some of the assessment criteria in developing the different design options;*
- *Eight out of nine stakeholders (including all external stakeholders) agreed that the presentation on the environmental impacts had improved their understanding of the context in which the project is operating in;*
- *All stakeholders (both internal and external) agreed that SHE Transmission is considering environmental impact in the design of overhead lines;*
- *Eight out of nine stakeholders (including all external stakeholders) agreed that the presentation on the geometry of OHT lines had improved their understanding of the factors that influence the geometry of OHT lines;*
- *Eight out of nine stakeholders (including all external stakeholders) agreed that following a presentation on the design concept they had a better understanding of the engineering constraints influencing the design concept;*
- *All stakeholders (both internal and external) agreed that the presentation and discussion groups had improved their knowledge of how height and span influence line design;*
- *All stakeholders (both internal and external) believed that the trade-offs between height and span had been well explained to them;*
- *Eight out of nine stakeholders (including three out of four external stakeholders) agreed that the presentation and discussion groups had improved their knowledge of insulator configuration and how they influence design;*
- *Nine out of ten stakeholders (including all external stakeholders) believed that the trade-offs between different insulator configurations had been well explained to them;*
- *10 out of 11 stakeholders (including all external stakeholders) agreed that the presentation and discussion groups had improved their knowledge of how the impact of construction on the environment is minimized;*
- *All stakeholders (both internal and external) believed that the trade-offs between construction factors and their impact on the environment had been well explained to them;*
- *Seven out of 11 stakeholders (including four out of five external stakeholders) said SHE Transmission's SAM tool is helpful at assessing the design features of OHT lines;*

Evaluation

- *All stakeholders (both internal and external) found the presentations during the event helpful in informing their views;*

SHE Transmission – Stakeholders' Views on a New Suite of Transmission Structures (NeSTS)

- *All stakeholders (both internal and external) found the group discussions, during the morning of the event, helpful; and,*
- *All stakeholders (both internal and external) found the event an effective approach for putting their comments and ideas forward to SHE Transmission.*

CONTENTS

Executive Summary 2

1.1 **Context** 13

1.2 **Stakeholder Engagement** 13

1.3 **Deliberative Event** 13

2 Deliberative Event on NeSTS 14

2.1 **What we did** 14

2.2 **Profile of Participants at the Deliberative Event** 15

2.3 **Motivation for Attending the Event** 16

3 Key Findings 17

3.1 **Context and Purpose** 17

3.2 **Environmental Impact of Overhead Transmission Lines** 18

3.2.1 **Impact of Presentation on Understanding of Project Context** 20

3.2.2 **SHE Transmission Considering the Environmental Impact of OHT Lines** 20

3.3 **Design Concept Overview** 21

3.4 **Exhibition and Evidence** 25

3.5 **Span and Height** 27

3.5.1 **Discussion Group: Span and Height** 28

3.5.2 **Impact of Presentation and Discussion Group on Span and Height** 35

3.5.3 **Satisfaction with How Trade-Offs between Height and Span Explained** 35

3.6 **Discussion Group: Insulators and Insulator Configuration** 36

3.6.1 **Discussion Group: Insulators and Insulator Configurations** 37

3.6.2 **Impact of Presentation and Discussion Group on Insulators / Insulator Configurations** ... 41

3.6.3 **Impact of Presentation and Discussion Group on Insulators / Insulator Configurations** ... 42

3.7 **Environmental Impact of OHL Construction** 42

3.7.1 **Discussion Group: Environmental Impact of OHL Construction** 44

3.7.2 **Impact of Presentation and Discussion Group on Knowledge of Minimising the Impact of OHL Construction on the Environment** 50

3.7.3 **Explanation of Trade-Off between Construction Factors and Impact on Environment**... 50

3.8 **Scoring Assessment Matrix (SAM)** 51

3.8.1 **Helpfulness of the Scoring Assessment Matrix (SAM)** 52

3.9 **Presentation on Undergrounding** 53

3.10 **Presentation on the Use of Composite Poles** 53

3.11 **Closing Remarks** 55

3.12 **Evaluation of the Event** 56

Appendix A: Event Agenda 58

1. Introduction

1.1 Context

A key strategic objective of Scottish Hydro Electric Transmission (SHE Transmission) is to develop and apply solutions to ensure that the electricity transmission infrastructure continues to develop in a way that minimises or reduces its impact on the environment while providing future capacity to meet customer needs in the North of Scotland.

As part of its overall corporate strategy to embrace innovation, SHE Transmission secured £7.5 million from Ofgem's Network Innovation Competition¹ (NIC) to develop new transmission and overhead line structures. With this funding the challenge for SHE Transmission is to develop a New Suit of Transmission Structures or NeSTS which produce a lower environmental impact than traditional designs. The project is targeting advances in the following aspects to achieve this;

- the structures are less perceptible;
- less material used;
- less construction; and
- less maintenance.

Funding for NeSTS was secured in 2015 with the project subject to the following timeline:

- 2016 - 2018 Design new structures & overhead line;
- Stage Gate – deployment decision (with Ofgem);
- 2019 - 2021 Construct overhead line; and,
- 2022 Publish e-tools and report.

1.2 Stakeholder Engagement

A requirement of all NIC funded projects is that funded organisations must commit to, and evidence, effective stakeholder engagement for the life of the funded project. SHE Transmission, as part of its application, submitted a stakeholder engagement programme to run alongside the roll out of the project. This first element focuses on stakeholder views on a number of designs for different transmission structures which SHE Transmission is currently considering for construction.

1.3 Deliberative Event

On 19 May 2016, SHE Transmission hosted an initial deliberative event (SMR understands that more are planned) in Inverness and invited a range of stakeholders pertinent to the Scottish marketplace to consider the environmental impacts of a range of transmission structures.

The event was targeted at organisations in a position to comment on the potential environmental impacts of the different design concepts under consideration and represents some of the first steps in an extensive stakeholder engagement programme that is planned until 2022.

¹ <https://www.ofgem.gov.uk/network-regulation-riio-model/network-innovation/electricity-network-innovation-competition>

2 Deliberative Event on NeSTS

2.1 What we did

Scottish Hydro Electric Transmission (SHE Transmission) and SMR worked collaboratively to design the format of the deliberative event, the presentation materials, and the points for deliberation / topics etc. Because of the extensiveness of the topic area within the proposed pilot, it was decided that a 'pre-read pack' would be prepared for background reading by participants. In addition, due to limited time on the day i.e. 6-hours for the event timings, it was agreed that several priority topics would constitute its focus. Note that the full Agenda is included as Appendix A. The event agenda consisted:

- Background regarding the NeSTS project including its context;
- The environmental impact of overhead transmission lines (OHLs);
- The design concepts (long-list of concepts and the short-list of concept designs);
- Span and height;
- Insulator configuration;
- Environmental impact of construction;
- SHE Transmission's Scoring Assessment Matrix (SAM);
- Composite transmission structures (composite poles); and,
- Undergrounding in relation to SHE Transmission's 'VISTA' project.

To support the discussions and deliberations within the event itself, photo montages of the different design concepts were used as well as scale models of different design options.

At appropriate points, SMR's electronic, interactive voting software was also integrated into the event. Primarily, this was done to generate quantitative metrics regarding stakeholder opinions about the effectiveness and/or knowledge exchange gained (or not) as a result of SHE Transmission's presentations. However, the voting software was also used to generate a gauge of the event format at the end of the event to understand how improvements could be made during the future roll-out of SHE Transmission's NeSTS stakeholder engagement programme.

Following presentations on three key topics (1) span and height; (2) insulator configuration; and, (3) the environmental impact of construction, stakeholders took part in a discussion group to explore participant views. For each topic, stakeholders were invited to:

- Give their reflections on what they heard during the presentation;

- Highlight any challenges or concerns around what they had heard; and,
- Offer and/or consider any opportunities moving forward.

Recruitment of participants to the event was undertaken directly by SHE Transmission.

With the permission of stakeholders, the event was audio recorded, with stakeholders reassured that comments would be reported on a non-attributable basis.

Due to the relatively small number of participants, full transcripts of both the plenary (question and answer) and discussion group for each priority topic area are noted in this report. The purpose of this is to illustrate the depth and intricacy of the research findings resulting from the deliberative event.

2.2 Profile of Participants at the Deliberative Event

Five external stakeholder organisations were represented at the event, all of whom are actively engaged already in the field of overhead transmission lines or NeSTS within their respective organisations. These organisations were:

- The Scottish Government, Planning Consents Department
- Scottish Natural Heritage
- Aberdeenshire Council
- Historic Scotland
- Highland Council

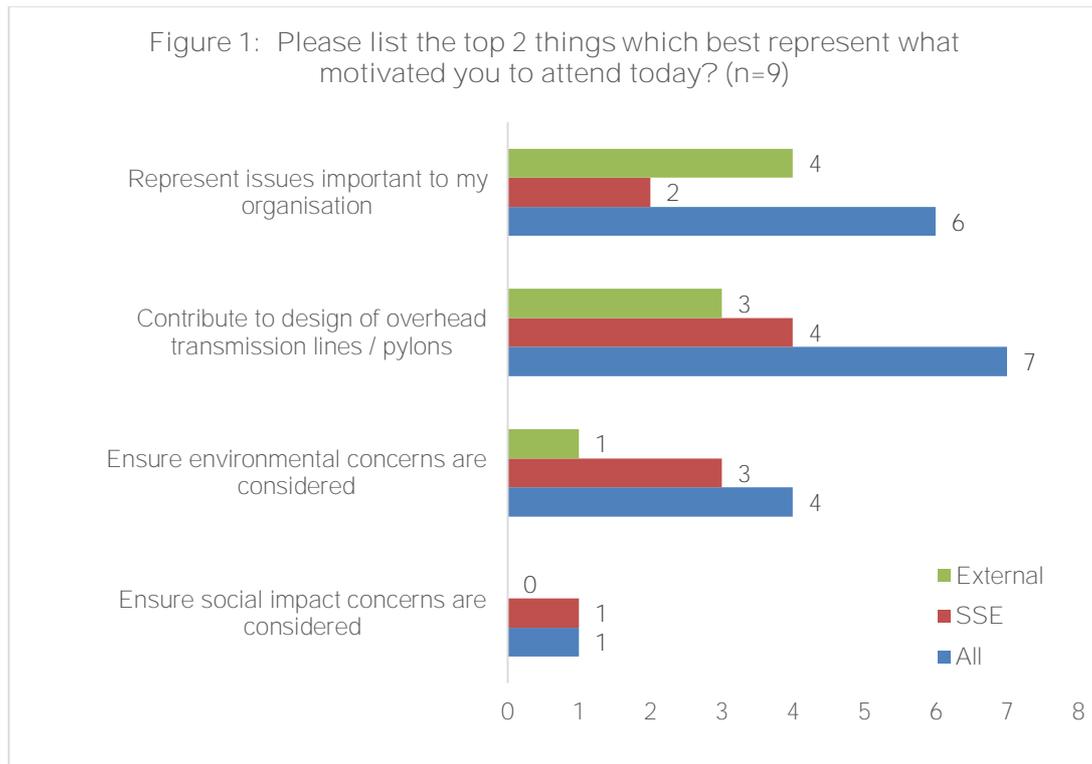
Internal stakeholders and suppliers within and/or to SHE Transmission were also represented at the event including:

- Stakeholder engagement team, SHE Transmission
- Group Accountant for Sustainability, SSE
- Energyline (contractor to SHE Transmission)

2.3 Motivation for Attending the Event

Using SMR’s digital voting facility, respondents were invited to say what motivated them to attend the NeSTS stakeholder event. Figure 1 shows that of the nine stakeholders who voted, seven said they were attending the event to contribute to the design of overhead transmission lines / pylons. Six out of the 9 attendees were there to represent issues important to their organization.

Among external stakeholders, all (n=4) said they were motivated to attend to represent issues of importance to the organization, with three attending to contribute to the design of overhead transmission lines / pylons. One external stakeholder said they were attending the event to ensure environmental concerns are considered.

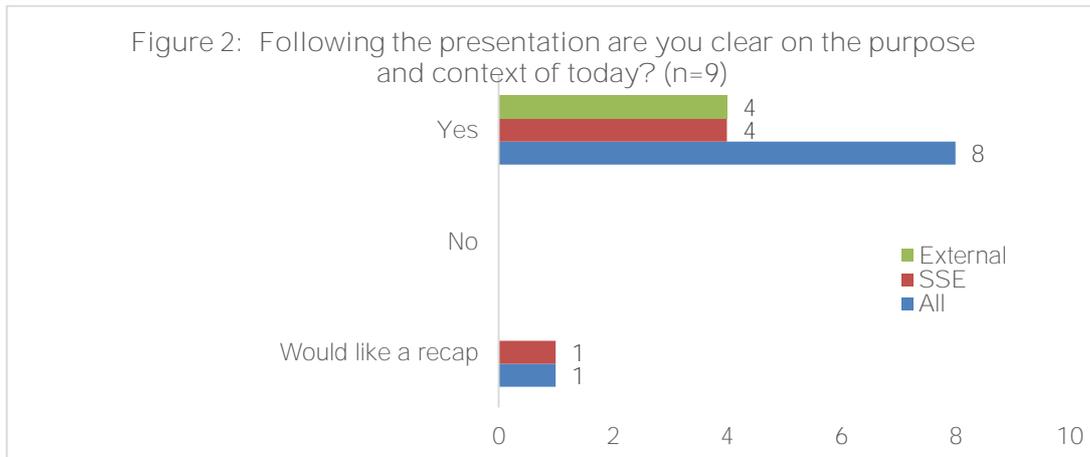


3 Key Findings

3.1 Context and Purpose

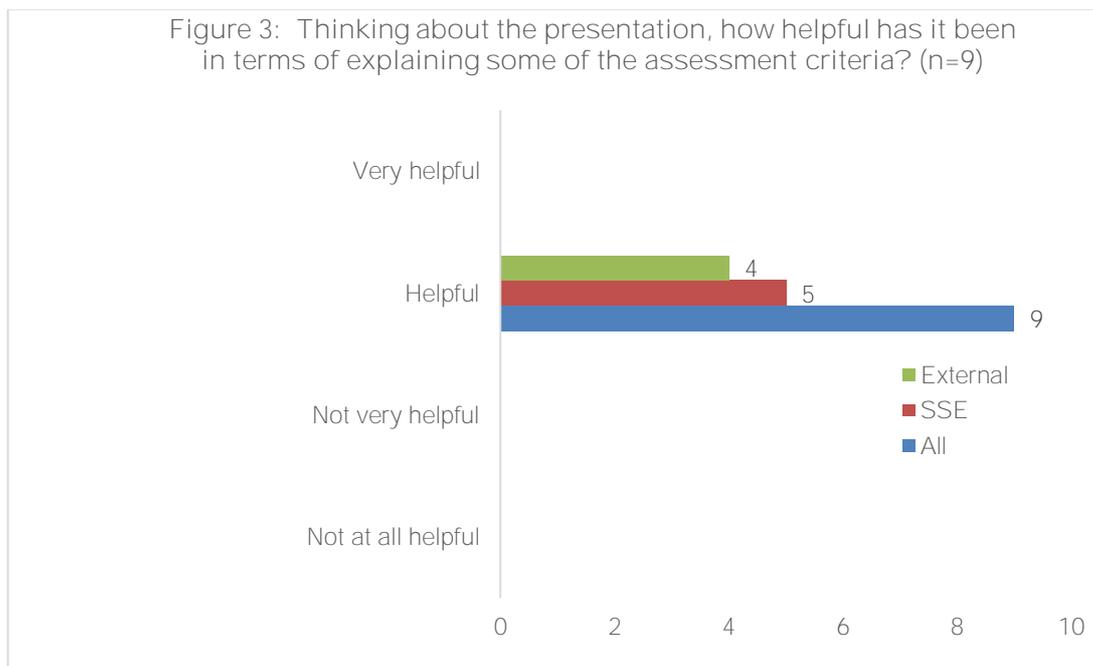
To provide a brief background to the NeSTS project, Tim Sammon (SHE Transmission’s R&D Project Manager) provided an overview of the NeSTS project to stakeholders. Following this presentation and, using SMR’s digital voting technology, stakeholders were invited to say if they were clear on the purpose and context of the day.

Figure 2 shows that eight out of nine attendees said they were clear and on the purpose and content of the day, with all external stakeholders (n=4) clear on purpose and content.



All stakeholders were asked how helpful they found the presentation in terms of explaining key aspects of the assessment criteria.

Figure 3 shows that all stakeholders (including all external stakeholders and internal SSE stakeholders) found helpful the presentation on the assessment criteria.



Following these structured voting questions, stakeholders were invited to comment or ask questions on the context and purpose of NeSTS. A description of this plenary session is now outlined:

- Q: “Is there a possibility of increasing separation by using different insulators? [to improve visual appeal]”.
- A: “Yes and no, but the best insulators do not increase separation so we are left with using the same insulators because of conducting”.
- Q: “Why are some of the weightings (on the scoring spreadsheets) so high?”.
- A: “The weights are the opinion of the experts who looked at it in the first place. So those are the opinions of the experts from Energyline and SSE and some of the weightings reflect items that are quite a big contributor to costs”.
- “If you look at the spreadsheets [in the SAM scoring booklet] you will see there are some tabs that look at different weightings, so there is a construction bias, there is an environmental bias tab and a construction tab. As a structural engineer I have put a high value on my aspects. A construction engineer is interested in safety and maintenance, so he weights his aspects highly. Environmental consultants tend to weight the environmental aspects highly, so that is why you have the different tabs to get the different perspectives”.
- Q: “Supports and Foundations have a high rating, does that include the landscape required for the foundations?”.
- A: “That would appear under Construction”.

3.2 Environmental Impact of Overhead Transmission Lines

Following the first presentation, a representative of Energyline (a SHE Transmission subcontractor) gave a presentation on the environmental impacts of Overhead Transmission Lines (OHLs). Following this presentation, stakeholders asked a number of questions and made a number of comments:

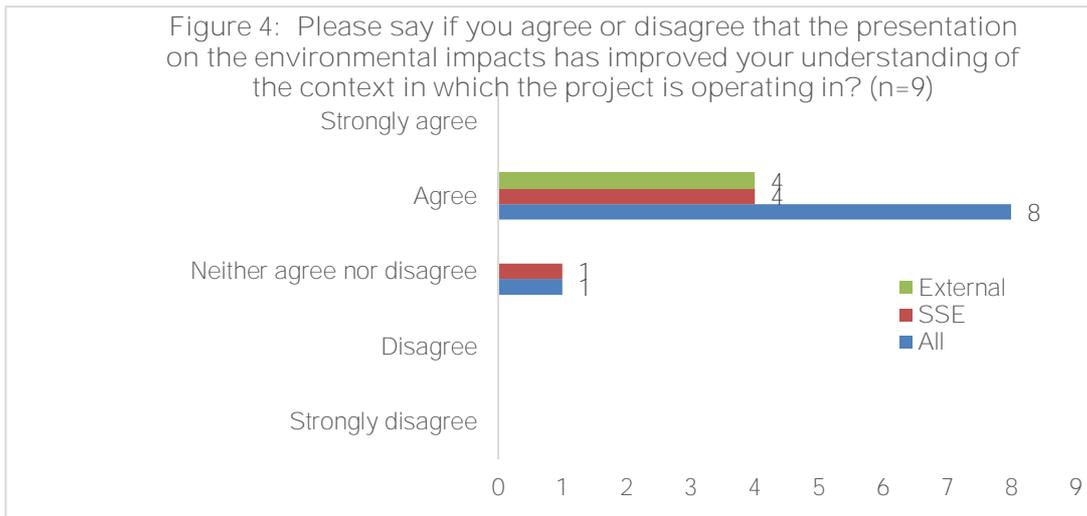
- Q: “To what extent, in terms of the national standards that you are working to, does climate have any impact at all? In different landscapes there are different climatic conditions. Do you, from a standards point of view, treat everything to the same standard, because we can all be hit by a hurricane, we can all be hit by different types of snow, is there an effect of climate that you can take into account in the standards that you apply?”.
- A: “Yes, it will change the climate loadings and things like the possibility of lightning strikes. We could incorporate different types, we could have 2 grades of suspension supports, heavy duty and light duty. The geometries are the same, but the materials may be lighter in the light duty. Also, foundations are designed to fit location and tower”.
- Q: “I am just curious as to whether these designs are all so robust that they could be put on top of “the passes” as well as down at the coastal estuary?”.

- A: “One of the features of the bid was that we have to design structures that will be suitable for use at altitude in the north of Scotland and so forth with the wind loadings and other loadings that are involved in those geographies. It is a practical reality that what the project will do is apply these structures to a line and quite how much of the remaining design envelope we end up filling out with medium or light duty structures, we don’t actually know yet, it will depend on what project we design for”.
- “Typically, you will have a suspension support, a D10 or a D30 support, and that is for maximum loading. What we talked about was having two grades of suspension support, for instance the heavy duty one would be suited to the extreme altitudes in the north and maybe a lighter variant for down south. The geometry would be the same or likely to be very similar, but in terms of the weight of the materials there may be some efficiencies to be gained”.
- Q: “When talking about geographic differences, presumably foundation design is a key point, subject to geological conditions?”.
- A: “The foundations would typically be designed to suit the location, so we wouldn’t put in a big foundation where it wasn’t needed”.
- Q: “You briefly mentioned potential impacts on birds. Can we make the assumption that there wouldn’t be an increased electrocution risk because of the likely separation of conductors and so on?”.
- A: “Good question. In the tool you will notice that there is a category for scoring the concepts in relation to birds in particular and we were going to score that today until our environmental consultants advised us that we should not do that in open forum and that we couldn’t do it as quickly as we intended to do the rest of the scoring. They advised us that we should go and see (the relevant stakeholders) separately to do that exercise. Some of the technology allows us to compact the corridor widths and place conductors closer together and we do need to consider those implications for birds”.

3.2.1 Impact of Presentation on Understanding of Project Context

Following the question and answer session, stakeholders were then invited to say if the presentation on the environmental impact of NeSTS had improved their understanding of the context in which the project is operating in.

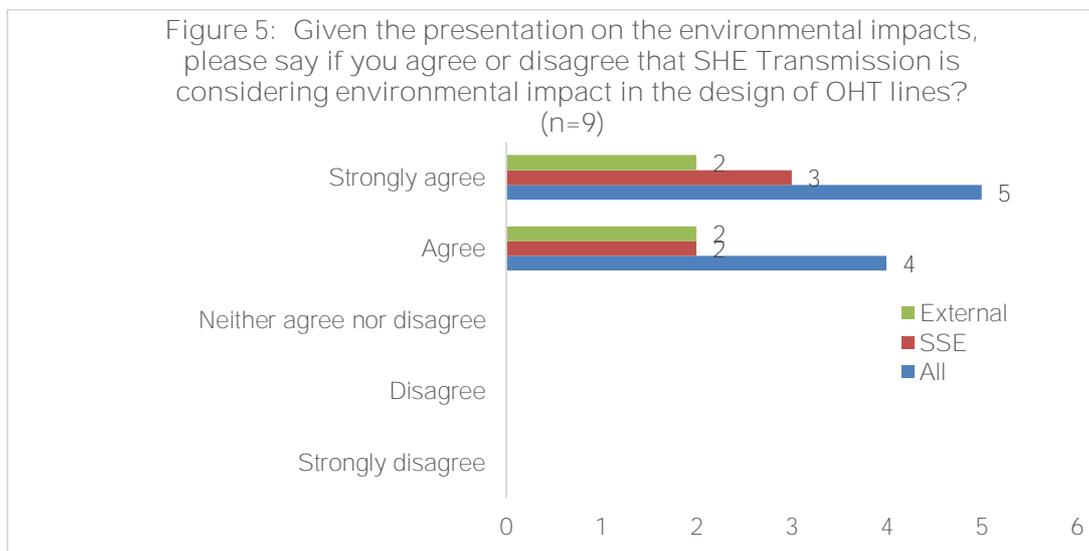
Figure 4 shows that almost all (eight out of 9) attendees agreed that the presentation on the environmental impacts had improved their understanding of the context in which the project is operating, with all external stakeholders (n=4) in agreement.



3.2.2 SHE Transmission Considering the Environmental Impact of OHT Lines

Stakeholders were also asked to register if they agreed or disagreed that SHE Transmission is considering the environmental impact of OHT lines.

Figure 5 shows that all stakeholders (both internal and external) either 'strongly agreed' or 'agreed' that given the presentation on the environmental impacts, SHE Transmission is considering environmental impact in the design of OHT lines. Among external stakeholders, two 'strongly agreed' and two 'agreed'.



3.3 Design Concept Overview

On behalf of SHE Transmission, a representative of Energyline presented an overview of the design concepts which included an explanation of the different tower structures, the process of moving from a long list of 23 potential designs to a short list of eight potential designs, and an overview of the 'optimal candidate' (i.e., the 510 Series).

Following this presentation, all stakeholders were invited to comment and present questions to the speaker. This question and answer session was extensive and is outlined below:

- Q: "The long-listed designs are all for 275Kv. Is there scope to go up to 400Kv or down to 132Kv?"
- A: "You could change the design to suit the other voltages, but it would be a different design to that for the 275".
- Q: "Can you expand on the logic of having a twin earth wire?"
- A: "The reason why we wanted two earth wires was to suit maintenance operations. With a typical pylon you can't lower the earth wire safely because the earth would be lowered between two live circuits. If you have two earth wires, you can work on the earth and have it offset, you turn off one circuit to work on one earth wire".
- Q: "Can I ask about conductors, what are the implications if you wanted to use a particular conductor for a particular condition?"
- A: "SSE expressed an aspiration for the rating that they needed for the 275 line and the Araucaria conductor provides that rating. You could use a different conductor on it, but we know that one works".
- Q: "So there wouldn't be scope for looking at other composite conductors, just the Araucaria?"
- A: "Good question. The Araucaria gives you plenty of scope, but it doesn't make the most of the advances in more recent conductors. We would be able to reduce the size of the supports if we were designing specifically for low sag conductors, so that's something we need to look at. It is within the scope of the project to look at different conductors.
- "However, if we design the supports for low sag conductors, we can't go back to AAAC, so we have to decide if we want to put that limitation on the future use of these supports"
- "You would be able to use other conductors if you design for AAAC, but you wouldn't be able to use AAAC if you design for other conductors".
- Q: "Can you just remind us what 700mm squared means in terms of diameter?"

- A: "35 diameter. Roughly speaking 700Kva at 275Kv".
- Q: "How does the span of these designs relate to the span of steel lattice towers?"
- A: "Lattice towers are typically 300m span. The new design can be spaced between 200 and 300, but you have to give consideration to the balance between height and span.
- "We are not too limited in what we can consider for this design. Opinions vary on whether you are better having more supports per kilometre that are lower or fewer supports per kilometre that are a bit higher. We are very interested to know what you think about that.
- "It's unlikely to be 200, the optimum is probably around 250".
- Q: "I notice that the foundations for these designs appear to be a bit deeper is that so? Are there issues around foundations and the type of environment in which these new designs will be located?"
- A: "The foundations for these supports are not limited to a particular type. We will consider the ground conditions at each site. We were hoping to start looking at caisson foundations as an efficient form of foundation, which would be deeper, but would have a smaller footprint area and may offer cost savings with regard to construction. Equally, we could use a raft foundation or piled foundation".
- Q: "Will the corridor widths be narrower?"
- A: "It probably will be narrower with the favoured design. Corridor width is influenced by span, in short spans, the conductors don't swing out too far. As you increase the span, the blow out of conductor increases and that increases the corridor width. It also depends on the type of conductor and how much it sags.
- "Corridor width is a scored concept, so there are very substantial differences between the different concepts in terms of corridor width".
- Q: "We are looking here at typical designs, but sometimes when you have to turn a corner you have a stronger type of tension tower. What are the implications of this design for the tension tower?"
- A: "In the information pack there were suspension supports and notional designs for tension supports. For the 510 series, bear in mind that you would have fixed cross arms with the addition of tension insulators.
- "One of the things that we are going to score is "continuity". It is difficult at the moment, we have concepts of what the tension and the termination structures are going to look like and on the scorecard for continuity you will see that we have gone with representations of them. It is something that we can discuss, what we anticipate the continuities to be, but it seems to be quite an important factor on visual impact, continuity or discontinuity between structures.

- “As far as this support series is concerned, the main, dominant component of the support is the pole. We have a single pole for this one and a single pole for the tension one as well”.
- Q: “When it comes to an angle tower, obviously if it is a number of spans we need to put in a tension tower, but obviously the degree of angle through which we would want to turn the conductor varies, do any of the towers give us advantages in a greater degree of angle through which we can turn the conductor?”.
- A: “No. Although there are different levels of continuity involved with how those changes in direction are supported. One of the advantages with a mono pole support structure is that even if you have to put in a lot more strength to deal with that angle and you have to increase the length of the cross arms, from a visual impact point of view and in contrast to some of the lattice designs, you have still got a single visual aspect in the mono pole”.
- Q: “Are you looking to take forward just one design at the end of the day or might there be advantages in having two alternative designs that fit different landscapes better and is it the intention that, whatever the winning design is, it would eventually replace the existing lattice towers?”.
- A: “The current proposal is to take the design that has scored most highly and take it forward to a stage where it could be deployed. If we develop two types, then that is twice the design effort. However, we did look at the 540 series as well as the 510, so once we have the 510 up and running there is scope to have a low height variant with a tri-form arrangement with a triangular arrangement of conductors allowing us to lower the height of the support.

“The project is going to develop two designs. At the moment we are planning to develop two embodiments of the same form to do two different jobs, one at 275Kv at a high rating and the other at 132Kv also at a high rating for that voltage. Soon we are going to select and actual overhead line development to work on. At that time, we might decide to cease working on two ratings and voltage levels and may decide to expand the breadth of the design to suit the landscape that we are working on”.

“One other thing. This project is to design another option in the suite of things that we have to deploy at the moment. It is very unlikely to provide a panacea. It is to provide another option rather than to replace the need for other designs. What we do design will become a design in the National Grid library, accessible to all the transmission network owners to use if they wish”.

“If you just wanted to deviate a lattice line and you were to stick in a few 510s it would look incongruous”.

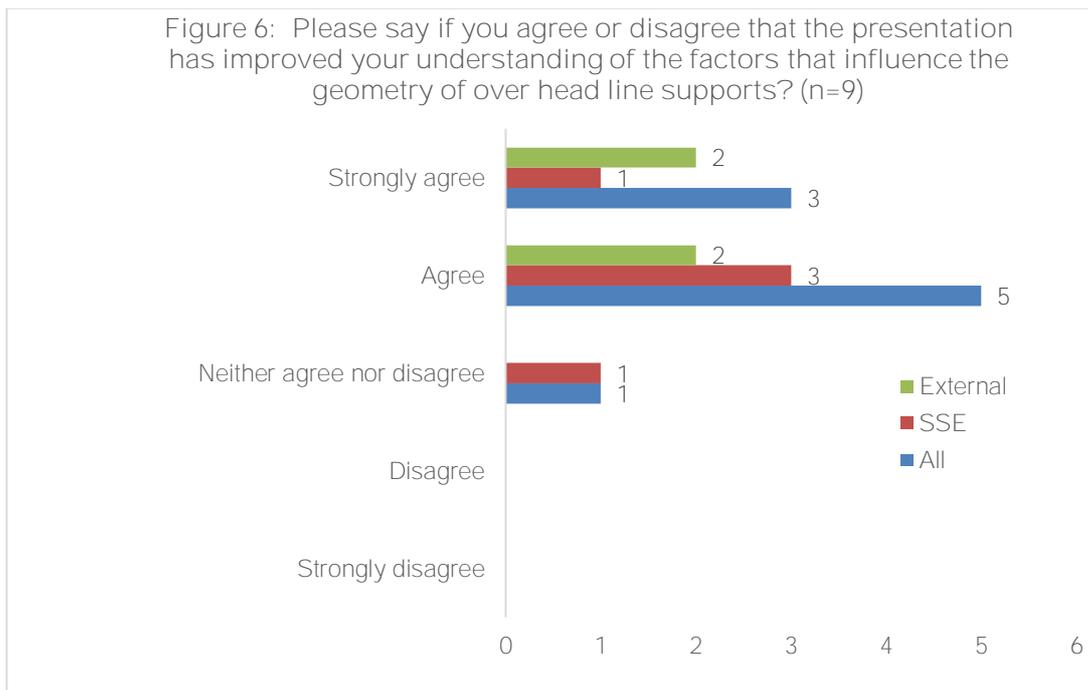
- Q: “When you switch a design from a 1 circuit to a 2 circuit, do you pretty much just chop off one side or do you balance them?”.
- A: “They would be balanced, but we won't be designing for 1 circuit. All are designed for double circuits and are designed to be worked on with one circuit out. That's for network resilience”.

3.3.1 Impact of Presentation on Understanding of Geometry of OHT Line Supports

Following the question and answer session, stakeholders were then invited to say if they agreed or disagreed that the presentation had improved their understanding of the factors that influence the geometry of overhead line supports.

Figure 6 shows that almost all (eight out of nine) attendees either ‘strongly agreed’ or ‘agreed’ that the presentation had improved their understanding of the factors that influence the geometry of overhead line supports.

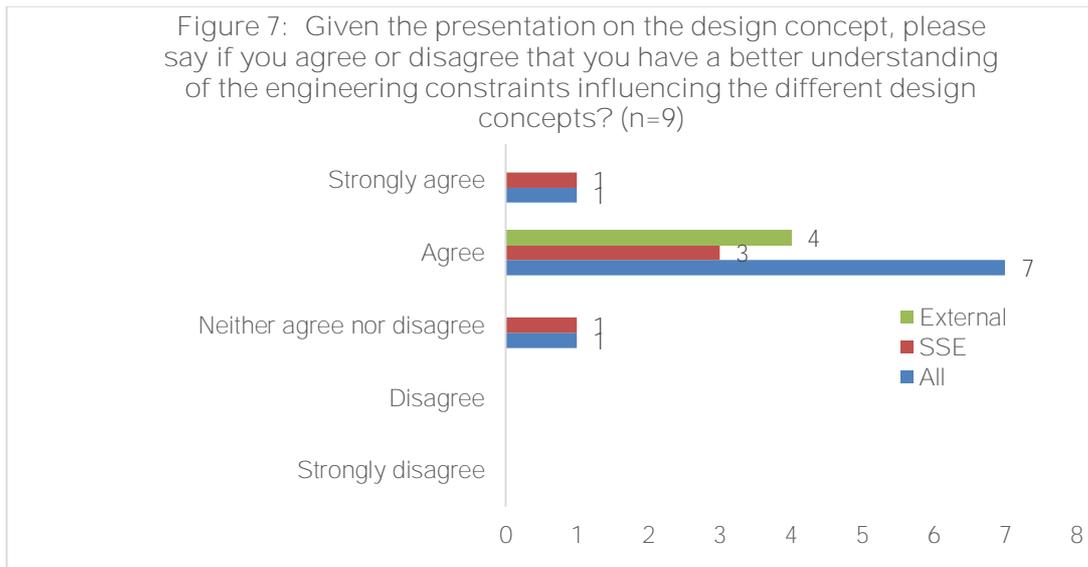
All external stakeholders (n=4) agreed that the presentation had improved their understanding, compared with four out of five internal SSE stakeholders.



3.3.2 Impact of Presentation on Understanding of Engineering Constraints

Stakeholders were also invited to say if the presentation on the design concept had improved their understanding of the engineering constraints influencing the different design concepts.

Figure 7 shows that eight out of nine stakeholders either ‘strongly agreed’ or ‘agreed’ that following the presentation on the design concept, they now had a better understanding of the engineering constraints influencing the different design concepts. All external stakeholders (n=4) said they had a better understanding following the presentation, with four out of five internal SSE stakeholders supporting this view.



3.4 Exhibition and Evidence

An extended coffee break was then held during which; more informal discussions were recorded by two SMR personnel. Some key conversations that were recorded at this time are described and recorded as “ES” representing External Stakeholder, “IS” representing Internal Stakeholder and “E” representing Energyline participants.

During coffee, all stakeholders were invited to review the exhibition of the different design concepts on display in the event venue. The exhibition was made up of photo montages of the eight potential designs in differing natural landscapes with a scale model structure of each design on physical display.

Exhibition Discussion 1:

- ES1: “One thing I wondered about the visualisations is that, and I had not really worked out, was an insulator. In the visualisations they are shown as being the exact same colour as the support and the cross arms whilst when you look at a transmission line normally insulators stand out because they are glass or ceramic and are quite shiny and prominent. It under represents the impact. It would have been clearer if they had been a different colour on the score cards.”

- ES2: "I am less sure about that than you are, it depends a lot on the lighting conditions, depending on the angle of light. Even on older lines, the insulators and even the conductors can be very prominent."
- ES1: "It was also one of the reasons I asked that question about the design of some of the components, I mentioned the conductors but do the insulators have to have a shiny finish, could they be made more matt and less prominent. There are probably very good electrical engineering reasons for why they are made out of what they are because it has good insulation properties, but do they have to be as reflective as they often are?"

It was clarified by a representative from Energyline what insulators will be used on future designs.

- E1: "It's anticipated that they will be made from a composite substance that will be a grey, dull in colour and lighter in weight, thus reducing the refraction of light and stand out in natural landscapes".
- S1: "That one is very chunky isn't it? However, it would be quite safe to work on because of the separation between the two however, it just doesn't look right. I think there is far too much steel in it. However, I think it's interesting there has not been a lot of change in this design because the old design works."

Reference made to 580 series.

- IS2: "There was quite a lot of confusion on our table as people weren't clear what MVA was?"

Exhibition Discussion 2:

- ES3: "I think for us routing and sighting of powerlines and how the structures will relate to the historical environment assets in the landscape and if that will be problematic for us in terms of views out of things in terms of how we understand the heritage aspect in the landscape. So we're happy to contribute and we understand there's scopes you move towards of lower impact solutions and we're happy for you to move towards that. But for us what's key is where they're plonked in the landscape. We keep an eye on where routes are planned and where they might have an impact (inaudible) monuments and archaeology in the hills so that kind of thing we all need to keep a close eye on. But it's great seeing all of the new designs. It's fascinating."
- ES4: "Have you got a favourite?"
- ES5: "The 510 series. I think for us guys it's quite tall but beyond that we considered it was quite low impact and quite pared back [*reduced size*] in terms of design. That did very well in our estimation and from the notes apparently they're quite easy to whip up in terms of there's only one leg in the ground, less land take as well. That seemed like a good option to us."
- ES3: "What do you think of the existing...?"

- ES5: "The existing, steel lattice towers? I was looking at the Beaulieu Denny line on the train on the way up and suddenly I'm all 'oh no, all about pylons."
- ES4: "When you start talking about it you see them everywhere. "
- ES3: "That's it, they're everywhere. Someone made a good point earlier when it's late evening and you have the sunlight bouncing off the wires and suddenly there's these big spiders webs you can see in the sky and they are so prominent in those sorts of light conditions. The big lattice towers they are very strong in the landscape. I can see the advantage in terms of span, they can span long long distances so you don't need as many interventions to get your line across but they are very distinct."
- ES4: "From a heritage issue, obviously you're focused in on the sites that are designated or particular importance. But from a wider heritage issue in Scotland there is a kind of history in that. In terms of why they're there."
- ES5: "Yeah absolutely 30 years down the line we may think that these structures are iconic images in the way they've been designed."
- ES3: "And the role they played in that part of the hydro and energisation of the north of Scotland."
- ES5: "Absolutely, so there are different factors that come into play but there is an argument for a more sculptural solution that is stronger in the landscape because they will never blend."

3.5 Span and Height

On behalf of SHE Transmission, a representative of Energyline presented an overview of the relationship between span and height in the context of OHLs. Following this presentation, stakeholders made a number of comments and asked a number of questions:

- Q: "Is there any addition to that in terms of foundations that are required building a taller structure?"
- A: "There are absolutely, yes. The taller your tower the bigger your foundation. But in this discussion, just thinking about the visual aspects. But yes, increasing the height of the support, there's going to be more steel so there's going to be more materials for it to be stronger to support a greater load and that applies to the foundations as well".
- Q: "I suppose those two criteria are relevant when you're discussing whether you want a long span or a short span for one particular option".
- A: "For this we're just looking at the span and height. But it is a good point that you can change the conductor configuration but that's other aspects of the support assessment. So I've taken the liberty of taking the montage and doctoring this on here. But that's typically a 300-meter span and that's a 200-meter span".

- Q: "You're raising the point that it depends on the landscape. How much is it a pick and mix? In terms of an engineering point of view do you have a consistent height and span across a range of territory? Or really can you pick and mix and say that we're coming to an area where it's open farm land and we'd like to increase the span here to get reduced impact and footprint on the farmer's field. Or you're leaping from one forest to another and therefore you can help design the line to mitigate the design of the line by trying to follow the form of the landscape through here. Does it matter from an engineering point of view that you flip and flop along an extension of the wires over several kilometres or are you always constantly trying to use the same".
- A: "The standard span isn't what you actually see in the field. It's right, you'll say I want a line from A to B and you go bang, bang, bang, bang down to where these supports are and then you look and you say 'well I can't put it there cause there's a river so we'll have to move it a little one way or another.' So you hardly ever end up with a set span. That's just a notional concept".

3.5.1 Discussion Group: Span and Height

Stakeholders were invited to participate in a 30minute discussion group which was co-facilitated by two SMR team members. The discussion group were invited to consider the following:

- A. Their immediate thoughts on span and height factors affecting design;
- B. Concerns or challenges in relation to span and height; and,
- C. Opportunities relating to span and height that they saw.

Immediate thoughts on span and height

- Facilitator 1: "What were your immediate thoughts on the presentation about height and span?"
- ES1: "Like David [name changed], I thought it was 'horses for courses'".
- Facilitator 1: "What would be 'the horse' for you and what would be 'the course' for you?"
- ES1: "It would depend on the course [landscape and future need] obviously".
- ES1: "As we previously discussed putting a line through different landscape character areas it just occurred to me that SNH have got a whole sweep of landscape character areas. It might be worthwhile looking into that as a basis for some form of policy. Certainly I can see it in simple, remote landscapes these sort of taller towers spread well apart and then once you get into the busier landscapes you'd need to put something in to fit with the infrastructure and development that's there already. But also possibly suit the character a bit more if it was smaller and more of it".
- Facilitator 1: "[David [name changed]] that's your view approximately too?"

- ES2: “Approximately yes, in terms of what we have as a ‘tool in our bag’. I think when you come forward with an application you almost about limits of deviation for this that and you want a bit of wriggle movement for construction which is highly understandable. From our point of view in terms of managing land use or mitigation in terms of impact of existing housing and stuff like this and how you, I would like to tighten up the approval process because I think along the line there are some key points where you say ‘Right that’s where we want the span and its fixed cause its next to the road, least intrusion in the field, or the way it’s spanning the river. That’s a fixture, there might be flexibility elsewhere down the line but then there’s probably another fixture to come into your sub-station or something like that. So it’s good to know that there’s a variety”.
- ES3: “It’s good to know there’s flexibility in design there. That you can actually make it specific along the route”.
- ES4: “I wonder if there’s some general rules that would apply and we have to accept as professional. In the Beauty Deny project I think the larger spans meant fewer pylons which was therefore seen as a tick, generally. So is that a premise that we all like and understand? Is that a rule of thumb? That the fewer pylons you have the better?”.
- Facilitator 1: “Well this is something you’d know about Moira [name changed]”.
- ES5: “Well I think I agree with horses for courses argument and completely concur that we’d like to see wriggle room because what’s so important to us is the sighting of these things and how they’re positioned so as and often it can be a degree, a question of micro sighting. So there can be a degree of meters in terms of impact on key views. We want to see a bit of wriggle room and flexibility in terms of the design and what comes forward. I can see a benefit in having fewer actual interventions in the landscape spaced further apart. Having said that, maybe shorter structure and more of them look better in different landscape types so it depends really. I think in terms of we’re looking, sometimes we look at key views and impacts on those and sometimes it might be more beneficial to have smaller structures so then they’re not as strong in interfering with key views. But really it’s a question of horses for courses really”.
- Facilitator 2: “In terms of span and height are you talking about small structures, closer spans and taller structures, longer spans depending on the territory?”.
- ES3: “Depending on the territory absolutely”.
- ES2: “I’d agree with you completely there. Thinking about the key views and how are they viewed and there could be advantages and slight high production which may transform how its perceived from that key viewed and would make it a lot more acceptable for small amounts of flexibility”.
- Facilitator 2: “People talked about continuity earlier on, so if you were varying height and span to suit various territories would change in continuity be a concern? Having shorter ones close together and then suddenly leaping to taller ones”.

- ES1: "That might be related to topography and it might be a way of improving continuity if it the different heights reflect topography. So I don't see that as being a major disadvantage. Still a bit unclear about the parameters for this discussion. Are we focusing now on the 510? Or are we considering height as a parameter for all the possible designs?"

Concerns or challenges regarding span and height

- Facilitator 1: "To capture some immediate thoughts you have following the presentation, lets discuss your immediate thoughts and then get into any possible concerns and challenges you may have around height vs span or how you weigh up the trade-off between the two. Perhaps we could start there?"
- ES2: "Yeah, I think looking across the different designs although the 510 does have what you might perceive as a disadvantage of having greater height than most of the other designs. From what we've heard this morning it appears there's flexibility within that. So that concern in height/impact sounds like there's options to reduce that so thinking about it again that may affect our thinking about the 510 which, I don't know if I should say now, which is one of the ones which is coming out quite high positively in terms of the reflection you've given on it at the moment. But if it does have the possibility of having a shorter version with more frequent spacing of course then that possibly would mean that we would consider that one even more positively or favourably. But certainly initially we were just thinking about that one as fixed at 29 meters whatever the situation".
- ES4: "Without being an engineer, I think the principle of span and height are across all the designs. I think you can actually reduce the height of any of the designs or increase the height based upon what you might think most appropriate. Inherently some of the designs would be their starting point would be higher than others which is a consideration but I think for any of the spans I think if there is a worry over height in a particular landscape there is a flexibility there to reduce or increase".
- Facilitator 2: "Charles [name changed] do you have anything of concern?"
- ES1: "Yeah I think in terms of perception I think it depends on the number of receptors and viewpoints in an area. If you've got a very remote area that few people are seeing, then obviously you can get away with more than you can where they're closer to the actual structures and where there's points of reference. If you've got buildings and normal development and you stick a tower in, people know or can perceive that it's extremely tall or uncomfortably big or whatever. Whereas if you're in a very remote area and looking for 5 miles and there's a line of pylons you don't know, or you can't easily perceive that they're particularly big or long or whatever. So I think the flexibility lies there. In terms of continuity for me it's to do with the actual composition of the structure, the style its design. Unless there's radical alterations in its scale and how it perceived for me continuity is the actual design and it could come in different scales and be put in different contexts and whatever. But that's what continuity is to me".
- Facilitator 1: "There's lots of nodding heads there on that last comment. Anybody want to add anything into that."

- ES3: "I think some of the design models blown up and enlarged at a great height will have a greater impact than other design models. Just looking at some of the lattice towers when they're skylines particularly they're dense, they're big structures and they're mass is very striking whereas, for example, with the 510 its slender and having it being taller isn't necessarily as problematic to me as having a bulkier structure being taller and proportionally bigger".
- Facilitator 2: "So what you're saying is the bulk of the structure towards ground level is more important than visual terms, perhaps, from your perspective than bulk of the structure that's present".
- ES2: "A bulkier design, made bigger is more problematic than a slender design made a bit taller. Just from my view".
- S2: "May I go back to some design principles too of the function dictates the form. I'm struggling with some of the design options that we've got at the moment to understand why is the form in that manner? That is adding to the functionality or anything else. So therefore the really chunky lattice tower that is bending over and crossing over to me is almost a modern art statement rather than actually fulfilling a function. Because I can't, as a layman, read it as having a purposeful form in that manner".
- Facilitator 1: "What are some of the struggles that you are having over the designs? Just to be really clear"
- ES5: "I always look for simplicity and functionality and therefore setting, context and impact".
- Facilitator 2: "What about the challenges involved in selecting the design in terms of span and height? In terms of what you heard today, do you think there's any specific challenges in your point of view?".
- ES2: "I'm not sure what you mean? I think we've touched on it already. Which is different landscapes will present a challenge and therefore you choose the height and span to reflect that".
- Facilitator 1: "Is it a measure of appropriateness? What fits best with the landscape but equally doesn't take away from the functionality and simplicity. Is that a fair summation?".
- ES3: "There's obviously a link between height and span and the construction footprint as well. The higher the tower, the greater the span, the fewer the access points, fewer construction and lay down areas. So in some situations where you might have sensitive habitats you might wish to reduce the number of access tracks and construction points. Maybe benefits the higher tower with the bigger span and therefore overall, fewer towers. Again if the 510 has that flexibility where in certain situations, taking into account other sensitivities as well, you would be able to reduce the terrestrial ground footprint. There could be advantages there".

- ES4: "I can see that in a situation where you might be looking down the length of a line and sort of seeing a stacking effect of lots of the towers almost superimposed onto each other and you could reduce that at the expense of height".
- ES1: "But it depends on the situation, the Beaulieu-Denny line as it went through the Corrieyairack. You basically had to start at the bottom of the hill and get to the top of the pass and you couldn't avoid doing anything but that. So you need your track from the top to the bottom. The fact that you had fewer paths or more paths were your building pylons comes pass this micro siting issue and the degree of ecology that underneath the line your still probably going to have to still build that track from A to B all the way".
- ES1: "Very project specific actually".
- ES2: "Absolutely, other ones you can criss-cross so you won't have to do that".
- Facilitator 2: "But what you're talking about clearly, is an opportunity when looking at the 510 to reduce environmental impacts as you go along because of the variation".
- ES4: "In some situations, yes".

Opportunities relating to span and height

- Facilitator 2: "Are there any other opportunities that anyone sees in reducing environmental impact?".
- ES3: "For us routing and siting are key, because the way we tend to approach things is on a receptive basis. Although we are more broadly thinking about landscaping considerations too. So, where things are positioned in relation to a country house makes a massive difference to us. Beyond that I think modifying the design so it's less obtrusive within the landscape is a good way to go and we'd certainly support more of the paired back models, simpler designs because there's less of an impact there".
- ES4: "Another thought I had about reducing environmental impact in the design is access tracks are quite significant in the impact they have. Both due to construction and access for maintenance. And dependent upon the construction methodology or maintenance requirements of different designs might have an impact upon the scale of access required and the make-up of that. If some are easier to construct, require less foundation or can be done modularly or need less big kit like 100tonne cranes and things like that. That could significantly change the requirements to construct and therefore reduce the impact as well".
- Facilitator 2: "So a modular design that can be brought in smaller pieces, for example. Having lower impact".
- ES3: "Yeah you need less weighty cranes equipment to actually construct it and therefore you don't need quite as wide access tracks, things like that can have a significant impact".

- ES2: “That's one of the design aspects that I was going to bring up just being underplayed or possible absent from the documentation that we'd received and that it is of considerable importance to us because often these access tracks might be planned as being temporary but then become permanent. Or might be designed as permanent from the outset. So construction and maintenance can have considerable landscape impacts and habitat impacts as well. I might be wrong but there didn't seem an opportunity to include that in our scoring at any point in the documentation?”.
- Facilitator 1: “Well, you'll be glad to know. There will be later. We're going to be holding another small presentation, another discussion group and then there's an opportunity to actually provide your own scores and make your own decisions this afternoon. The afternoon bit is actually very key because we're looking for how you would score each criteria and one of them is that”.
- ES4: “But we might need to know a bit more about what do each of these designs mean. In terms of access provision. And as R said do you need a huge crane to put them up or can it be done much more simply”.
- Facilitator 1: “It's about how construction can minimise the impact on environment factors so it's very pinpointed on that theme”.
- ES5: “I'm a bit confused as to where we've ended up. When we first started we were discussing do we go big and fewer or small for less impact and stuff like that. I think what we've done is horses for courses [i.e. where we started from]”.
- ES1: “I think detailed comments about access track, not speaking to just access to pylon lines in particular but generally high level tracks. Certainly in my experience, design is very important and sensitivity to the location because some of the worst environmental damage I've seen, certainly on high ground has been done with access tracks. It needs a degree of sensitivity. I think realistically an applicant comes in and says 'Oh it's just a temporary track' but I think it needs to be treated as a permanent feature. Cause often it's not and we get left with them. Because they can be sensitively designed and they need to be sensitively designs. They need to be designed to minimise the earthwork. They need to flow with the contours not through them. There's a possibility that habitats can somehow be worked into these positively. Looking at the Beaulieu-Denny line you can just see the track just following the line and I think it could definitely be done much more sensitively. For me the elephant in the room is burying cables and sections should be an option. Constantly they turn round and say 'well we just can't cause we have to comply with whatever regulation'. But if you do have a particular sensitive receptor I don't see why we shouldn't have that option”.
- Facilitator 1: “That's an excellent question to bring up in the discussion around construction actually. It's clearly a key interest area for you. So certainly its one worth addressing”.
- ES2: “You've got issues around disturbance of habitat”.
- ES3: “It's certainly not a universal solution to environmental impacts”.

- ES4: "I think Ross [name changed] has been working on a simple explanation behind it?"
- ES2: "We were discussing it last week actually, internally. About having a basic fact sheet about pros and cons to underground because there are pros in some situations and cons in others. I don't want to go back to the phrase horses for courses but it is very project specific and site specific."
- ES5: "Certainly in the Aberdeenshire area we've got gas pipeline after gas pipeline and oil pipeline after oil pipeline. Obviously by the nature of that it has to be buried. I have to say the developers have done quite a good job. Everything gets reinstated exactly as it was. Technically I don't see it as being a big issue".

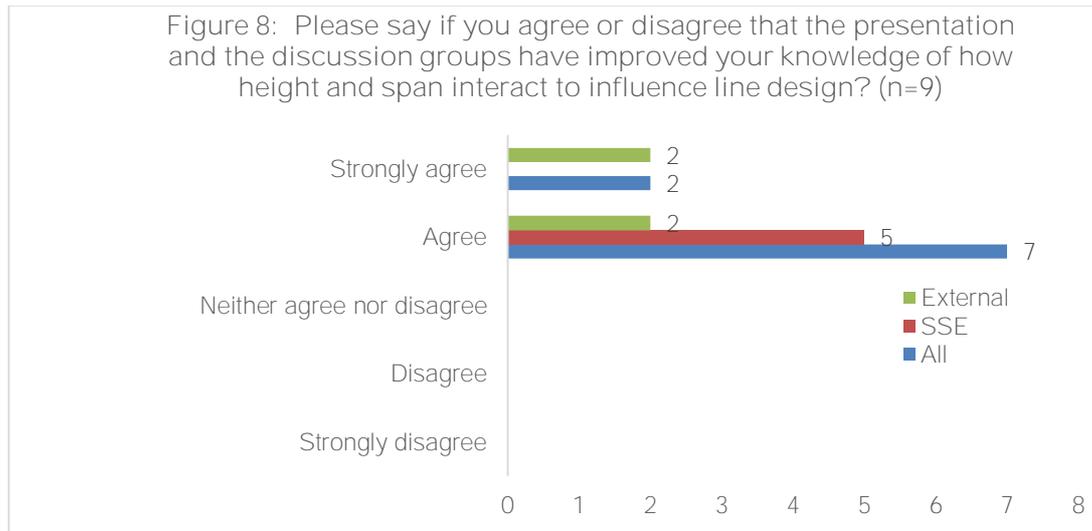
Internal SSE stakeholders also took part in the discussion groups. Feedback is outlined below:

- IS1: "I was thinking about maintenance costs. If you have an existing line with one type of tower and you have got new lines with another type of tower, what does that mean in terms of maintenance costs?"
- IS2: "yes. What does it mean if I am customer who is paying in and I know it is a socialised cross / GB cost but if you end up with a network with two different types of tower?"
- IS3: "You also got to think of the costs [to the customer]. At the end of the day, I am paying for this as a customer so I would just wonder..."
- IS2: "The presentation looks at span and height differentials. So my question is: if I am paying for a wind farm trying to connect to the network and I have a contribution to pay towards that section of line. Understandably, I want to go for the least cost option and if the old option was a wee bit cheaper, would I be able to influence that decision like these larger organisations?"

3.5.2 Impact of Presentation and Discussion Group on Span and Height

Stakeholders were asked if the presentation and discussion group on span and height had improved their knowledge of how span and height interact to influence the design of OHLs.

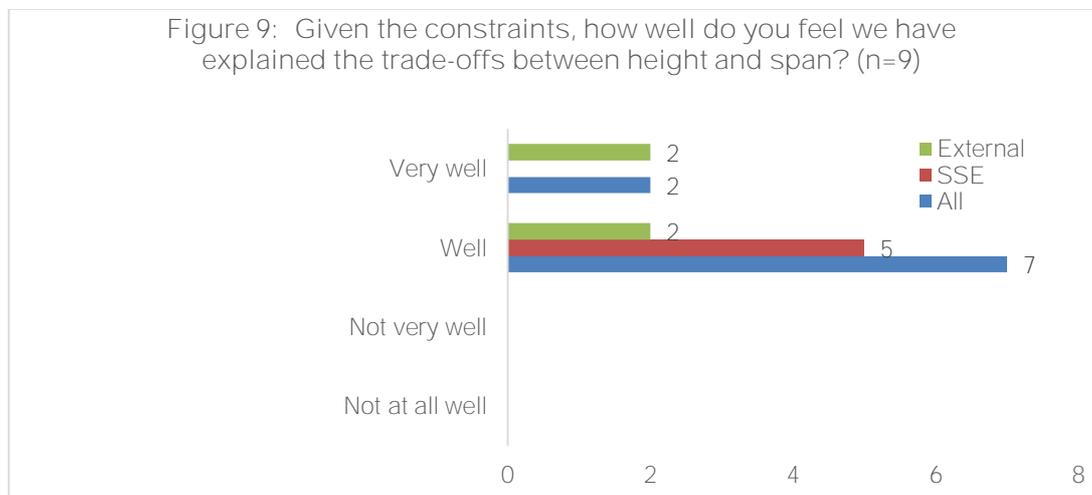
Figure 8 shows that all nine stakeholders (both internal and external) either 'strongly agreed' or 'agreed' that the presentation and discussion groups on span and height had improved their knowledge of how height and span interact to influence line design.



3.5.3 Satisfaction with How Trade-Offs between Height and Span Explained

Stakeholders were also asked, given the constraints, how well the trade-offs between span and height were explained to them.

Figure 9 shows that all stakeholders (both internal and external) believed that the trade-offs between height and span had been either 'very well' or 'well' explained to them.



3.6 Discussion Group: Insulators and Insulator Configuration

On behalf of SHE Transmission, a representative of Energyline presented an overview of insulators and insulator configuration. Following this presentation, stakeholders made a number of comments and asked a number of questions:

- Q: Before we move on can we just go back one picture because we had a useful discussion in the breakout session. Why are those, in effect, downward pointing configuration which is generally not regarded as the happiest looking aesthetically.
- A: So this pivot axis and the conductor being at a low point compared to the points on the support is needed so that the conductor swings back to a neutral position which is on the transverse axis of the tower. If it was up the other way, then it would be an unstable position.
- Q: So if it was like that a whole string would be inclined to pull in one direction?
- A: That's right, with this the gate swings to the neutral position. OK. The braced post system is similar to the hinged horizontal V but the bottom compression insulator has a (inaudible) connection to the support which resists longitudinal movement of the (inaudible). That's a problem as far as the engineer is concerned because that's bigger forces that need to be engineered for. The pros and cons are similar to the horizontal, but there are design challenges in broke wire scenarios and in order to withstand bending the bottom insulators are typically larger in diameter.
- Q: Can I just check, when you talked about the different materials that you can insulate, ceramic, glass or polymeric are all those configurations possible with those materials?
- A: No they're not totally interchangeable. You wouldn't be able to use I strings with a compression arm with the horizontal V for example.
- Q: OK, but the choice of materials in terms of glass or ceramic?
- A: No there are restrictions. You can't just say 'Oh I want one glass' because for instance the compression insulated on the horizontal V isn't available in glass. It isn't available in glass or ceramic.
- Q: Is there any efficiencies in maintenance. So does glass last longer or does ceramic or are they all the same life expectancy?
- A: I don't know the answer to that. My understanding is the polymeric run a similar life span to the glass and the ceramic but I'd need to check up on that.
- Q: Glass has been our preferred option for a number of years. What would that typical life span be?
- A: Typically, about 40 years for the life span depending on different conditions.

- Q: Why do insulators look like stacks of linked disks as oppose to a cylinder? Why are they like that? Is that a stupid question to an engineer?
- A: It increases its length. If you pretend you're an electron and you're trying to get from high potential to low potential you'd just shoot down the side of the cylinder. Whereas a lot of disks you have to go all the way around if that makes sense?"

3.6.1 Discussion Group: Insulators and Insulator Configurations

Stakeholders were invited to participate in a 30-minute discussion group to consider the following:

- Their immediate thoughts on insulators and insulator configurations;
- Concerns or challenges in relation to insulators and insulator configurations; and,
- Opportunities relating to insulators and insulator configurations.

Immediate thoughts on insulators and insulator configurations

- Facilitator 1: "What are your immediate thoughts about the insulator presentation?"
- ES1: "For me it's a don't know much about the engineering around them, for me it's much more of a do they fit with the design of the wider structure and overall the overall impression of the structure not the specific insulator elements of that. It's how well it fits in. I'd be happy to work with the solution that contributes towards a coherent structure that sat well in the landscape".
- S5: "Ditto"
- Facilitator 1: "Consensus already, excellent. What about from an engineer's point of view?"
- S4: "I'm coming from more of an architectural background as well. But I'd just concur with what's been said. From a visual perspective it's about how the structure holds together as one and particularly given that you can't interchange cause its very dependent on the design of each structure what insulators would work with that. You've just got to look at..."
- Facilitator 2: "Are you clear enough on that from the information that you've had so far. We're primarily looking at the 510 here. Have you had enough information on the insulators that would go with the 510?"
- S1: "From the pre-tea break discussion in my understanding was it would be the polymeric option that would go with the 510, which to me sounds beneficial because glass and possible ceramic insulators have a disproportionate visual impact when you look at existing structures given the scale of them. It's often the insulators that catch your eye in certain lighting conditions such as low angle light, for example. We discussed if that because they're new and fresh but I don't think it is. I think it's something that persists during the lifespan of a transmis-

sion line. I understand that the polymeric insulators can have a matt finish so they wouldn't be reflective and are likely to be less visible, especially if they're integrated into the structure. But even if they weren't I think there'd be benefits there in terms of reduced visual impact".

- S3: "Colour pallet and thing such as that in terms of how well that fits in with the wider structure and the landscape environment in which they sit as well. So consideration like that".
- Facilitator 2: "Colour coordinating them you mean?".
- S4: "I just find a neutral colour that fits well with the wider structure as well as the environment the towers been positioned".
- Facilitator 1: "Does glass answer that a little? On that issue?".
- S2: "I think if there, from what I understand, is an increased visual impact in certain light conditions from glass then it might be better to go with a solution that's matt and doesn't quite throw off the light so much".
- S4: "Or even frosted glass?" (Laughter)
- S5: "I think as long as it's a coherent design and that it sits well that's the most important factor for us".
- S3: "So do you think the existing design where the insulators hang down on strings below the cross arms".
- S2: "I suppose in a way that's less-neat than other configurations that were on offer".
- S1: "I was intrigued by the pictures up there with something that was blue. I haven't seen blue before in the colour. We're dealing all the time with glass or white or at times dark brown. But I haven't seen blue before so was wondering if we'll see red coming in then yellow the next".
- Facilitator 2: "Colour would be a concern from your point of view?"
- S2: "Yes, absolutely in terms of if you're trying to keep something very neutral and not eye catching".
- S4: "Maybe it's from a country from where the skies are always blue?". (Laughter)
- Facilitator 2: "Perhaps we should have dove-grey or something!". (More Laughter)
- S5: "I think it's an important point though, colour of insulator. Especially if you go for the polymeric one which I'm assuming are more adaptable to change the colour. It's a consideration when looking at the design as to what the optimum colour is".
- Facilitator 2: "Are there any concerns in terms of design as well as colour?".

- S5: "Well yes, but in terms of the insulator? They're not a big part of the design but if they form part of the visual structure then it's clearly part of the whole".
- Facilitator 1: "So it's the look of these things, the visual aspect of primary concern. For example, if the wind is blowing through different insulator designs will there be noise in certain circumstance than others. Would noise be a factor for you or is it mainly the visuals?".
- S2: "Definitely noise. Particularly in an urban area, the crackle of the line gives cause for concern. The noise of a pylon at the moment, I'm not aware of it and I've lived quite close to some of these things so I don't find it a problem. But if any of the new designs introduces noise...".
- Facilitator 2: "So a whistling insulator would be a problem?".
- S4: "I've always assumed that this is all going to be quiet [i.e. little or no noise]".
- S4: "I think it's a good question, has it been considered as part of the design because it's a very important consideration. The wind itself is noisy. Whether you get a reception of a whistle or something".
- S5: "I think you tend to get that more from distribution lines than transmission lines that kind of whistle".

Concerns or challenges regarding insulators and insulator configurations

- S1: "A question? "We've discussed insulators shape size etc. But we've focused mainly on colour but we were just getting into the topic and noise and nuisance arising from any of the structure in terms of design. But does any of the insulator, have they been tested for noise? Because at the moment we're all assuming that your structure is relatively quiet. But have the new designs been wind tested, thoughts on the noise aspect. Is there a whistle arising?".
- E3: "One of the electrical design aspects was noise. That arises from the voltage and the diameter of the conductor. It's not a function of the insulator as I understand it. It's not my area of expertise".
- S1: "Do any of these options have a noise themselves? If the wind whips past?".
- E3: "There's a conductor characteristic and a voltage characteristic".
- E1: "I know of that, that's the crackling".
- Facilitator 2: "Is there a whistling factor as the wind blows through?".
- E3: "Ah I see. To be honest that's not been discussed at all. Are lattice towers noisier than a tubular support? No idea. Not sure there is evidence either way".
- S2: "Do these configurations for the insulators, are they used elsewhere? Are you aware of anything that might be raised when you actually install them?"
- E3: "With regard to noise? No".

- Facilitator 1: "May I suggest something? That we actually go away and you allow us to feedback on that? Because I think it's a fair point".
- E3: "Definitely, we'll do some research on that".
- S2: "If you're in a marina and you've got all these tubular masts of that design...".
- S1: "On the wire?".
- S5: "No, no we're talking about..."
- E3: "...talking about the marina".
- S3: "Well, the marina will have a flapping, they will have wires against a tubular thing. You don't have that sort of thing on your structure, I presume. But I'm just thinking, is there anything in the dynamics of what you're introducing here that would be a new experience for people?".
- S4: "The same way you get a fence whistling, or a roof rack. Just the nature of the way it's designed. It whistles".
- Facilitator 2: "So they overall tower design and the selection of the insulators. That's, the question. Not just the tower but also the insulator noise factor".
- E3: "Just listening to the question now, and thinking about it on the spot. I can't think of any reason why the insulators that we're planning to use would cause any greater noise than what we've got on the line now. But we can do some research into that and see whether there that's a factor or not".
- Facilitator 2: "It's a really good area to have a look at because of stakeholder concern. Equally this is why we do stakeholder engagement. To get a wider perspective as well on areas that haven't been considered at this early stage.
- E3: "I'm not aware of any complaints that have been raised in relation to wind noise in overhead line supports. Maybe that's something that SSE can help us with to see if there are any".
- S1: "I mean wind itself is actually quite noisy. Therefore, hearing something else above it. But it does happen".
- E3: "If there was a howl that resulted from a certain insulator configuration then obviously we'd want to know about that. But I'm not aware of anything like that".

Opportunities relating to insulators and insulator configurations

- Facilitator 1: "Is there anything else we want to add in? I sort of feel we've come to a consensus really and we did that very early on. We've had obviously had the wider discussion around the noise. Is there anything we want to add in before we get into the next topic? Because the next topic is about construction and environmental impact. Which I know we're keen to discuss. Anything else to add before we move on guys?".

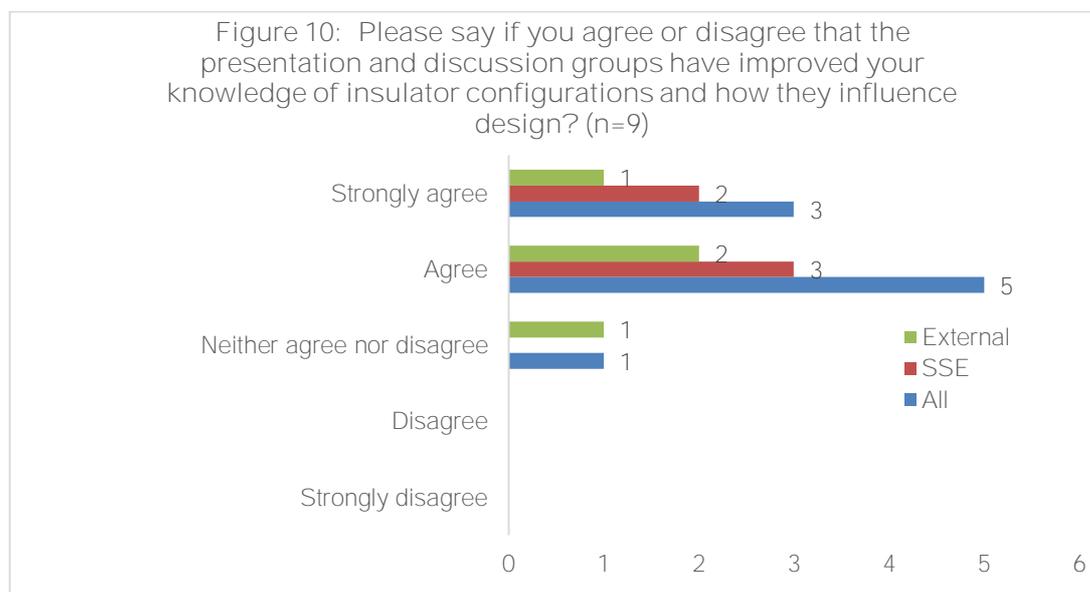
- S2: “The horizontal V could use shorter cross arms and certainly seemed to be a benefit if it was compressed a bit more. But can’t really think of anything else”.
- S3: “Those points we’re interesting for me, (inaudible) the possibilities to create the rest of the structure”.
- Facilitator 1: “Oh right, what in particular interested you there?”.
- S3: “The difference on the possibilities for length of cross arms”.
- Facilitator 1: “So it’s that flexibility thing again possibly?”.
- [pause]
- “Overall, there’s agreement regarding making an aesthetic point/scoring. What I’m hearing is that proportionally, it needs to work together as a whole”.
- S5: “Yeah, we’re back to that consistency of look. Appropriateness to the environment”.
- Facilitator 1: “I’m going to stop there, I think we’ve covered enough on this and let’s get into the meat of the next presentation before lunch”.

3.6.2 Impact of Presentation and Discussion Group on Insulators / Insulator Configurations

Stakeholders were asked if the presentation and discussion group on insulators and insulator configurations had improved their knowledge of insulator configurations and how they influence design.

Figure 10 shows that almost all (eight out of ten) stakeholders either ‘strongly agreed’ or ‘agreed’ that the presentation and discussion groups had improved their knowledge of insulator configurations and how they influence design.

Of the four external stakeholders in attendance, three either ‘strongly agreed’ or ‘agreed’ with one answering ‘neither agree nor disagree’.

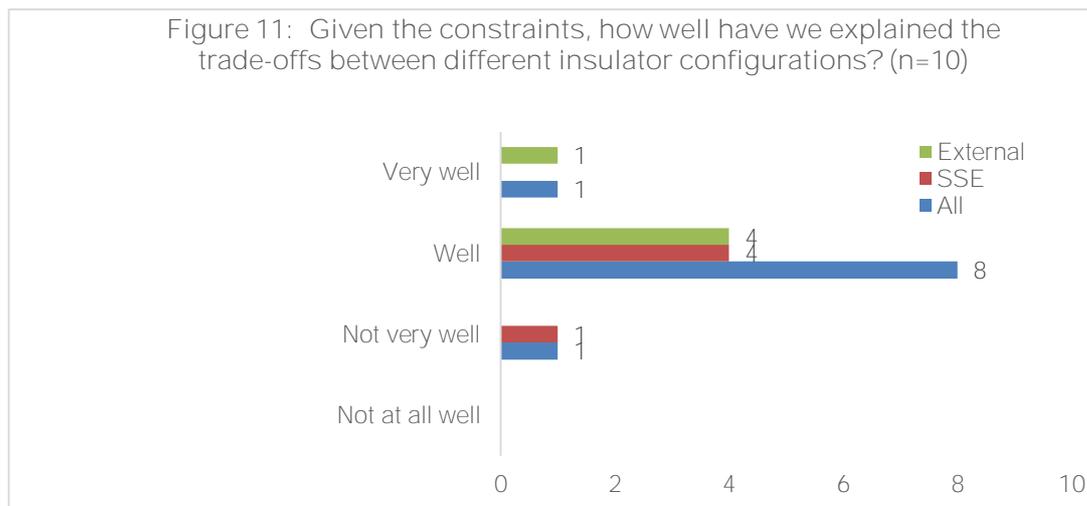


3.6.3 Impact of Presentation and Discussion Group on Insulators / Insulator Configurations

Stakeholders were also asked, given the constraints, how well the trade-offs between different insulator configurations had been explained to them.

Figure 11 shows that given the constraints, nine out of ten stakeholders said that the trade-offs between different insulator configurations had either been 'very well' or 'well' explained to them.

All external stakeholders indicated that the trade-offs had been either 'very well' or 'well' explained to them, with one internal SSE stakeholder reporting that the trade-offs had not been very well explained to them.



3.7 Environmental Impact of OHL Construction

On behalf of SHE Transmission, a representative of Energyline presented an overview of the environmental impacts of OHL construction. Following this presentation, stakeholders made a number of comments and asked a number of questions:

- Q: I understand the difference in the lay down areas around the tower sites and the increased area for steel lattice. Can you maybe describe a bit about the scale that required for the different options? Whether it be a pole or a steel lattice and could the design of the access be different because of the different kit on sight.
- A: The access is going to accommodate all aspect of construction and the main aspect is the foundation placement. There wouldn't be any difference between the equipment between sites for excavation of foundations. Excavations, concrete etc.
- Q: OK one of the things I've experienced on other jobs is quite often the largest piece of plant that you need to get to a tower site is the crane. Would the size of crane change depending on the type of design?
- A: The crane could potentially be smaller The panels and the proposed elements of the pole would be much lighter than the sections of a lattice tower you need to erect.

- Q: OK, would that change the gradient that you could build the track at? Or the construction of the track? Is that the limiting factor essentially for access to towers, the crane? Or is it the concrete wagon, so the foundation?
- A: As far as access to a site is concerned you can't generalise on it. It's site specific. Whatever the gradients are, whatever the land use is going to dictate what kind of access you'd need to build to gain access to the sites.
- We could generically say that if we design a structure that requires a lighter crane we can generically say that the access would be better. Or the access would have less environmental impact because it'll have to bear less load.
- Q: If it's taking less time that quite a big advantage because removal of the track is likely to be more effective if it hasn't been used for very long.
- A: You'll see in the scoring pack that S has put a lot of work into quantifying many of these things. You'll see he's quantified the footprint required for each design option and he's gone into the number of access visits required. So when you're scoring you can do it based on data. It's difficult because as S says when we start building for a particular line each tower site will be different. But we can be generic in terms of the loads required to be lifted. The number of components required to be taken to site. You'll see that on the score cards.

For that I've considered the worst case situation for the poles where a raft foundation, which is a rectangular block of concrete, that would probably be the worst case situation.

- Q: Some of the models on display have two poles. Some of which are spaced quite far apart. So in terms of the area of construction is that going to greatly increased?
- A: That is shown on the card.
- Q: Do you have any experience of, or would you just assume, that farms, if this was going through agricultural land, farmers would probably prefer the much reduced land take of the monopole for ploughing purposes and arable purposes?
- A: I'm sure they would. Obviously the land take of a lattice structure is significantly more than a monopole. So yes I'm sure that would be correct.
- Q: What about maintenance? So would you need to put something back in to carry out maintenance?
- A: Generally, high suspension maintenance I'd say no. Just general maintenance I'd say no. If you were going in to do fault repairs, replacing insulators, repairing conductors then you might have to consider putting track access in but probably not the extent that you'd put in initially with the stone roads to get foundations in etc.

The ops group have basically constrained the work to be such that we have to provide a similar level of access to our current designs. So for example like the T pylon, we can design it such that we have to be able to get a heavy plant there to fix it. We still need to be able to walk in and climb.

- Q: OK, so it's kind of a like for like so it's almost a non-consideration?
- A: We're taking it very seriously in terms of what we can do to make it better, particularly less visits. In fact, we have a discussion with them tomorrow to look at what they have to take in. When we walk in or when we take it in, specifically what is it they have to take in. So one of the benefits in that regard is if we have structures with many fewer components obviously there's a higher chance they'll be put together correctly, less to inspect, less to re-treat and re-tighten So we are looking to improve the structures performance from the operation and maintenance perspective. But in access terms we will only reduce requirements there won't be any difference in what's required to get there.

I think (inaudible) expressed a desire to have a permanent grass access to every support. But that's not for me to decide, that's for SSE to go over with planning and requirements.

- Q: Can I just ask a general question in terms of security. I'm aware that with the current lattice towers they have a lot of barbed wire and anti-climbing devices. What are the implications for some of the new proposals? In particular, your tubular towers. I presume it might be less crucial for stuff like this which is a real plus point.
- A: I think the pole that supports itself probably won't need any kind of device. What they would probably need to develop is an access method that the maintenance team would take to site and put it up. Somewhere 2-3 meters high.
- Q: I suppose that ties in with the question I was thinking of. On the design and the concept design it doesn't show how you would scale that, for instance. Would there be small runs, or holes you'd plug into? How would that work?
- A: I appreciate these bits of detail but what we're working on at the moment is climbing tracks. These are channels of steel which are bolted onto the tubes which have step hold on them which our preferred way of climbing these. So they would be a permanent feature on the poles above a certain height. So then we would provide our teams with something to get up to that pipe. So we wouldn't need anti-climbing. That would also be compatible with our current (inaudible) and give us similar access in terms of needing to do it in a hurry or emergency.

3.7.1 Discussion Group: Environmental Impact of OHL Construction

Stakeholders were invited to participate in a 30-minute discussion group to consider the following:

- Their immediate thoughts on the impact of OHL construction on the environment;

- Concerns or challenges in relation to the impact of OHL construction on the environment; and,
- Opportunities relating to minimising the impact of OHL construction on the environment.

Immediate thoughts on the impact of OHL construction on the environment

- S5: "He said it was a no brainer. Less construction traffic, shorted period of time, stuff like that., Why wouldn't you go for a simpler design? If it's exactly what he's saying it is, I think that's his suggestion, then why wouldn't it be better? I've got no worries with what he said. He's identified all the benefits, great. Where that comes in with the weighting of everything else, that's another matter".
- S3: "There could be fewer constraints on what the routing lines are if the construction access needs less heavy equipment's needed".
- S2: "How can you say it's less heavy equipment? He did say what about the crane but I presumed what he was saying it was all standard HGV's, normal construction site, it's just there was less of it. Which is fine. So if it is as simple as that, thumbs up".
- S1: "I think if it's easy to whip up that it doesn't have an impact on the area of ground, which is great. In terms of impact tracks, access tracks, he's identified from our perspective that areas of archaeology need to be avoided. Beyond on that we're just happy to see minimum interference and equipment can be easily constructed is a bonus".

Concerns / challenges regarding the impact of OHL construction on the environment

- S3: "I suppose the issue I have which I think was asked earlier in the day was did this need more of a deck as oppose to your 4 legged one which can be thinner. And I'm just thinking what would you do on hard rock? What do you do on peat, what do you do on other soils? A current pylon sits with quite a range of simple options for solutions. Does this present or does it need somewhere that's deeper? So if you had an area of hard rock what do you do? Do you get a fixture easier? Would that be right?".
- S1: "I was going to say, why don't we get S in. S would you come and join us? Thanks".
- S2: "I think the summary of my question was, I think you presented a no brainer in terms of, this is a simple model design and less impact for all the reasons you said. But I just wondered given the different geology and environments across Scotland, what are the consequences of foundation in particular of this model?".
- S4: "It's the same for any structure, but this particular model I've presented the worst case foundation which is a raft foundation. That height of monopole is just over 7meters squared".

- S5: "How deep?".
- "Five - to 5.5 meters deep so the potential for reducing that by either having a driven tube, driven piles it's going to reduce if you like from a square raft to a circular type design".
- S3: "Is it always better than the foundation for a lattice tower? Or in some circumstances where it has a bigger environmental impact?".
- S2: "And if you come across a hard rock area?".
- S1: "Turn to a rock foundation, it's the same as any kind of foundation. In one areas we might come across bottomless peat, we might be driving 18 piles down to get the necessary grip. The rock we might be drilling into the rock to place rock anchors to create the foundation for what's on top. To try and generalise the foundation, you get such a variety which could potentially major differences".
- S3: "I think that's accepted. What the point is it always better than for the older fashioned lattice towers? Now I understand the circumstances for environmental impact of putting in a foundation for 510 could be greater, could you think of an example?".
- S4: "No I think even with a raft foundation on a 510 its smaller, could potentially be smaller than the same sized L8RD".
- S1: "So comparatively speaking its almost always better than...".
- S3: "I would say yes".
- Facilitator 1: "Now earlier, you mentioned that you thought you'd be asked questions and I know we've got questions on the table around access routes into support construction. So remember we talked earlier and I said we've got an opportunity to discuss this. Do you want to use the opportunity?".
- S5: "I think Ross asked some of those questions just after the presentation so I think a lot of that has been addressed. I've thought of another question though for one of the experts".
- Facilitator 1: "Great. He's here. Go ahead".
- S4: "It's one about seasonality. Sometimes there's a tension between avoiding the bird breeding season and that being the best time of year to put up a transmission line. I can see that the 510 its quicker to put up so that's one way of reducing the overlap between the construction in that sensitive period. But is it likely that you could put up the new design in more adverse weather conditions or is that just not going to be a factor".
- E2: "I don't think it would be. We were actually discussing this to minimise the access impact. Rather than using a crane we could potentially use a derrick, or a scissor lift to actually hinge the support to the foundation point and, it's like a tri-

pod method if you like, where if that the pole and that the foundation point there you put a scissor there and a winch down to the bottom and you winch this up and as this comes back it lifts the head up. So there's potential for reducing heavy plant access. We have discussed the use of helicopters but then again there could be constraints because my understanding is this design is potentially going to be built adjacent to an existing route. If that's the case that could potentially just cut out the use of a helicopter because of the proximity to the service. So again, I've tried to paint the picture as a worst case situation and I think we would look more in detail with interested parties into minimising that impact".

- S5: "But at the moment there's things such as wind speed as a constraint of putting up transmission lines".
- E2: "With the winds, yes. The crane drivers won't work under certain conditions. But potentially we wouldn't be working with the weights that we would be with the lattice tower. If the wind was a factor we could actively consider, with a single pole, breaking it up into 5 smaller lifts instead of one".
- S5: "Any further questions for E2?".
- S5: "Good answers".
- Facilitator 2: "So what were you expecting to be asked E2?".
- E2: "Well it's always the biggest point, I feel, around construction is access. You can't make an omelet without cracking an egg. The longest meeting's I've ever had have been...".
- S5: "I think the issue, which you raised earlier, is the permanency of the access track. Does every pylon need a permanent access track?".
- E2: "Well that's the operations view, but that's not what we do on every job. I suppose that's an area as a business and an industry it would be helpful to try and raise that".

Opportunities relating to the impact of OHL construction on the environment

- Facilitator 1: "Thinking about the opportunities. Your all very aware about how to minimise the impact of environment when looking at the design, construction and implications of those designs. What do you feel are the key opportunities to minimise, as far as possible from the discussions this morning, the impact on the environment? Where do you see the main opportunities?".
- S1: "I think in terms of the developer it's flexibility. Cause certainly in cases we've dealt with, you go to meeting that they call stakeholder events and they are in fact presentations of preconceived ideas. It lessens the input and the affects you can actually have. I think in terms of environmental impact the strategic level is very important as well. Where the line actually goes, not just the specific details of what's going on with each tower, with each access track. We need to go through a clear filtering process in terms of avoiding the areas of designations

and sensitivity, settlements, areas of environmental interest. It is the case that the solution is a bit more expensive than having a straight line from point A to point B but in terms of culture I would like to see the developers take more of an open mind in terms of all the opportunities. Cause that the only way that the environments going to benefit. It's often the case that the issues which are important to us, the decision has already been taken".

- Facilitator 1: "Moirá [name changed]"?
- S3: "I'd just like to second a lot of what you've just said. In terms of having opportunity for input into the evolving design and development at the strategic level. Being able to have an input at the route selection stage cause that's paramount in avoiding sensitive areas. Slightly lower scale looking at siting in particular at mitigating potential impacts on the environment. Then at that stage that when the design of the solution comes in really. So it's a little bit further down the list. At that stage we'd prefer an option that was again, easy to assemble, had the minimum environmental impact in terms of works on the ground and then a minimal visual impact as well. So that's how we'd address it. Top level strategically, then we'd look at individual sights, then look at the model that went in".
- Facilitator 1: Is that how the rest of your organisation look at it? The same thought processes?"
- S3: "Routing is a key stage and SHE I feel are good at engaging with us at an early stage in the project to let us examine this. Before it goes to public consultation, for example. So you might see options that are never taken further in terms of public consultation. Yes, routing is a key stage but in terms of the different designs there are potential options and benefits from the potential designs. But probably more important is getting the routing right to start with. I'd say that's 75% mitigating the impacts and the remaining 25% or whatever is very detailed design of how the route and design of the structures. But we're not looking at the 75% today, we're looking at the 25%".
- Facilitator 1: "That's a nice analogy you used. David [name changed]"?
- S2: "Well, the way the process works with Scottish Government applications that come to us, and the work that leads up to that, we would listen to what SNH and HAS say so you guys are probably more in there at the early stages informing the route options than we are. But I would support everything I've heard and to me it sounds like bringing up wider possibilities for mitigating impacts for routing, different landscape, visual impacts and construction impacts being lessened. I'm trying to think of something in here that makes me particularly concerned which isn't the case at the moment. I can't think of anything serious yet".
- Facilitator 2: "Is it an issue that because we're not discussing routing today that your concerns aren't being adequately addressed by this?"
- S6: "I'm quite satisfied that we will be consulted and that we do as a matter of course get consulted early on about route options. So that's something with the process that we're really happy with and can help steer. We're satisfied".

- S4: "As a matter of curiosity, I'm interested to know which route this is theoretically planned for".
- S5: "But having said that we do recognise as well that there is an opportunity, through an improved design, to minimise impacts even further. So we're happy to come and help with that".
- S1: "One of the key components to eliminating the impact prior to detailed design but the one area where there's been crossover is could a certain design make one route more preferable to another? And its understanding what the design is as part of the routing as well. It could actually change the route depending on what design being picked depending on the types of sensitive landscape. I think that's where the crossover is".
- S5: "One last thought I had was whether all of these designs are equally suitable for high altitude routes. I'm not necessarily advocating high altitude routes but would picking one design make its more likely that higher altitude routes, say across the Cuillins would be thought about in future".
- Facilitator 1: "Well that is the \$60 million question".
- S1: "I suppose it is a slightly construction issue or could be an operations issue".
- Facilitator 1: "I think we need both of you [Energyline experts]. We're slightly undecided".
- S1: "In terms of the ability of the structures to withstand conditions in higher altitude areas are they all being designed, would they all have the same ability to cope with high altitude and be constructed at high altitude locations?".
- E2: "They'd all have the same load withstanding capabilities yes. So in terms of extreme wind but in terms of constructability in high altitude places that is a key concern of ours. So although we would like to reduce the component count, for some of the reasons I mentioned, we don't want to end up with components that are so heavy that we can't get them to some of these situations. So there is quite a lot to consider in this. Does that?".
- E3: "Yeah because the myth is that some of the old lines were constructed by components going in on the backs of ponies. Probably not quite true but...".
- "It is true".
- S1: "I wasn't involved with it but..."
- "We did some work on the Beaully Blackhillock route and (inaudible) in remote locations and we were the first human beings they'd seen in the last 6 months so they started telling us about when they actually built these lines there'd been 100 men hand digging the foundations and 200 men erecting these pylons".
- E3: "I think the modern equivalent is helicopters. So we can use helicopters to alleviate access concerns and help with getting to different locations. But at this

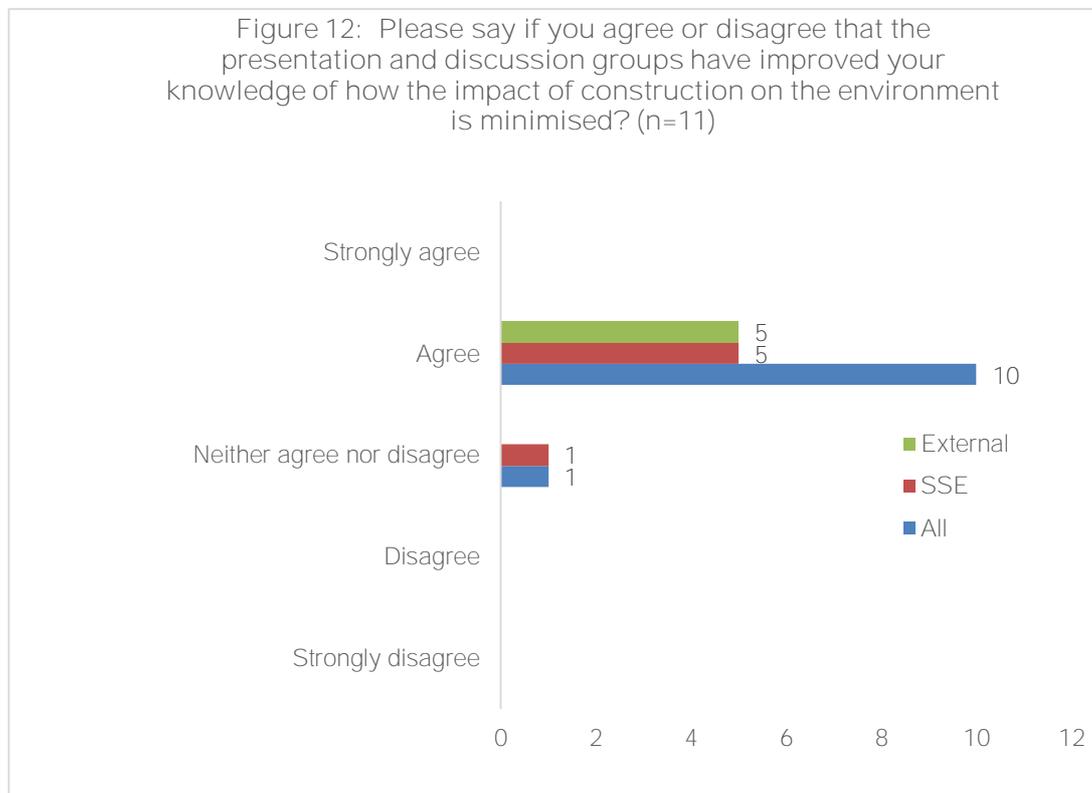
stage, the concept stage, it’s just something that we’re acutely aware of. That we will be designing for”.

3.7.2 Impact of Presentation and Discussion Group on Knowledge of Minimising the Impact of OHL Construction on the Environment

Stakeholders were asked if the presentation and discussion group had improved their knowledge of how the impact of OHL construction on the environment can be minimised.

Figure 12 shows that of the eleven stakeholders who voted, ten ‘agreed’ that the presentation and discussion groups had improved their knowledge of how the impact of construction on the environment is minimized.

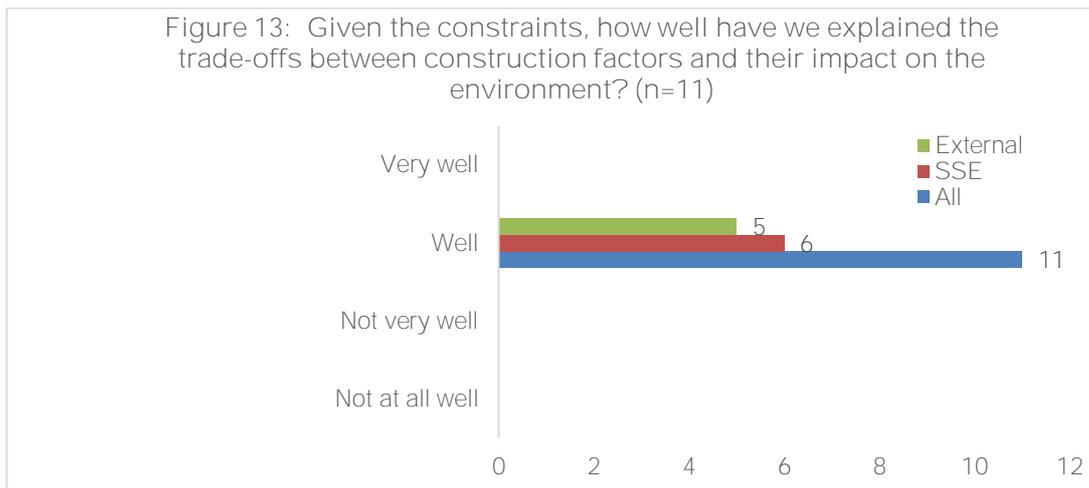
All five internal stakeholders agreed that the presentation and discussion groups had improved their knowledge of how the impact of construction on the environment is minimized.



3.7.3 Explanation of Trade-Off between Construction Factors and Impact on Environment

Stakeholders were also asked, given the constraints, how well the trade-offs between construction factors and the impact on the environment had been explained to them.

Figure 13 shows that all stakeholders (both internal and external) believed that the trade-offs between construction factors and their impact on the environment had been either ‘well’ explained to them.



3.8 Scoring Assessment Matrix (SAM)

A representative of SHE Transmission presented an overview of the Scoring Assessment Matrix which had been developed to score the different design options being considered.

As part of this presentation, stakeholders were shown how to use the SAM including how to weight the main design aspects (i.e. electrical, construction, environment etc.) as well as how to weight the different sub elements within each main design aspect. Stakeholders were also shown how to score (1 to 9) each of the designs on the various aspects.

Following the presentation, stakeholders were then invited to complete a SAM booklet. Having completed the SAM stakeholders were then invited to comment and ask questions on the SAM:

- Q: “Could you outline some observations about what you experienced during the completion process?”.
- A: “We were given a similar scoring range for all these criteria but for me some of these criteria weren't comparable full in terms of weighting. The importance of foundation design in terms of construction and direct impact on the environment. Yes, it's important but in terms of the aesthetics you're not comparing like with like when looking at the profiles of the towers themselves. So that was my feeling as I was going through. You weren't comparing like with like in terms of scoring for the different criteria.

“Just to build on that, when you're considering visual impact a lot of it you can't translate into numbers. It's more of an appreciative thing and so it doesn't translate as easily I think onto a scoring system The designs are broken down to such an extent that you kinda of lose the general first impression that you get. It was helpful and I think certainly when it comes to quantifying things such as construction costs an assessment matrix like this is brilliant. For some of the more subjective categories it's harder to apply the scoring.

“Just a similar observation that there wasn't an aspect weighting for visual impact. It's got insulator visual impact but not overall visual impact so I stuck additional weighting on design aesthetics to compensate for that. I'm not sure if that

was terribly appropriate and I didn't feel a bit rushed in considering the design aspect weightings and I don't have an awful lot of confidence in the scores that I've given them. Not quick enough at arithmetic either to make sure the total adds up to roughly the right number. So a bit of doubt about the weightings that I've given the aspects.

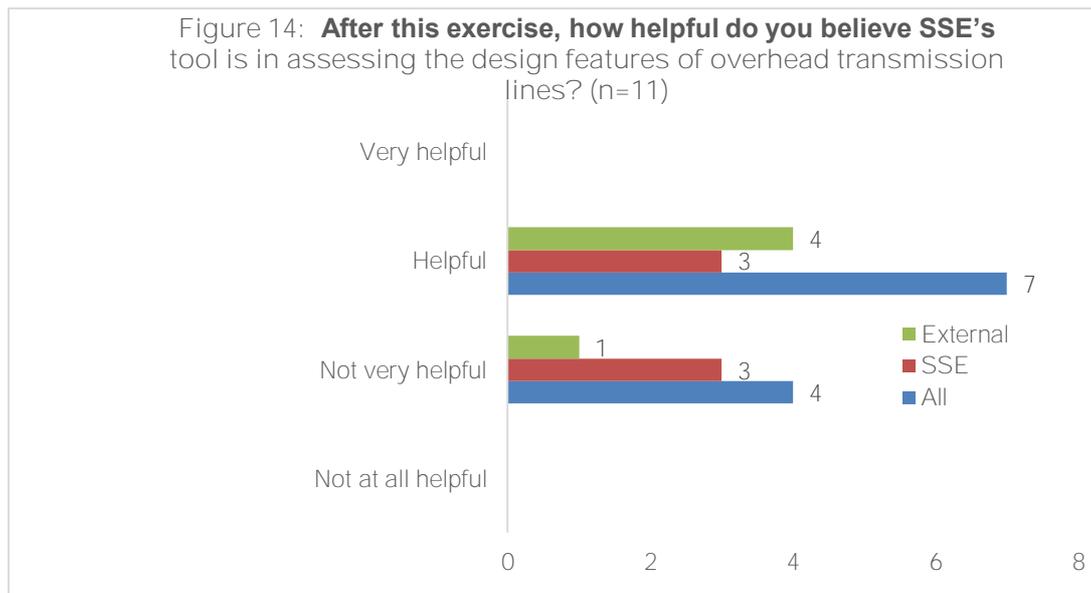
“I can appreciate this is your first go at this so if things come to you in the following days that you might want to comment on then please get in contact and tell us. This is just the start of dialogs.”

3.8.1 Helpfulness of the Scoring Assessment Matrix (SAM)

Following this question and answer session, stakeholders were asked how helpful they found SHE Transmission's tool (the SAM) in assessing the design features of OHLs.

Figure 14 shows that of the eleven stakeholders who voted, a majority (n=7) found the SAM tool 'helpful', with 4 stakeholders finding it 'not very helpful'.

Among external stakeholders, four out of five found the SAM helpful, whereas among SSE internal stakeholders, half (n=3) found it 'helpful' and half (n=3) found it 'not very helpful'.



3.9 Presentation on Undergrounding

A representative of SHE Transmission presented an overview of SHE Transmission approach to undergrounding including showing a video on the subject and about how to nominate an area to be undergrounded under SHE Transmissions funding scheme.

Following the presentation, stakeholders were invited to comment or ask questions. Only one question was asked:

- Q: "When does the distribution window for nominating schemes for undergrounding distribution, when does that close?"
- A: "It doesn't close. We'll keep going until we've used up the pot of money. So if you have any in mind the best thing to do is get them in and we'll start assessing them".

No voting questions were posed after the presentation to gauge reaction because it is unlikely that undergrounding will form part of NeSTS project.

3.10 Presentation on the Use of Composite Poles

A representative of SHE Transmission presented an overview of the use of composite poles as an alternative to the use of traditional wooden poles for supporting overhead line construction. Following the presentation, stakeholders were invited to comment and/or ask questions:

- Q: "What about tension structures?"
- A: "For Dorenell, it's got to be a full stage pole structure so tension structures will be stayed initially. We could have put heavier duty structures in and removed the need for stays but we've decided that would have meant changes to safe working or working capacity of the helicopter, if you like. So we'll just try and keep it uniform if we're going to stay them all. They're all under 2 tonnes but we could have put stronger poles in effectively and changed that".
- Q: "What about circuits? How are these accommodated?"
- A: "Well the double circuit on this one will be effectively use three steel cross arms, insulators hung vertically. There's 101 different permutations but given the design time we were looking for something that was really straight forward at present. There's a lot of options we're going to look at in future for the 132[kV]".
- Q: "And access?"
- A: "Access is still being decided by the operations team. There's a lot of hardware etc. that the pole manufacturer can supply. We're effectively going to leave it to them to decide what they actually want. Whether it's going to be a retractable, permanent clip in".
- Q: "What about clearances for operational means? When you're actually accessing the single structure".

- A: We did have a single structure in there additionally for Dorenell and that was one of the things highlighted by the operations team. With clearances and I believe there may have been an incident on a similar structure, I don't know if it was in the UK recently, whether it was a double circuit structure, that didn't look too dissimilar to this one, where the linesman upon climbing up managed to get disorientated and went from the dead side to the live side. That was fresh in the mind for our operations staff and they decided they'd rather an H pole structure given the time we've got to design it. In the future we would probably look at something like that. Again one of the reasons we kept it as an H pole structure so you can effectively work on one at a time (inaudible).
- "Spans and heights you said that the spans had increased from 80 meters to 200 meters, earlier on we were hearing about that relationship between span and height. If you say that you'd gone up to 20 meters height by 4 or 5 meters from about 15.
- "I think all the early discussions through the planning process the structure height was always staying at 16 meters. We're taking that up to 20-22 meters at present for an increase in span from roughly 80 to 200 meters. We're installing an OPPC conductor, they actually limit the span length, ideally we would drop it but we need it for communications between Dorenell and Blackhilllock substations. That's dropping the span length by 20 or so meters because we were beyond 220 meters initially."
- "16-22 doesn't sound like a huge amount for the benefit that you're getting, more than doubling span length. That's quite good."
- Q: "I thought you'd be considering the HDLS conductors?"
- A: "We're trialling that on another project at present. At another wind farm. It due to be installed perhaps May of this year. But the project team, decision was made before I became involved. They just decided to use traditional triple AC just now. They all lacked experience in HDLS conductors. It was maybe thought a step too far trying an innovation like this, with different types of cross arms and a different conductor at the same time. Maybe too many things in one go".
- Q: "So the clearance to ground has been increased?"
- A: "Yes."
- Q: "From what?"
- A: "Our remit was to clear the minimum ground clearance of 6.7 meters for the 1-3-2. That gave us a structure height, we had face to face clearance heights of roughly 19 meters now they've increase that to 22 meters just now. We've had to do that for the OPPC. We could just add another module on and that would give us additional ground clearance".
- Q: "Is the clearance between the conductors and the ground still 6.7?"

- A: “Yes. It’s been an issue for some land owners were they’ve asked for additional ground clearance so what we’ll give them is an increased structure height but those will be one offs if you like”.
- Q: “One other question is, my observations of 132 KV pole structures in a tree’d landscape, like that example there, is that they are quite sympathetic because they look woodie and clearly these don’t. They’re going to look relatively industrial. They are clean lines but they are relatively industrial. Do you get any loss of loss of sympatheticness of appearance in this change? Had any comments to that effect?”.
- A: “I could see that point. The structure we’re putting in for Dorenell is not too dissimilar to a standard wood pole tension structure. It’ll not look too dissimilar in appearance than that. It’ll be taller obviously”.
- Q: “But the material itself, the surface”.
- A: “They do them in a couple of different colours. They do the standard grey which I think is the one we’re actually favouring. But they also do them in brown to match the wood pole. They’re different from wood poles, they have a shiny finish, a hydrophilic coat just to allow it to shed water as well as giving it UV protection as well. It effectively increases the design life of the structure. So these should be roughly 80 years so if you compare that to a new wood pole line these days your looking at roughly 35 years”.
- Q: “Do they withstand broken wire conditions?”.
- A: “They do yes. The Dorenell is designed for broken wire conditions. Suspension and tension”.

3.11 Closing Remarks

Following the presentations on undergrounding and composite poles, Tim Sammon from SHE Transmission closed the event and outlined future things and next steps that would be undertaken to include those stakeholders in attendance.

Stakeholders were once again invited to ask any final questions and/or make any further comments. No questions were asked by attendees at this time.

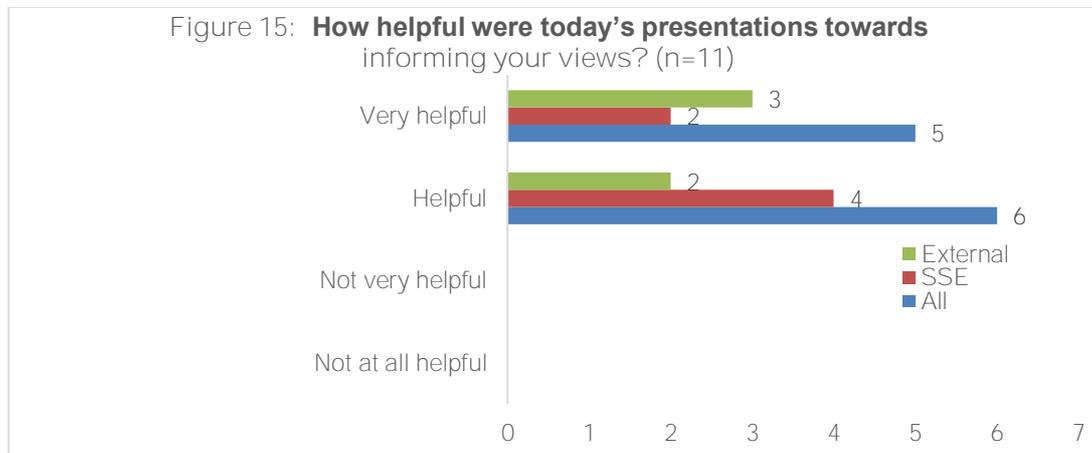
3.12 Evaluation of the Event

Voting software was used to gauge overall stakeholder views regarding the event, its format and approach. The voters anonymised responses and were used by participants to rate the approach and implementation of the NeSTS deliberative event across several different assessment areas. Respondent evaluation findings are described below.

Presentations

Stakeholders were invited to rate how helpful they found the NeSTS Event Presentations overall.

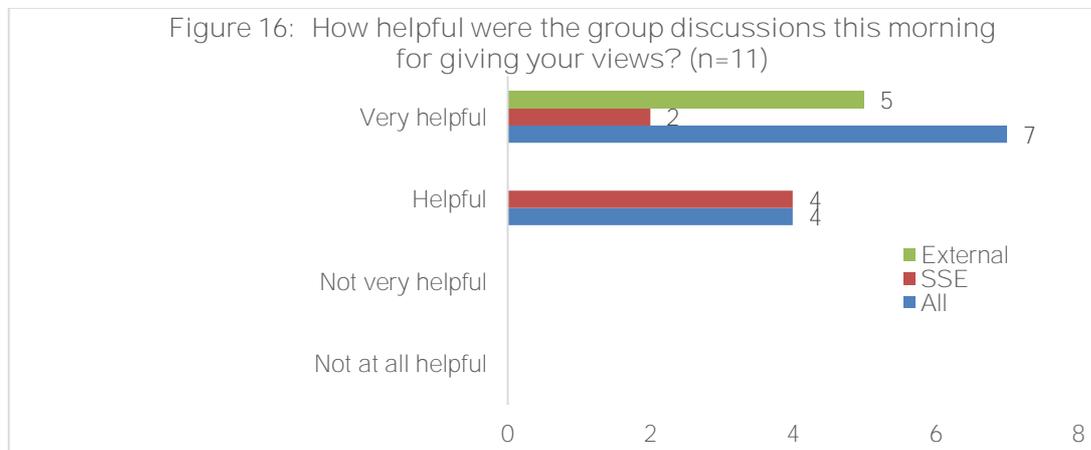
Figure 15 shows that all stakeholders (both internal and external) found the presentations throughout the day either ‘very helpful’ or ‘helpful’ towards informing their views.



Group Discussions

Stakeholders were also invited to rate how helpful they found the NeSTS Event Presentations overall.

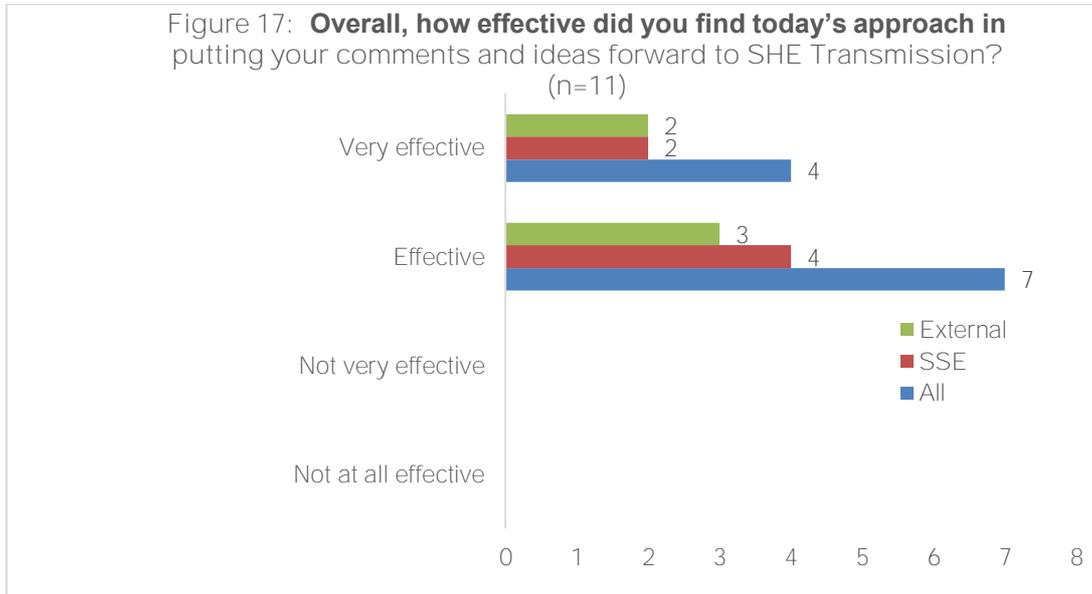
Figure 16 shows that all stakeholders (both internal and external) found the group discussions in the morning either ‘very helpful’ or ‘helpful’.



Effectiveness of the approach for inputting comment and ideas

Stakeholders were also invited to rate how helpful they found the NeSTS Event Presentations overall.

Figure 17 shows that all stakeholders (both internal and external) who voted on the question found the approach used for the event either ‘very effective’ or ‘effective’ as a means of putting their comments and ideas forward to SHE Transmission.



Appendix A: Event Agenda

9.00	Breakfast and Registration
9.30	SESSION 1 - PRESENTATIONS AND VOTING Context, Purpose, Introduction – Tim Sammon Environmental Impact of Overhead Transmission Lines – Mick McLoughlin Design Concept Overview – Malcolm Lowe Evidence, Sign-post to Exhibition
1100	Coffee break, exhibition and networking
1130	SESSION 2 - DISCUSSION GROUPS AND VOTING Priority theme discussion 1 – Span and Height Priority theme discussion 2 – Insulator Configuration Priority theme discussion 3 – Environmental Impact of Construction
1300	Lunch
1400	SESSION 3 - YOUR OPPORTUNITY TO SCORE OUR DESIGN CONCEPTS Assessment Matrix
1530	SESSION 4 - ADDITIONAL INFORMATION OVER COFFEE Composite Transmission Structures – Shirley Robertson Vista – George Cobb Undergrounding – Kirstine Wood
1600	Summary and closing remarks