E.ON UK
Westwood Way
Westwood Business Park
Coventry
CV4 8LG
eonenergy.com

Matthew Cullen
External Affairs Executive
matthew.cullen@eonenergy.com

Open Networks Project
Electricity Network Association
4 More London Riverside
London
SE1 2AU

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Dear Sir or Madam

Thank you for the opportunity to respond to the Open Networks Project consultation on the future worlds impact assessment. Please find below E.ON's response.

Executive summary

E. ON believes that this initial impact assessment has captured many of the relationships and trade-offs that need to be considered in the decision to transition to flexibility markets. However, E. ON is disappointed not to see a filtering of the five worlds down to 2 or 3 that can then be assessed in greater detail. Leaving all five worlds as potential options will only serve to slow down the process of enabling consumers to participate in the energy market.

Of the five worlds, we believe that the one best suited to customers (as it is likely to offer the lowest cost) is World D. We believe that Worlds D&E are the only ones that can offer the optimum solution as the other worlds all involve multiple parties having to negotiate local balancing issues versus national balancing issues. Even with the best intentions, we believe that the chances of missing the optimum balancing solution are high in these multiple party worlds and therefore believe that worlds where one party is solely responsible for balancing all the networks will lead to the best option for customers. As World E is more expensive to implement, we believe that World D is the best option.

As shown below, the transition to a World will be highly dependent on distributed energy resource (DER) uptake. We believe that this uptake needs to be considered as two groups, HV/EHV connected uptake and LV connected uptake. We believe that HV/EHV DER will develop first followed by LV DER as HV/EHV DER can participate directly in current flexibility tenders whereas LV DER will require critical mass in order to be aggregated. As HV/EHV connected customers are already familiar with dealing the National Grid ESO to offer ancillary services, it is a natural choice to run flexibility tenders through National Grid ESO rather than the DSOs. As LV connected DER takes off, an impact assessment of shifting from ESO led flexibility tenders to DSO led flexibility tenders would have to be considered (including the potential for sub optimal solutions). See Figure 1 for more details.

We have highlighted five specific concerns with this impact assessment below.

1. **The fundamental assumption that all five worlds can achieve the same level of benefits in their full maturity (Stage 2) is flawed** and that more analysis is required to understand the degree to which optimising on a local basis before considering the national balancing position leads to an overall suboptimal solution. See Appendix A for a simple example of where optimising locally generates a suboptimal national solution.
2. **The definition of an independent Flexibility Co-ordinator (World E) remains unclear.** Would the legal separation of the DNOs from their DSO activities (in the same manner as National Grid Transmission and National Grid ESO) be sufficient and is this the basis that has been used throughout the assessment or does it assume the creation of separate entities with no connection at all to the DNOs?
3. **The assessment does not appear to consider the critical mass of LV connected DER assets required to deliver flexibility services** in that whilst nationally there maybe 4GW of demand turndown available from EVs in 2028, these assets will be too widely separated to support distribution network reinforcement deferral. The example of 45% of all EV owners in the Brandon area in 2028 being willing and available to forego charging at peak times to deliver 2.3MW as required by UKPN in their current flexibility auction is evidence of this constraint. Critical mass for LV DER appears to come around 2030 (at this point in the Brandon example only 21% of EV owners need to participate to deliver the required capacity), but using the maturity dating methodology, all Worlds (bar World E) can access this supply at this point.
4. **The transition paths suggested by the Impact Assessment do not take account of an early move from World B Stage 1 to World D Stage 1 and therefore does not allow for the potential to move from World D Stage 1 to World D Stage 2.** The transition from World B Stage 1 to World D Stage 1 will be triggered by high uptake of HV and EHV connected DER and therefore high levels of complex co-ordination between DSOs and the ESO making it more sensible

for the ESO to deal with these assets directly. If this happens, then it is likely to occur before the World B Stage 1 to World A Stage 2 transition as this transition is about high uptake of all voltage level connected DER. Once on the World D Stage 1 path, it is feasible that LV connected DER take up also becomes high, but that a move from World D Stage 1 to World A Stage 2 is not cost effective and that the more economical rational option is to progress to World D Stage 2 (see diagram below).

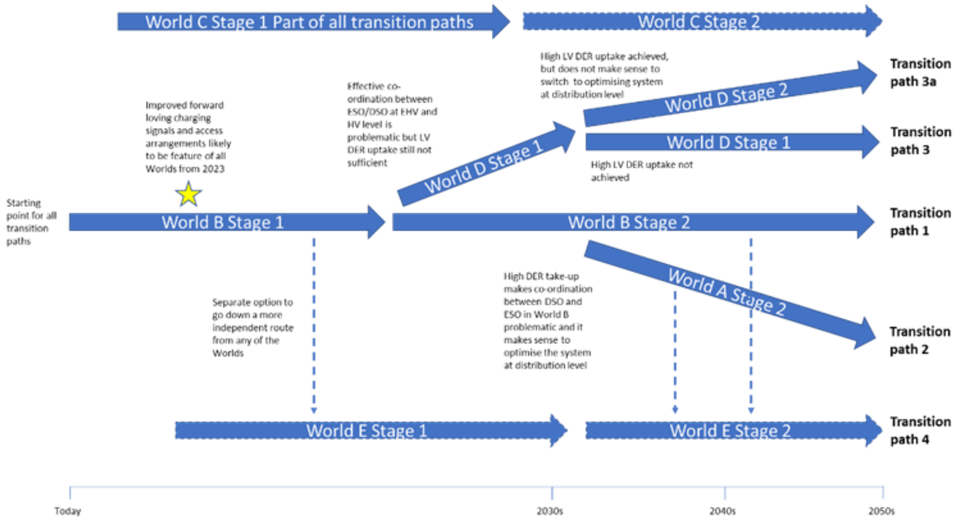

Figure 1 - Possible flexibility transition paths

5. **Some of the assumptions used in the benefits methodology do not appear to be consistent with historic data.** For example, the assumption that the reduction in transmission constraints cost over time is a function of the percentage change in transmission connected generation over time is stated in Appendix B.2.2 with no evidential justification. Historic data suggests there is no link between these variables (see Figure 2). Similarly, the assumption that balancing costs are related to the percentage of intermittent generation is based on two data points (2005/6 and 2017/18). A fuller analysis suggests that the relationship suggested is not particularly strong (See Figure 3).

Q1. Please confirm which stakeholder group you believe that you belong to; this will enable the Open Networks Project to understand the spectrum of respondents to this consultation.

Within the definition of actors included in the Future Worlds, E. ON UK would classify itself as a **Supplier** and an **Aggregator** which also owns several **Distributed Energy Resources (DER)**.

Q2. Please provide your views on Baringa's interpretation of the Future Worlds, detailed in Section 2, for the purpose of this impact assessment and the overall approach, highlighting any key strengths or weaknesses, or areas which should be explored in more detail?

The inclusion of the two stages of development for each World is a sensible addition to the modelling as it seeks to quantify the level of change that is required from the current world and how quickly this can be achieved. However, we have some concerns over the rationale used for setting the dates of maturity to Stage 2.

Our first issue is that these dates are set and have no degree of uncertainty around them. Instead we would prefer to see analysis that considered different relative gaps between the worlds' maturity dates.

The second issue is that the methodology described in Appendix D does not appear to be consistent. For the maturity gap assessment, it is not clear why in World A when the ESO devolves some of its functions to the DSO it achieves a negative score whilst in World D when the DSO devolves some of its functions to the ESO it has a positive score. Also in the business change gap assessment, World D and World E score the same ('Very high') when World E describes the creation of a totally new body that needs staffing, premises, systems whilst World D does require transfer of some staff from DNOs to the ESO, but not to the same degree as World E. The third and final issue regarding maturity dates chosen is that the methodology in Appendix D6 does not take account of Ofgem's 'minded to' move of the ESO price control periods to two-year cycles[1]. Therefore, to constrain World D's maturity date to the RIIO-4 ET date seems wrong. We believe that under a corrected maturity date methodology, World D's Stage 2 maturity date could be put on a par with World A & B at 2028.

Baringa's interpretation of World A highlights the fundamental issue that it does not deliver a whole system approach[2] and that this will lead to sub optimal balancing solutions. This has implications for the quantitative analysis in that the 'size of the pie' is different under World A than it is under other worlds where a single party is optimising over the whole system. This 'suboptimality of the balancing solution' is not covered by the proportion mapping procedure and is also ignored in the assumption that all worlds can

[1] https://www.ofgem.gov.uk/publications-and-updates/riio-2-sector-specific-methodology-consultation

[2] As the Distribution System Operator (DSO) uses DER to balance the local network first and then offers remaining DER, aggregate together, into the Balancing Mechanism (BM) and other ancillary services run by the Electricity System Operator (ESO).

deliver all benefits in Stage 2. Please see Appendix A for an example of a suboptimal solution that would be chosen under World A compared to the optimal solution that would be chosen under Worlds D or E.

We agree with Baringa's highlighting of the lack of clarity over conflicting usage of DER by the DSOs and the ESO and believe that the assumption of 'DSO first' usage is a sensible one to use in this initial stage impact assessment.

We also agree with Baringa's adoption of the access and charging reform aspects of World C into each of the other worlds. Because of this, there is no longer much need to consider World C as a separate option.

The level of ESO co-ordination of flexibility in World D is absent in the original definition. We are supportive of Baringa's clearly defined assumption used in the Impact Assessment (that the ESO procures flexibility from HV and EHV connected loads in Stage 1 and only procures additionally from the LV network in Stage 2). What is clear from the DNOs today[3] is that constraint issues are most acute at the EHV and HV level and therefore it is at this level that any flexibility co-ordinator will look to tackle flexibility issues first. An example of the limitations of flexibility from LV connections (even by 2028) can be seen from UKPN's recent auctions on PicloFlex. In Brandon, Norfolk, UKPN are looking for 2.3MW of generation turn up/consumption turn down for reinforcement deferral purposes. It would take the aggregation of 329 7kW EV charging points to deliver this flexibility. However, the population of Brandon in 2011 was 9636 people[4] which at 0.6 cars per capita[5] and an EV penetration of 12.8%[6] in 2028 suggests only 724 EVs in the town. This suggests that 45% of all EV owners will want to (and be available to) participate in offering flexibility to provide the 2.3MW needed. Therefore, it is far more likely that flexibility of this scale over this geographical area in 2028 will be supplied by loads connecting to the HV and EHV network. 2028-2030 does appear to be a good tipping point from HV flexibility to LV flexibility though (as EV penetration will have risen to 21% by 2030[7]).

We are also in agreement with the clearer definition of the role of the Flexibility Co-ordinator in World E being that of an independent party taking DER procurement and eventually dispatch decisions. There does remain

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[3] Section 3.1.1 WPD flexibility roadmap http://futuresmart.ukpowernetworks.co.uk/wp-content/themes/ukpnfuturesmart/assets/pdf/futuresmart-flexibility-roadmap.pdf
[4] 2011 Census
[5] https://www.ceicdata.com/en/indicator/united-kingdom/motor-vehicle-registered and https://www.ceicdata.com/en/indicator/united-kingdom/population
[6] National Grid ESO Future Energy Scenarios Databook Table RT2
[7] National Grid ESO Future Energy Scenarios Databook Table RT2

questions over whether independent parties can be achieved by legal separation (as between Nation Grid Transmission and National Grid ESO) or whether it will require completely separate entities.

Q3. Do you agree with the conclusions and insights within the Executive summary? If not, please explain your rationale. Please provide reference to more detailed comments against individual sections if this is appropriate.

Baringa's conclusions are broadly as follows

1. Worlds A & B are best suited to scenarios where LV flexibility takes off during the 2020s.
2. Worlds D & E are best suited to scenarios where the bulk of the flexibility is on the HV network (such as co-located storage with generation and large I&C demand side response).
3. World D is likely to be the cheapest option to implement and run.
4. World B is the quickest option due to its proximity to today's world.
5. World E is the most transparent, fair and neutral world.

E. ON does not disagree that Worlds A & B are best suited for high uptake of LV flexibility solutions (such as EVs, heat pumps and domestic storage), but as highlighted in Q2, the level of uptake needed (to deliver likely flexibility requirements from the LV network alone) is much higher than the levels suggested by the most optimistic National Grid's Future Energy Scenarios. A more realistic option to the large number of EVs required to deliver 2.3MW of flexibility in Brandon is a single co-located battery at the Toggam Farm 12.4MW solar farm (which is connected to the 33kV network). E. ON believes that LV flexibility will come, but it is likely to be after 2031 at which point all the Worlds will be able to access this resource equally.

Another issue not raised by the Impact Assessment in its quantitative modelling (but which is addressed in the qualitative assessment) is that of suboptimality of solution. Also addressed in Q2, Worlds A, B and E (under a multiple regional flexibility coordinator model) will not be able to 'see' the entire network to select the best national (including local) balancing solution. These 'losses' need to be included (if only as a factor with high degrees of uncertainty) in the 'size of the prize' benefit. This also challenges the Baringa assumption that all the Worlds are equivalent by 2050.

Q4. Do you agree with the options set out as potential transition paths?

We agree that the starting point of all the transition paths being World 2 Stage 1 is the correct one as it is the closest option to today's world and there is no firm evidence to suggest that the industry should be moving towards one of the other worlds in the near future. However, it would be useful to see the net benefits for each of the transition paths as (unlike in the diagram), it is unlikely that all the paths will transition at the same point in time.

For example, it is not clear when the switch from World B Stage 1 to World E Stage 1 occurs, when the switch from World A/B Stage 2 to World E Stage 2 occurs or when the switch from World B Stage 1 to World D Stage 1 occurs. We agree that a switch to World E is predicated on a conscious decision from Government that a neutral market is unobtainable without total independence and that this could come at any point, but it would be helpful to have examples of the net benefits of various points in time e.g. 2025, 2030, 2035, 2040 etc.

Because there is no maturity date for World D Stage 1, it is feasible that this could occur any time after the introduction of the Access and Forward-Looking Charge SCR recommendations (notional 2023) whilst the transition to World A Stage 2 is set by the maturity date of 2028. The main trigger for this decision (from World B Stage 1 to World D Stage 1) is not clear, but it is assumed that it is driven by the complexity of the ESO/DSO co-ordination actions across EHV/HV connected assets. This date will certainly be different to (and is likely to be earlier than) the modelled 2028 trigger point for a switch to World A Stage 2 which is predicated on the complexity of the ESO/DSO co-ordination across all voltage levels.

If a switch from World B Stage 1 to World D Stage 1 has occurred at an earlier time than 2028 (for example 2025) and sufficient uptake of LV flexibility assets to offer flexibility occurs at a later date (for example 2030), it is feasible that it is more cost efficient to continue to World D Stage 2 from World D Stage 1 than to switch path to World A Stage 2. E. ON believes that this path needs to be added as Transition Path 3a (whilst retaining the Transition Path 3 option if LV DER flexibility does not take off) and that Figure 3 from the Executive Summary is updated to incorporate these potential options (see Figure 2).

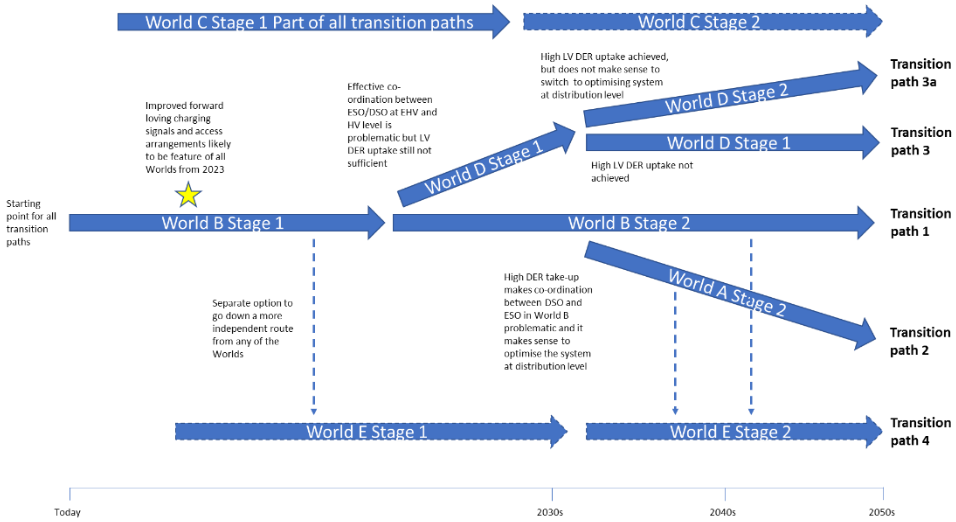

Figure 2 - Alternative DSO transition paths

Q5. Do you believe there are any other viable transition paths? If so, please explain why.

See response to Q4.

Q6. Do you agree with the assumption that all transition paths start in Stage 1 of World B?

We agree that this is the most sensible starting point for today's world.

Q7. Do you agree with the areas identified for further work in the 2019 workplan and the further work ideas in the impact assessment or do you feel there are other areas of work that should be prioritised to progress in this area?

We broadly agree with the areas identified for further work.

Q8. What future work do you believe would enhance the debate and body of evidence around transitioning to the potential Future Worlds?

We agree with the four areas of further work that have been identified by the impact assessment (impact of access and forward-looking charges, value of flexibility at LV level, potential conflicts of interest and possible mitigations and different pace of change across regions).

However, to add to these, we would recommend investigation of

1. Suboptimality of solution through having multiple balancing parties (see Q2 &3).
2. Net benefits (and ranges of net benefits) for each of the transition pathways.
3. Potential time gap between the uptake of EHV/HV DER assets for flexibility and the sufficient uptake of LV DER assets for flexibility to calculate net benefits of each of the transition pathways.

Q9. Do you agree or disagree with the four categories of system operation benefits identified? Are there areas that should be excluded from the list and/or other areas that should be included?

We agree with the four broad categories of system operation benefit being:

1. Avoided Transmission Investment
2. Avoided Distribution Investment
3. Avoided Generation Investment
4. Reduced Balancing services Costs

Q10. Do you agree, disagree on the key benefits assumptions contained within Appendix B (e.g. all Worlds, apart from World C, achieve the same benefits by 2050 etc) and used in the impact assessment? If you disagree, please explain your reasoning. Do you have any other comments?

As outlined in Q2&3, we are not convinced of the assumption that all Worlds can achieve the same level of benefit by 2050 due to the suboptimality of solutions found by having multiple balancing operators.

Furthermore, we are also concerned that no evidence has been provided for the assumption that the reduction in transmission constraints cost over time is a function of the percentage change in transmission connected generation over time. Looking at the transmission constraint costs from 2013 to 2018, there is a noticeable increase, but over that period transmission connected generation in fact fell (Figure 3). This data suggests that there is no historic relationship between transmission constraint costs and transmission connected capacity

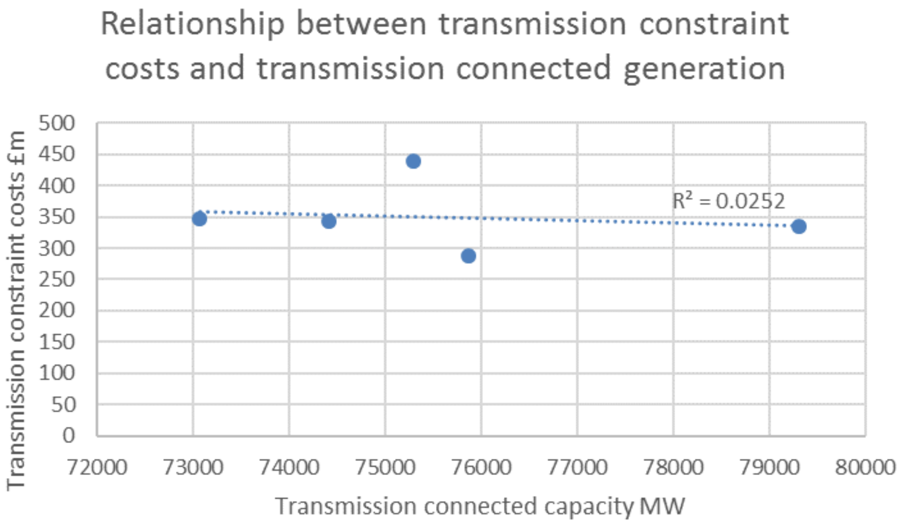

Figure 3 - Source: National Grid MBSS (2013-2018) and National Grid Future Energy Scenarios (2013-2018)

With the distribution network reinforcement avoidance through generation turn up profile, it is not clear why some technologies have been avoided from the analysis. It is unlikely to change the general form of the generation constraints, but for completeness it is not clear why dispatchable technologies such as biomass, biogas, landfill, waste and AD have been excluded from the analysis.

One class of assets capable of providing flexibility to avoid investment not covered by the quantitative analysis is that of interconnectors. A recent Bloomberg report[8] suggested that investment in large interconnectors with the Nordic countries could deliver a significant proportion of the UK's flexibility requirement at a cost-effective level. We do not have a strong opinion of whether this result is true, but its potential impact should be incorporated into the next iteration of the impact assessment.

[8] Bloomberg NEF report https://about.bnef.com/blog/flexibility-solutions-high-renewable-energy-systems/

Whilst the assumption that balancing costs are related to the percentage of intermittent generation was partially demonstrated in the impact assessment (by taking the balancing costs and % of renewable generation in 2005/6 and 2017/18), it would have been better to show the relationship for all years between these two data points. Figure 4 suggests that the relationship is not as strong as suggested in the analysis, and therefore highlights the dangers

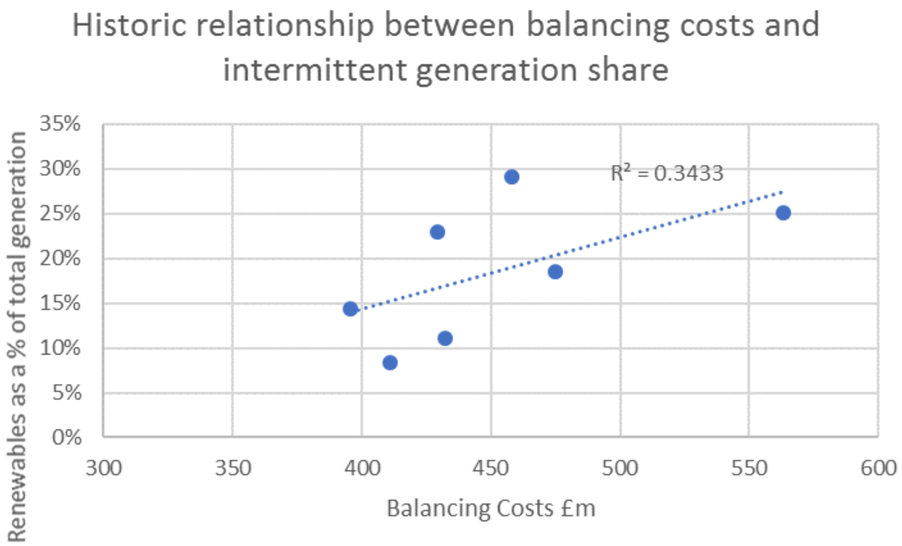

Figure 4 - Source: National Grid MBSS reports and National Grid Future Energy Scenarios (2011-2017)

of choosing a particular point in time.

Q11. Do you agree or disagree on the approach used to assess the overall potential benefits of improved system operation?

As per the response to Q8, we believe that the net benefit of World's A and B may have been over-estimated due to the inclusion of 100% of the total benefits by Stage 2 which ignores the suboptimality issues of having multiple balancing operators.

Q12. Do you agree with the assessment of the proportion of benefits which each Future World is capable of delivering in Stage 1 and Stage 2?

We are in broad agreement with the assessment of proportion of benefits assigned to each World.

Q13. Do you agree or disagree on the approach taken to deal with the uncertainty/range of benefits? If you disagree please explain your reasoning.

We are broadly in agreement with the approach taken to deal with the range of benefits although as highlighted in Q2, we believe that an uncertainty range for maturity to Stage 2 should also be applied to each World.

Q14. Do you agree or disagree with the areas identified for quantification of the implementation costs that will be faced by DSOs and ESO in Appendix C? If you disagree please explain your reasoning.

We agree with the areas identified for the quantification of implementation costs faced by DSOs and the ESO.

Q15. Do you agree or disagree with the approach used to assess the costs of each world? If you disagree, please explain your reasoning.

We agree with the four identified cost areas of technology, resource, interface and business change.

Q16. Do you agree or disagree with the approach to dealing with the uncertainty/range of costs? If you disagree please explain your reasoning.

We agree with the approach taken to deal with the range of costs and appreciates that the wide range is necessary for this initial level of analysis.

Q17. Do you agree with the trade-offs of each of the Future Worlds identified against each of the high-level criteria in Table 1 of the Executive summary?

The trade-offs of each World identified against the key objectives described in Table 1 do not allow for additional actors to participate in the system. For example, the decarbonisation of heat and transport can be achieved in Worlds D and E if independent aggregators become a popular route to market for LV DER. The ESO or Flexibility Co-ordinator would then concentrate on system operation and less on direct customer engagement (which was identified as the bottleneck for these Worlds to succeed at LV level.

However, on a pure DSO/ESO/Flexibility Co-ordinator structure, we accept that the trade-offs appear sensible.

Q18. Do you agree or disagree with the Appendix A approach of ranking of worlds to help identify the strengths and weaknesses of each World against each criteria? If you disagree please explain your reasoning.

It is sensible to analyse the five worlds both quantitatively and qualitatively (due to the high levels of uncertainty in many of the parameters modelled quantitatively). Using the Government five case model for the qualitative analysis is also appropriate to ensure a wide view of different perspectives.

Q19. Do you agree or disagree with the rankings and whether they are suitably justified? If not, please comment on which ones and why?

Whilst some of the rankings are sensible, in some instances, we believe that the qualitative analysis suffers from similar issues to the quantitative analysis. These include:

1. The assumption that all Worlds can achieve the same level of benefit in Stage 2 (see Appendix A for details on the issue of suboptimality).
2. Taking an assessment of benefits and costs in 2030 will be sensitive to the maturity dates for each World (see response to Q2).
3. The rationale for the inclusion of local optimisation as an assessment criterion is not clear. Local optimisation will lead to suboptimal solutions and will lead to higher than necessary costs to customers.

Q20. Do you agree or disagree with the list of potential unintended consequences identified in Section 4.5, and their prioritisation and potential mitigation as charted in Figure 20? If you disagree please explain your reasoning. Should the Open Network project progress further work on unintended consequences?

The impact assessment has captured a good range of unintended consequences and that the assignment of high prioritisation to the market power and gaming risks is a sensible one.

Appendix A – Suboptimality of World A compared to Worlds D and E

We are concerned with the assumption that all five worlds deliver the same level of benefit once they reach Stage 2. This is because we believe that multiple parties being involved in balancing will lead to sub optimal solutions on a regular basis (even with the best intentions of all parties involved). Below, we outline an example of where this is demonstrated.

Under World A, each regional DSO will aggregate DER assets within their geography to use to balance their own networks. Any residual assets left after balancing the distribution network will be offered to the ESO for national balancing (as long as it is above the minimum level of 1MW).

This differs from Worlds D and E where all the DER assets are aggregated together by the ESO (World D) or a Flexibility Co-ordinator (World E) to balance the entire network.

Let us consider a simplified user case with only three regions (Figure 5) under the two different balancing regimes (World A and Worlds D/E).

Under World A:

Regions A & C both have a demand of 100MW and purchase 75MW from transmission connected generation, leaving an imbalance of 25MW. Region B has a demand of 200MW and purchases 99MW from transmission connected generation, leaving an imbalance of 101MW.

As each region's DSO wants to balance its own region for lowest cost, Regions A and C both purchase 25MW of DER generation, leaving the region balanced with a surplus of 0.5MW in each region. However, this is too small to enter into the national balancing system and therefore the region's DSO doesn't make it available to anyone else. Region B also wants to balance at lowest cost and purchases 100MW from 'cheap' DER generation but is forced to purchase 1MW of 'expensive' DER generation as nothing cheaper is available from the national balancing market.

Overall cost of power under World A:

£	Region A	Region B	Region C
Transmission connected generation	750	990	750
'Cheap' DER	750	3000	750
'Expensive' DER	0	60	0
Total	1500	4050	1500
System total			7050

Under Worlds D & E:

With one national balancing party who can see all the assets and demand, the expensive DER is not required. Region A & C both purchase 74.5MW from transmission connected generation and 25.5MW of 'cheap' DER from their own region, leaving them balanced with no spare capacity for the national balancing market. Region B purchases 100MW from transmission connected generation and 100MW from 'cheap' DER from its own region, leaving 1MW of 'expensive' DER for the national balancing market (which is unneeded)

Overall cost of power under Worlds D & E:

£	Region A	Region B	Region C
Transmission connected generation	745	1000	745
'Cheap' DER	765	3000	765
'Expensive' DER	0	0	0
Total	1510	4000	1510
System total			7020

A system saving of £30 which it is feasible would be missed with numerous balancing parties being involved (and with different goals).

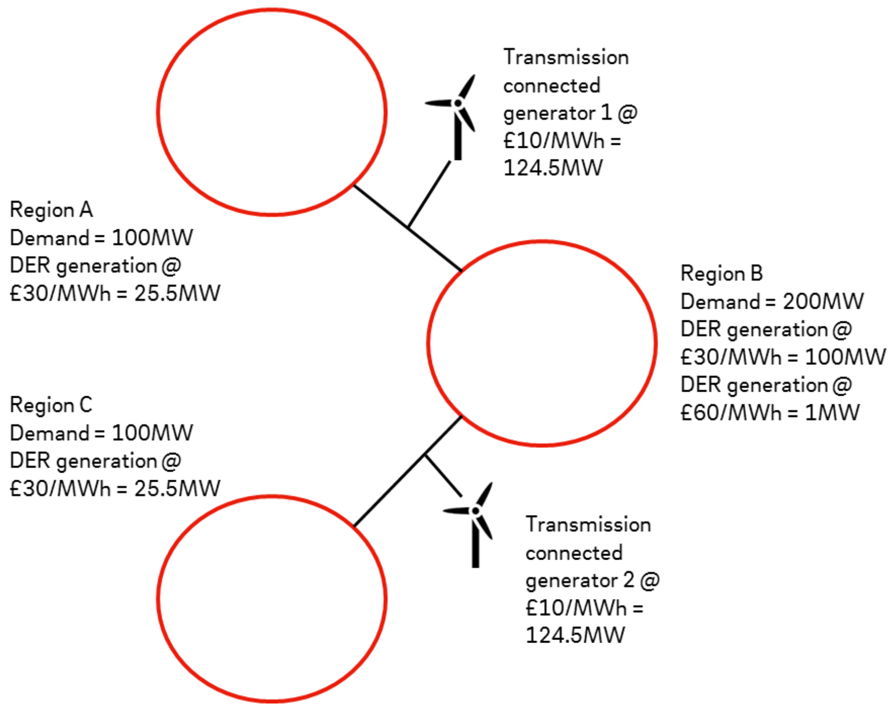

Figure 5 - Simplified electricity network