COLLABORATIVE GOVERNANCE CASE DATABASE

Purpose of database

This database provides a collective repository for collaborative governance case studies from around the world. The mission of the repository is to foster rich but systematic medium and large-N analysis of the conditions, processes, and outcomes of collaborative governance. Researchers who contribute a case to the database may use the entire dataset for their own research purposes. Moreover, contributed cases will be cited by other researchers in their analyses.

Key definitions and scope conditions

- *All types of collaborative governance cases from all policy domains are welcome*: Cases may involve only government entities, only non-government entities, or a mix of the two. Cases may represent successes or failures or something in between.
- *Definition of collaboration:* When two or more actors aim to constructively manage their differences in order to produce joint solutions to common challenges.
- *Definition of governance:* The arrangements and processes through which interdependent but operationally autonomous actors aim to formulate and achieve common goals through collective decision making.
- *Definition of collaborative governance:* A collective decision-making process based on more or less institutionalized interactions between two or more actors that aims to establish common ground for joint problem solving and value creation.
- *Definition of a case:* A set of actors collaborating on a shared issue over a specified time period within a given geographical space. The database allows contributors to chart the evolution of a collaboration over time. However, if the set of actors, the focal issue, or the geographical scope change drastically, the data may also be entered as separate but related cases.

Instructions to contributors

The survey consists of eight thematic sections, each starting with a series of closed questions and ending with an open text question that allows you to add your qualitative insights. Please provide as much information as you feel confident in providing on the basis of your knowledge of the case.. You can select 'Don't Know' if you do not have the answer. A confidence measure at the end of each section asks you to make a self-assessment of your level of confidence in the validity and reliability of the data you have entered. The survey takes about four hours to complete one case.

Before your survey is accepted into the database, a peer researcher will review your case description to make sure it is clear and consistent. You will also be asked to check at least one case submitted by a fellow contributor. Please contact the database editors at s.c.douglas@uu.nl to discuss any queries you may have about the database and about potential case contributions.

Content of survey

1. General case information

1. Please provide a unique name for the case you are describing.

Riding Sunbeams

2. Please provide your name, institutional affiliation, and email address.

Case author(s)	Colin Nolden
Institution / University	University of Bristol and University of Oxford
Email address first author	colin.nolden@bristol.ac.uk and colin.nolden@ouce.ox.ac.uk

3. Please specify the start and termination date of this collaboration.

Start of collaboration		End of collaboration	
March	2017	Ongoing	Ongoing

4. Please specify the period of the collaboration covered by your research data. Note: This is not about when you collected the data, but what period your data covers.

Start of period observed		End of period observed	
March	2019	November	2019

5. Please specify the type of data collection methods you used.

Methods	Used
Documents	✔
Interviews	✔
Observations Social network data	✔
Surveys	
Other, namely:	

6. Please provide up to three weblinks to published reports, articles, or books that document this case (e.g. a peer-reviewed article or an evaluation report).

https://www.bristol.ac.uk/media-library/sites/policybristol/briefings-and-reports-pdfs/Riding%20Sunbeams.pdf
https://www.network-industries.org/wp-content/uploads/2020/09/Powering-trains-with-renewable-energy.pdf

7. At which jurisdictional level did the collaboration occur? Choose more than one if necessary.

Level of collaboration	Start of period observed	Middle of period observed	End of period observed
Local	✔		
Regional	✔	✔	✔
National	✔	✔	✔
International (across borders)			
Supranational (UN, EU, etc.)			
Multi-level (collaboration between levels)			✔

8. In which country or region was the case situated? Pick more than one if necessary

Europe	Select	UK	Select	Select

2. Main case characteristics

9. What was the policy domain of the case? Choose more than one if required.

☐Agriculture	☒Environment & Climate	☐Social/Employment Policy
☐Culture/Leisure	☐Infrastructure & Planning	☒Technology & Transport
☐Economy & Trade	☐Public Health	☐ Other, namely …….
☐Education	☐Security & Public Safety	

10. To what extent was the collaboration driven by any of the following ambitions? (1 = not at all an ambition, 5 = this was the core ambition)

Ambitions of collaboration	Start of period observed					Middle of period observed					End of period observed					Don't know
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Develop a plan or policy for a shared problem or societal issue	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐
Develop a regulatory framework for a policy domain or industry	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐
Create innovative solutions in existing policies, programs, practices	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐
Increase efficiency by lowering costs or boosting benefits	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐
Increase effectiveness by increasing impact of interventions	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐
Increase legitimacy and support among different constituents	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐
Organize crisis and emergency planning, response and/or recovery	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	☐
Create holding environment to contain conflict among stakeholders	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	☐
Other, namely:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

11. To what extent did the collaboration aim to include any of the following forms of collaborative governance? (1 = not at all an aim, 5 = this was the core aim)

Purpose of collaboration	Start of period observed					Middle of period observed					End of period observed					Don't know
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Co-initiation: Jointly identify required policies, services, or regulation	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐
Co-develop: Jointly create and arrange policies, services, or regulation	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐
Co-production: Implement policies, deliver services, or provide regulation	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐
Co-assessment: Jointly monitor and evaluate impact of policies, services, or regulation	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐

12. **How confident do you feel the answers you provided to the questions in this section are valid, reliable, and rooted in data and observation?**

Mostly confident

13. **Please describe in max. 600 words the (a) societal challenges and organizational issues the collaboration sought to address, (b) the stated ambitions and desired outputs and outcomes, (c) how these challenges, issues and ambitions evolved during the period observed.**

a) Riding Sunbeams sought to power trains directly with renewable energy to create a subsidy-free route to market for community and commuter co-owned renewable energy developments for direct-wire traction power supply. For utility services such as railways where there is little scope to reduce or flex demand, procuring renewable energy at the point of such demand provides a direct means of decarbonizing and securing supply. This is of particular relevance to the transport sector which has failed to reduce greenhouse gas emissions in many rich countries. In countries where railway electrification is still in its infancy, directly powering trains with renewables in combination with battery storage provides a low-cost decentralized alternative to costly centralized electrification solutions. In the UK, a feasibility study conducted by Riding Sunbeams suggests that around 15% of traction power demand can be supplied by direct-wire renewable energy supply, thus contributing to the decarbonization of transport. Community and commuter co-ownership of such supply assets can help democratize participation in the energy sector.

b) As part of the Small Business Research Initiative: First of a kind Round 2 funded project covered by the data, Riding Sunbeams, a non-profit organization, sought to demonstrate the technical viability of powering trains directly with renewable energy. Riding Sunbeams seeks to power railways through community and commuter co-owned renewable energy developments to maximize the social impact of this innovation. Funding provided by he UK's Department for Transport through Innovate UK supported the development of a commercial, a legal and a social value framework alongside technical demonstration. A route to market hinges upon the procurement of direct-wire renewable energy supply by Great Britain's railway infrastructure provider Network Rail through a power purchase agreement. Collaborative governance of this innovation is thus led by Riding Sunbeams in collaboration with Network Rail and supported through pre-commercial procurement by the government.

c) After extensive feasibility work and research, Riding Sunbeams connected the world's first direct-wire renewable energy installation to Great Britain's railways as part of a pilot project in August 2019 in Aldershot on one of London's busy commuter routes. Despite technical feasibility, however, Great Britain's railway infrastructure provider Network Rail has been reluctant to address commercial and legal issues standing in the way of creating a route to market through procurement. This is the result of its highly risk averse business model, high transaction costs associated with arranging associated contracts and uncertainty surrounding this innovation's feasibility at scale.

3. Starting conditions

14. To what extent did the configuration of actors that made up the core of the collaborative process have a pre-history of mutual engagement? (1 = Very little history, 5 = Very extensive history)

Score					Don't know
1	2	3	4	5	
☐	☐	◉	☐	☐	☐

15. To what extent was there trust between core participants at the start of the collaboration? (1 = Very low trust 5 = Very high trust)

Score					Don't know
1	2	3	4	5	
☐	☐	◉	☐	☐	☐

16. How was the collaboration first initiated? Please select one option.

Independently convened by a third party

17. To what extent did the participants have more or less equal levels of resources, (e.g. knowledge, influence, skills) to bring to the collaborative process? (1 = Highly unequal, 5 = Highly equal)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
◉	☐	☐	☐	☐	◉	☐	☐	☐	☐	☐	◉	☐	☐	☐	☐

18. To what extent were there incentives to collaborate for the participants, e.g. financial gain or increased influence? (1 = Very little incentives, 5 = Very strong incentives)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	◉	☐	☐	☐	☐	◉	☐	☐	☐	☐	◉	☐	☐	☐

19. To what extent did the participants feel mutually dependent on each other for fulfilling their ambitions? (1 = Very low sense of interdependence, 5 = Very high sense of interdependence)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	◉	☐	☐	☐	☐	◉	☐	☐	☐	☐	◉	☐	☐	☐

20. How confident do you feel the answers you provided to the questions in this section are valid, reliable, and rooted in data and observation?

Highly confident

21. Please describe in max. 600 words the (a) the prehistory and past interactions of participants, (b) how the collaboration was initiated, (c) the sense of interdependence between participants and the incentives to collaborate, (d) any significant changes over time in the period observed.

a) and b) The origins of Riding Sunbeams can be traced back to 2014 when Tom Parker, director of REPOWER Balcombe, a community energy organization from East Sussex, UK, suggested connecting a planned solar farm to the local railway through a power purchase agreement. The long-term contractual certainty of a such an agreement would help address the shortfall of declining feed-in tariff subsidies while plugging a solar farm into Network Rail's shadow grid would help overcome local distribution network constraints. Climate change advocacy 10:10 Climate Action (now We Are Possible) subsequently assembled a team to conduct a feasibility study. With support from funding through Innovate UK’s Energy Game Changers competition, researchers from the Energy Futures Lab at Imperial College London and experts from Turbo Power Systems, the technical feasibility of this innovation was established in 2017. With the help of the Feasibility Study, further funding was secured from the Rural Community Energy Fund administered by the UK's Department for Energy, Business and Industrial Strategy. This funding supported the identification of suitable pilot sites for the development of community and commuter co-owned solar traction farms. With the establishment that this innovation can work in practice as well as in principle, competitive Small Business Research Initiative: First of a kind Round 2 funding was secured in 2018. This funding, provided by the Department for Transport and administered by Innovate UK, led to the founding of Riding Sunbeams Ltd. to build and connect the world’s first solar traction demonstrator as part of the ‘First Light’ project in 2019. It also established a formal collaborative partnership with Network Rail.

c) This research involved the development of a social impact framework to address the Small Business Research Initiative: First of a kind 4C business objectives of Cost reduction (50% or more), Capacity increase (doubling), Carbon reduction (halving emissions), and Customer satisfaction (improving their experience) established by the Department for Transport. Both the 4C business objectives and the social impact framework can be interpreted as impositions by an outside sponsor (the Department for Transport). A route to market for Riding Sunbeams' innovation in Great Britain is entirely dependent on Network Rail's procurement strategy which is strongly influenced by the Office of Rail and Road's regulatory compliance requirements. Network Rail currently procures traction power supply through a single 10-year contract. Network Rail's incentive to collaborate is driven by the recognition that current decarbonization efforts are not deemed sufficient to contribute to the UK government's net zero targets and by its search for alternatives to costly centralized electrification. This is thus a highly unequal collaboration with Riding Sunbeams to gain or lose everything through the procurement of its innovation and Network Rail to gain or lose hardly anything.

d) The demonstration helped address several technological issues, related primarily to signalling and harmonics, and enabled Network Rail to take solar power traction through compliance. Efforts to establish a route to market, however, have stalled. More funding has been secured to demonstrate the technical, commercial and legal viability of this innovation at scale. Despite support and enthusiasm for this innovation within Network Rail, the Department for Transport and the media it is unclear if Network Rail are willing to change their principles of procurement to create a route to market for direct-wire renewable traction power supply.

4. Institutional design

22. How many (institutional/group) actors were involved in the collaborative process?

Start of period observed	Middle of period observed	End of period observed	Don't know
1-5	1-5	1-5	☐

23. What different types of actors took part in the collaboration. Please select the backgrounds of the different participants.

Background of participants	Start of period observed	Middle of period observed	End of period observed	Don't know
Political organizations / politicians	☐	☐	☑	☐
Public organizations / civil servants	☑	☑	☑	☐
Private, for-profit organizations	☐	☐	☑	☐
Private, non-profit organizations	☑	☑	☑	☐
Citizens / informal citizen groups	☑	☐	☐	☐

24. To what extent were the procedural ground rules for the collaboration clearly explicated by and for the participants? (1 = Very little articulation of ground rules, 5 = Very detailed articulation)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
●	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐

25. To what extent were the procedural ground rules observed and applied? (1 = Very rarely applied, 5 = Almost always applied ground rules)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑

26. To what extent was the collaboration inclusive? (1 = Very few of the relevant and affected actors included, 5 = Almost all of the relevant and affected actors included)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐

27. To what extent were the decision-making processes in the key collaborative forums transparent? (1 = Rarely clear to participants how decisions were taken, 5 = Almost always clear)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐

28. How confident do you feel the answers you provided to the questions in this section are valid, reliable, and rooted in data and observation?

Mostly confident

29. Please describe in max 600 words (a) the ground rules of the collaboration, (b) the inclusiveness of the collaborative forum(s), (c) the transparency of decision making within the collaborative forum(s), (d) any significant changes in the institutional architecture of collaboration over time

a) Initially, Riding Sunbeams was established to create a route to market for commuter and community-owned renewable energy developments through direct-wire traction power supply. This was supported through funding such as Innovate UK's Energy Game Changers and its Small Business Research Initiative: First of a kind Round 2 funding. However, once the technical feasibility of this innovation had been demonstrated and the focus shifted towards commercial and legal feasibility it became clear that Network Rail deemed the risks and transaction costs of engaging with individual community renewable energy developments too high. The rules of collaboration that emerged required Riding Sunbeams to take on an intermediary role in securing commercial funding and driving a commercial route to market while modifying its objective to the delivery of significant social impact for line-side communities.

b) Initially, Riding Sunbeams held meetings with representative from several community energy groups which had been identified as part of the feasibility study in 2018 as suitable for direct-wire connections. As the Small Business Research Initiative project progressed, however, it became evident that large-scale demonstration at a single site would be necessary for Network Rail to assess the risks and transaction costs of procuring this innovation. As technical, commercial and legal sensitivity increased, inclusive collaborative governance efforts declined.

c) Despite support and enthusiasm for this innovation within Network Rail, the Department for Transport and the media it became clear that risk and transaction cost considerations outweighed the benefits of this innovation. The opacity of decision-making regarding these considerations made it difficult to establish the feasibility of creating a route to market and understand where leverage lies to foster institutional change and collaborative governance.

d) What started off as a collaboration among community energy groups, non-profit organizations and technological innovators on the one hand and Network Rail on the other evolved into a collaboration between Riding Sunbeams (acting as an intermediary for the community energy sector), commercial funders, Network Rail and facilitators (especially grant awarding bodies such as Department for Transport, Innovate UK, South West Local Enterprise Partnership).

5. Leadership

30. Characterize the locus of leadership roles in the collaborative process

Locus of leadership	Start of period observed	Middle of period observed	End of period observed	Don't know
One lead actor				
A few lead actors	✔	✔	✔	
Shared collective among all actors				

31. What were the backgrounds of those exercising leadership? Choose more than one if necessary.

Background of participants	Start of period observed	Middle of period observed	End of period observed	Don't know
Political organizations / politicians				
Public organizations / civil servants	✔	✔	✔	
Private, for-profit organizations			✔	
Private non-profit organizations	✔	✔	✔	
Citizens / informal citizen groups	✔			

32. To what extent was the leadership effective in convening / bringing together the relevant and affected actors (1 = Highly ineffective, 5 = Highly effective)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐

33. To what extent was the leadership effective in guarding the focus and integrity of the collaborative process intended in this case? (1 = Highly ineffective, 5 = Highly effective)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐

34. To what extent was the leadership effective in resolving or mitigating conflicts between actors? (1 = Highly ineffective, 5 = Highly effective)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐

35. To what extent was the leadership effective in creating and realizing concrete opportunities for creative problem-solving resolving? (1 = Highly ineffective, 5 = Highly effective)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐	●	☐	☐	☐	☐

36. How confident do you feel the answers you provided to the questions in this section are valid, reliable, and rooted in data and observation?

Mostly confident

37. Please describe in max. 600 words the (a) the form and style of leadership within the collaboration, (b) the dynamics and impact of leadership on the collaborative process (c) changes in the leadership dynamics in the period observed.

a) Initially it was assumed that community energy groups would lead the development of renewable energy projects (including feasibility studies, land leases, installations, connection, operation and maintenance) to power railways, Network Rail would procure the electricity generated through power purchase agreements and Riding Sunbeams would act as a broker between them. Due to the risks and transactions costs associated with multiple supply contracts and Network Rail's existing single traction supply contract, community leadership was abandoned in favour of Riding Sunbeams taking on the developmental role. Upon completion, Riding Sunbeams would subsequently offer shares in renewable energy developments to line-side communities and commuters.

b) and c) Although Riding Sunbeams' innovation has received significant support from leading figures in the Department for Transport and Network Rail, the decision-making structure regarding the potential procurement of this innovation and underlying risk and transaction cost considerations remain opaque. At the same time, this uncertainty necessitated a shift away from community leadership of renewable energy developments towards a commercial route to market, commercial investors and a more competitive outlook.

6. Collaborative process

38. To what extent did the participants engage in face-to-face dialogue through holding regular meetings with good attendance? (1 = Very infrequently, 5 = Very frequently)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐

39. To what extent was the collaborative process concentrated in a single forum/arena/group? (1 = Very low concentration; 5 = Very high centralization in a single forum/arena/group)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐

40. To what extent did the participants in the collaborative process invest in joint fact finding? (1 = Very little investment, 5 = Very high investment)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐

41. To what extent did the participants in the collaborative process invest in knowledge sharing? (1 = Very little investment, 5 = Very high investments)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐

42. To what extent did the collaborative process focus on the alignment of interests and values among all actors? (1 = Very weak focus, 5 = Very strong focus)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐

43. To what extent did the collaborative process focus on joint problem-solving (e.g. joint problem framing, co-designing solutions)? (1 = Very weak focus, 5 = Very strong focus)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐

44. To what extent did the collaborative process explicitly focus on producing tangible intermediate outputs (quick wins)? (1 = Very weak focus, 5 = Very strong focus)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐

45. To what extent did the collaborative process explicitly focus on producing tangible strategic outcomes? (1 = Very weak focus, 5 = Very strong focus)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐

46. How confident do you feel the answers you provided to the questions in this section are valid, reliable, and rooted in data and observation?

Mostly confident

47. Please describe in max. 600 words (a) the collaborative process in terms of how the actors interacted with each other, (b) how they formulated and achieved shared outcomes, (c) how the process changed over the period observed.

a) Funding requirements necessitated close collaboration between Riding Sunbeams and the organizations it represents on the one hand and Network Rail on the other. The technical teams in particular collaborated closely and successfully throughout the development of the pilot site at Aldershot, UK, and the subsequent development of the pilot project. The commercial and legal teams found less common ground regarding the creation of a route to market for this innovation. Demonstration at scale will hopefully address Network Rail's concerns regarding risks and transaction costs.

b) Shared outcomes regarding the 4Cs of Cost reduction (50% or more), Capacity increase (doubling), Carbon reduction (halving emissions), and Customer satisfaction (improving their experience) were required by the Department for Transport. Funding through the South East Local Enterprise Partnership specified the creation of green jobs (up to 40 over the project's 25-year lifetime), annual carbon projected savings of over 820 tonnes/year, social and financial benefits for the local community arising from community ownership, boosting the resilience of the local electricity network and facilitating Network Rail’s ability to source low carbon power. Network Rail on the other hand appears to be primarily driven by financial and carbon savings vis-a-vis risks and transaction costs.

c) Network Rail's reluctance to procure direct wire supply from renewable sources despite successful conclusion of the Small Business Research Initiative: First of a kind Round 2 project was an indication that contribution to the 4Cs was not sufficient for Network Rail to do so. Riding Sunbeams' efforts subsequently focused more specifically on addressing the assumed risks and transaction costs that have prevented procurement to date. Overall, the emphasis shifted from community (co-)leadership to a commercial route to market while delivering significant social impact for line-side communities. As a result, commercial actors have been increasing their contribution to this project.

7. Accountability

48. To what extent were explicit joint goals articulated through statements of intent, memoranda, strategic plans, etc.? (1 = Very little explication of goals; 5 = Very highly explicated goals)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐

49. How were the joint goals operationalized? (1 = Very little operationalization of goals, 5 = Very highly operationalized goals)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐

50. To what extent was there active monitoring of goal attainment? (1 = Very little monitoring of goal achievement, 5 = Very active monitoring of goal achievement)

Start of period observed					Middle of period observed					End of period observed					Don't know
1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐

51. To what extent did the participants render account of the collaboration to the following actors? (1 = Very little account-giving, 5 = Very active account-giving)

Actors	Start of period observed					Middle of period observed					End of period observed					Don't know
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Elected politicians	●	☐	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐
Oversight bodies (e.g. auditors, courts)	●	☐	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐
Civil society organizations	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐
Affected and/or concerned citizens	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑

52. To what extent did the following external actors have influence over collaboration (1 = Very little influence, 5 = Very large influence)

Actors	Start of period observed					Middle of period observed					End of period observed					Don't know
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Elected politicians	●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐
Oversight bodies (e.g. auditors, courts)	●	☐	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	☐	●	☐
Civil society organizations	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐
Affected and/or concerned citizens	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑

53. How confident do you feel the answers you provided to the questions in this section are valid, reliable, and rooted in data and observation?

Reasonably confident

54. Please describe in max. 600 words (a) how the goals of the collaboration were formulated and monitored, (b) how participants, elected officials, oversight bodies, and citizens held the collaboration to account, (c) how these dynamics changed over the period observed.

a) The goals of collaboration regarding the 4Cs were included in the social impact framework. Regarding cost, commercial sensitivity regarding Network Rail's existing supply contract as well as opacity surrounding other contracts such as those with Distribution Network Operators regarding power outflow at grid supply points complicated the establishment of a traction power supply cost baseline. Regarding capacity increase, the key concern for Network Rail was whether this innovation can increase power supply at constrained grid supply points. Regarding carbon emissions, Network Rail's existing traction electricity supply contract with Energie de France is mostly from nuclear power which is relatively low carbon. If traction power supply from renewables replaces electricity supplied by nuclear power plants the carbon savings are modest. If such power is used to replace diesel locomotion the carbon savings are very significant. Similarly, if a greener railway system encourages less car use, carbon savings are also significant. It has therefore been difficult to establish Riding Sunbeams' exact contribution to the 4Cs.

b) Despite these uncertainties, Riding Sunbeams received additional funding, most prominently through the South East Local Enterprise Partnership, to power trains with renewables. Many benefits such as the 4Cs and those specified under 47 b) will only materialize over the course of 25-year project lifespan. They are nevertheless derived from existing renewable energy developments that prioritize community benefits. Riding Sunbeams' and Network Rail's social impact reporting will play a significant role in accounting for these projected benefits.

c) The shift from the vaguely formulated 4Cs to the benefits specified under 47 b) points towards growing expectations regarding both the successful development of a route to market and the social benefits associated with such a route to market. This increases the pressure on Riding Sunbeams to deliver but it fails to take into account that success or failure depend entirely on Network Rail's appetite to engage in the procurement of traction supply arrangements with unfamiliar risk and transaction cost profiles.

8. Outputs and outcomes of collaboration

55. To what extent did the collaboration produce the following outputs or outcomes? (1 = Very low, 5 = Very high). Note: This question mirrors the ambitions formulated in question 10.

Produced outputs and outcomes	Start of period observed					Middle of period observed					End of period observed					Don't know
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Develop a plan or policy for a shared problem or societal issue	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐
Develop a regulatory framework for a policy domain or industry	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐
Create innovative solutions in existing policies, programs, practices	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐
Increase efficiency by lowering costs or boosting benefits	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐
Increase effectiveness by increasing impact of interventions	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐
Increase legitimacy and support among different constituents	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐	☐	☐	☐	☐
Organize crisis and emergency planning, response and/or recovery	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	☐
Create holding environment to contain conflict among stakeholders	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	☐
Other, namely:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

56. To what extent did the collaboration use any of the following forms of collaborative governance? (1 = Very low extent, 5 = Very high extent) NB: This question mirrors question 11.

Realized collaboration	Start of period observed					Middle of period observed					End of period observed					Don't know
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Co-initiation: Jointly identify required policies, services, or regulations	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐
Co-develop: Jointly create and arrange policies, services, or regulation	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐
Co-production: Implement policies, deliver services, or provide regulations	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐
Co-assessment: Jointly monitor and evaluate impact of policies, services, or regulations	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐

57. To what extent did the collaboration produce innovations, such as novel solutions, systems, and processes? (1 = Very little innovation, 5 = Very highly innovative).

Type of innovation	Start of period observed					Middle of period observed					End of period observed					Don't know
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Develop novel products or services for clients and partners	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐
Develop novel production processes for producing products or services	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	☐
Novel ways of coordinating between roles and/or services of participants	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐

58. To what extent did the collaboration create outcomes beyond its stated aims? (1 = Very little outcomes going beyond stated aims, 5 = Very high degree of outcomes beyond stated aims)

Type of innovation	Start of period observed					Middle of period observed					End of period observed					Don't know
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Built support and legitimacy for investing in future collaborations	☐	●	☐	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐	☐
Built joint operational capacity for solving future problems and challenges	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐
Created positive unintended societal consequences	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	☐
Created negative unintended societal consequences	●	☐	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	☐

59. To what extent did the collaboration achieve support among the different constituents of the collaboration? (1 = Very little support, 5 = Very extensive support)

Constituents	Start of period observed					Middle of period observed					End of period observed					Don't know
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Participants in the collaboration	☐	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐
Elected politicians	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐
Oversight bodies (e.g. auditors, courts)	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐	☐	●	☐	☐	☐
Civil society organizations	☐	☐	●	☐	☐	☐	●	☐	☐	☐	☐	●	☐	☐	☐	☐
Affected and/or concerned citizens	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑

60. How confident do you feel the answers you provided to the questions in this section are valid, reliable, and rooted in data and observation?

Mostly confident

61. Please describe in max. 600 words (a) the output of the collaboration in terms of results produced by the collaborative governance process, (b) the outcomes in terms of the impact on problem solving, goal achievement and legitimacy, taking into account any unintended consequences, (c) the changes to collective outputs and social outcomes over time.

a) To date, the collaborative governance of traction power supply from renewable sources has demonstrated, for the first time ever, that it is possible. This in itself is a huge success and testament to the commitment of all participants to collaborate governance processes. Regarding the 4Cs it has demonstrated the reduction electricity supply and electrification cost through direct-wire solar traction power at the same or a lower price as Network Rail currently procures grid electricity; the reduction carbon emissions as direct-wire solar traction power is the lowest carbon options available to Network Rail; an increase in capacity as additional direct-wire solar traction power can be provided in grid constrained areas characterized by technical limitations to the amount of electricity that can be supplied through transmission and distribution networks; and community and commuter share ownership of electricity supply assets which maximizes social benefits of this innovation.

b) Despite these outputs, the outcomes regarding a route to market are still unclear. To date, this collaborative governance of traction power supply from renewable sources suggests that risks and transaction costs have not been sufficiently reduced for Network Rail to procure this innovation although it has achieved regulatory compliance. In particular, it is unclear how issues such as uncontrolled power outflows at grid supply points influence the procurement decision-making process and how demonstration at scale can contribute to alleviating (or amplifying) such concerns.

c) From Riding Sunbeams' perspective, the major change in collective outputs and social outcomes over time has been the shift from community leadership of renewable energy project development to the need to develop a commercial route to market whilst delivering significant social impact for line-side communities. From Network Rail's perspective, such a transition is a prerequisite to satisfy risk and transaction costs concerns associated with its principles of procurement. Funders' continued emphasis on social outcomes, on the other hand, suggest that there appears to be an underlying desire to impose these upon Network Rail and its principles of procurement.