Smart Sustainable Plastic Packaging

Final Evaluation Progress Report

Prepared for UK Research and Innovation

WINNING MOVES®

UK Research and Innovation

Date	19th January 2023
Version number	3
Author	Doro Georgiou, Paul Woodcraft and Alicia Bentley
Approved by	Karl King (Director)

www.winningmoves.com

MRS Evidence Matters™ Company Partner

MRS Net Zero Pledge

Market Research Services ISO 20252 MQA

CYBER ESSENTIALS

Executive Summary

Introduction

UK Research and Innovation (UKRI) commissioned Winning Moves to complete the second phase of a three-phase evaluation of the Smart Sustainable Plastics Packaging (SSPP) Challenge. This phase is divided into two constituent parts:

- A Process Evaluation; and
- An Interim Evaluation of progress.

This document outlines the Interim Evaluation of progress with the following specific objectives to:

- Review evidence collected through internal monitoring processes to assess whether the Challenge is on track for delivering the expected benefits.
- Highlight areas of policy or action where specific adjustments could be made to the Challenge to increase the likelihood of obtaining its intended benefits.
- Review and adjust the evaluation approach as necessary/if required.
- Identify foreseeable issues to the evaluation and appropriate mitigation strategies.

The above objectives have been addressed drawing on evidence available to date from UKRI, along with primary and secondary research and analysis conducted by Winning Moves. Progress is discussed with reference to:

1. The Impact Evaluation questions developed in the first phase of the evaluation.
2. The Theory of Change – reviewed and updated by Winning Moves as part of Phase 2 of the evaluation.

Summary of progress

At the interim stage, evidence suggests the SSPP Challenge is on target to realise impact from the funding delivered. Within the Challenge there are several projects that will likely deliver impact within the lifetime of the UK Plastics Pact, in particular demonstrator projects that boost the UK's capacity to process plastic packaging. Projects supported at lower commercial readiness are also likely to have impact beyond the lifetime of the UK Plastics Pact but will need to be followed up with in future to understand their successes and whether they are taken further to full commercialisation. These projects include those focused on reuse and refill, understanding consumer behaviour, and the introduction of new plastic packaging.

Early indications show a strong case for attribution to the fund, with successful projects reporting they would not be able to proceed in the same timeframe and at the same scale in its absence. Further, a substantial proportion of unsuccessful projects reported they were unable to progress without SSPP funding. A full assessment of additionality will need to be made in the final phase of the evaluation.

A review of the assumptions that underpin the Theory of Change alongside the evidence collated shows good progress and supports the conclusion the Challenge is on track to realise impact. When considering the Impact Evaluation questions specified in the evaluation framework, a summary of key findings on progress for each is included below.

Table 1. Overview of findings by Impact Evaluation Question

Impact Evaluation Question	Key Findings
IE1: To what extent, and how, did the Challenge achieve its Objectives	> At this interim phase, there is clear evidence the Challenge is on track to meet its objectives: o There is evidence for a significant increase in R&I spend through projects supported; data collated by UKRI shows grant awards of £50.02m, and total co-investment totalling £209.91m to date (140% of the £149m co-investment target). o The portfolio of successful projects funded shows potential contribution to all four UK Plastics Pact targets. It will be important to consider which projects are likely to contribute to targets in the lifetime of the UK Plastics Pact, set to conclude in 2025 as although some projects are aligned to targets, impact may not be realised for some projects in time. o There is clear evidence from Benefits realisation work and qualitative interviews conducted during this Phase of the evaluation that there is collaboration across the value chain. Future assessment should be made once all projects have conducted a project closure interview, as these collect information about the extent to which relationships existed prior to the Challenge. This will help to understand whether collaborations are above and beyond what may have occurred otherwise. > Review of successful project application forms shows there are projects with the specific aim of: o Improving understanding of environmental impacts. o Improving understanding of consumer behaviour. > Assessing the impact of the SSPP Challenge on the UK's international recognition is difficult to assess at this early stage. However, there is already evidence of dissemination of project findings through academic papers and presentations at both UK and international events.
IE2: Did the Challenge result in additional effects in alignment with the Objectives of the programme?	> Overall, available evidence provides strong early indication of additionality, where: o Successful projects reported they either could not progress without funding or may have progressed at reduced scale in the absence of the fund. o Evidence collated from unsuccessful projects shows the impacts of SSPP funding with almost three quarters of unsuccessful projects interviewed in the qualitative interviews stating that they have had to suspend or 'moth ball' their planned projects due to a lack of financial resources or alternative funding. > Qualitative interviews show that there has been progress towards a more sustainable value chain, with increased collaboration. There has been evidence of data sharing and dissemination despite concerns that there may be a desire to protect intellectual property. > With demonstrator projects alone, an increase in UK capacity for recycling will be achieved, reducing the environmental impacts of plastic packaging, and encouraging clean growth. Many other projects still in progress will also realise impacts but given their early stage at this time tracking their successes and intention to commercialise will be necessary in Phase 3.

	> COVID-19 represented the most cited and detrimentally impactful barrier, leading to delays in project set-up and delivery, the suspension of all face-to-face and practical research and engagement, including laboratory-based and consumer facing (ethnographic) research. COVID-19, Brexit and increasing costs also led to difficulties in the effective functioning of the supply chain, with projects unable to access capital equipment, electronics components, and other materials. These supply chain issues also extended to recruiting the technical and scientific skills and expertise needed to start projects, and specific aspects of projects, on time. It is clear that these barriers have led to inevitable delays in the completion of certain project activities, and therefore delays in the achievement of impacts, but overall projects have managed to work through most of the challenges reported.
IE3: Were there any unintended adverse impacts from the activities of the Challenge that conflicted with the Aims of the programme?	In the main it is too early to look at this evaluation question and it will need to be assessed in the next phase of the evaluation. Based on data currently available, Winning Moves is not aware of any unintended adverse impacts to date. Suggestions for the future evaluation phase are included in the section below.
IE4: To what extent did the challenge offer good value for money?	In the main it is too early to look at this evaluation question at this stage and a full method on Value-for-money will need to be developed and agreed for the final phase of the evaluation. This is discussed further in the section below.

Considerations for future evaluation

When approaching the final evaluation of the SSPP Challenge, Winning Moves recommends that UKRI and the designated contractor consider the following:

1. **Initial project scoping:** It was important for the programme logic to be updated at the outset of this phase and to also expand upon the existing content to a Theory of Change. Given the eventual impact evaluation is likely to be a Theory Based evaluation, it will be necessary to again review this content and ensure it is fit for purpose.
2. **Project-level and Sector level indicators**: The indicators proposed to track the progress of the Challenge total 101. Although most map to the overarching evaluation questions, there are likely too many to enable robust conclusions on the success of the Challenge to be made. In addition to this, the indicators requested directly from projects can be difficult for respondents to answer, particularly in an online survey when beneficiaries cannot be provided with further explanation around the indicator in question. As a first phase of the next evaluation, Winning Moves recommends UKRI and the preferred contractor conduct a review of indicators. A detailed list of suggested steps for this review process are included in the final section of this report.
3. **Consideration of mechanism to capture data:** This should be considered for two reasons:
    - There are multiple requests on projects to supply data, at the interim phase successful projects were asked to complete a qualitative interview and accompanying online survey. It would be good to reduce this to one interaction for future rounds of data collection, as much as possible.

- Quantitative data provided through the online survey was sparse for some indicators. This was due to varying reasons including, the timeframe being too early and lack of relevance for particular indicators. Winning Moves recommends integrating data capture into the telephone approach is considered in the next phase to allow for questioning to be tailored to particular projects. The task of reviewing relevance of indicators by project will also help to refine the sub-set of questions relevant to each individual project.
  The next phase of the evaluation may wish to consider alternative mechanisms to gather feedback from UKCPN and UK Plastics Pact members given the response rate to the online survey issued in this phase was low.

4. **Selecting the overarching evaluation method:** The initial evaluation framework suggests that a realist evaluation may be appropriate to understand the impact of the Challenge. However, it was discussed with UKRI that (even at the interim phase), in the absence of realist theories being developed during the first phase of the evaluation, it was likely too late to initiate an evaluation of this type and it would likely not be fit for purpose. Winning Moves recommend that either contribution tracing or process tracing is considered as the basis for assessing the overall impact and contribution of SSPP in the final phase.
5. **Assessing future impact:**
   a. It is likely some impacts will not be realised until the closure of the competition. It may therefore be advantageous to assess the projects that will and will not realise environmental benefit or other kinds of impact within the competition lifetime, with a view to use this information to:
      i. Consider whether approaches to forecasting of impact should be adopted where possible and to frame the types of questions that can be asked to each project.
      ii. Set the scene for any final impact reporting, making clear where estimates are likely to be conservative.
   b. To fully address Impact Evaluation Question 3 on adverse impacts, Winning Moves recommends that the final evaluation includes a technical assessment of any negative environmental impacts that may be associated with projects. For example, quantifying the environmental impacts of the new solutions compared to those they are replacing to ensure that elimination of plastics does not create other issues or considering whether it takes more energy to produce alternatives, whether projects have created new waste streams to deal with.
6. **Assessing value for money:** Winning Moves suggests that in the next phase UKRI and the chosen evaluator consider carrying out a cost effectiveness analysis (CEA) for the fund, with a focus on cost effectiveness in leveraging additional investment in this area. This is because for some projects it will not be possible to adopt a full CBA. A full CBA should, however, be considered for demonstrator projects on the basis of the costs and benefits achieved in the context of the project, and beyond (where the evidence allows).

Contents

1 INTRODUCTION 1

1.1 BACKGROUND AND RESEARCH OBJECTIVES 1
1.2 TIMING OF THE CHALLENGE RELATIVE TO THIS OUTPUT 1
1.3 RESEARCH APPROACH 2

2 PROGRESS AGAINST IMPACT EVALUATION QUESTIONS AND TARGETS 2

2.1 INTRODUCTION 2
2.2 IE1: TO WHAT EXTENT, AND HOW IS THE CHALLENGE ON TARGET TO ACHIEVE ITS OBJECTIVES 2
2.3 IE2: IS THE CHALLENGE ON TARGET TO RESULT IN ADDITIONAL EFFECTS IN ALIGNMENT WITH THE OBJECTIVES OF THE PROGRAMME? 32
2.4 IE3: WERE THERE ANY UNINTENDED ADVERSE IMPACTS FROM THE ACTIVITIES OF THE CHALLENGE THAT CONFLICTED WITH THE AIMS OF THE PROGRAMME? 44
2.5 IE4: TO WHAT EXTENT IS THE CHALLENGE ON TARGET TO OFFER GOOD VALUE FOR MONEY? 45

3 PROGRAMME LOGIC AND THEORY OF CHANGE 46

4 SUMMARY 55

4.1 OVERVIEW OF KEY FINDINGS 55
4.2 CONSIDERATIONS FOR THE PHASE 3 EVALUATION APPROACH 61

5 APPENDIX 1: EVIDENCE ASSESSED IN ASSESSING PROGRESS BY EVALUATION QUESTION 64

6 APPENDIX 2: PLASTICS PACT CONTRIBUTION BREAKDOWN 72

7 APPENDIX 3 PROGRAMME LOGIC 74

8 APPENDIX 4 GLOSSARY 76

Figures

FIGURE 1. TRL PROGRESSION AS CAPTURED IN PROJECT CLOSURE FORMS. 11
FIGURE 2. STATUS OF UNSUCCESSFUL PROJECTS COMPLETING THE ONLINE SURVEY; WHEN ASKED OF THE PROJECT WENT AHEAD WITHOUT CHALLENGE FUNDING (N=35) 35

Tables

TABLE 1. OVERVIEW OF FINDINGS BY IMPACT EVALUATION QUESTION III
TABLE 2. IMPACT EVALUATION QUESTIONS 1
TABLE 3. SSPP DELIVERY SCHEDULE 2
TABLE 4. ONLINE BASELINE SURVEYS ISSUED AND RESPONSES RECEIVED. 3
TABLE 5. NUMBER OF SEMI-STRUCTURED INTERVIEWS COMPLETED BY COMPETITION AND STATUS. 1
TABLE 6. IE1 SUB-QUESTIONS 2
TABLE 7. SSPP CHALLENGE OBJECTIVE LINKED TO IE1.1. 3
TABLE 8. DEFINITIONS FOR INVESTMENT TYPE. 4
TABLE 9. BREAKDOWN OF PROJECTS BY COMPETITION. 5
TABLE 10. LEVERAGE RATIO ACHIEVED, CALCULATED AS TOTAL CO-INVESTMENT (FORMS 1-4) DIVIDED BY UKRI GRANT. 7
TABLE 11. TECHNOLOGY READINESS LEVEL (TRL) SCALE CAPTURE IN PROJECT CLOSURE FORMS. 10
TABLE 12. SSPP CHALLENGE OBJECTIVE 12

TABLE 13. QUALITATIVE ASSESSMENT OF TARGET CONTRIBUTION BASED ON APPLICATION FORMS. 13
TABLE 14. PROJECT EXAMPLES CONTRIBUTING TO PLASTICS PACT TARGETS. 15
TABLE 15. PROJECTS COMPLETING AN ONLINE SURVEY CODED AS CONTRIBUTING TO EACH TARGET. 17
TABLE 16. SSPP CHALLENGE OBJECTIVE 21
TABLE 17. SSPP CHALLENGE OBJECTIVE LINKED TO IE1.4 24
TABLE 18. SSPP CHALLENGE OBJECTIVE 27
TABLE 19. SSPP CHALLENGE OBJECTIVE 30
TABLE 20. SUMMARY OF ADDITIONALITY BY APPLICANT TYPE 33
TABLE 21. SSPP CHALLENGE RATIONALE 46
TABLE 22. SSPP CHALLENGE EXTERNAL FACTORS 46
TABLE 23. SSPP CHALLENGE THEORY OF CHANGE ASSUMPTIONS 47
TABLE 24. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE1.1 64
TABLE 25. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE1.2 64
TABLE 26. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE1.3 65
TABLE 27. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE1.4 66
TABLE 28. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE1.5 67
TABLE 29. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE1.6 68
TABLE 30. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE2 69
TABLE 31. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE2.1 69
TABLE 32. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE2.2 70
TABLE 33. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE2.3 70
TABLE 34. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE2.4 71
TABLE 35. OVERVIEW OF EVIDENCE USED IN ASSESSING PROGRESS AGAINST IE2.5 71
TABLE 36. QUALITATIVE ASSESSMENT OF CONTRIBUTION BY COMPETITION. 73

1 Introduction

1.1 Background and research objectives

UK Research and Innovation (UKRI) commissioned Winning Moves to complete the second phase of a three-phase evaluation of the Smart Sustainable Plastics Packaging (SSPP) Challenge, one of 23 challenges funded through the Industrial Strategy Challenge Fund (ISCF). Building on Phase 1, which provided an evaluation framework and a set of project and Challenge level baseline indicators, this phase is divided into two constituent parts:

- A Process Evaluation; and
- An Interim Evaluation of progress.

This document outlines the Interim Evaluation of progress. The objectives of the interim evaluation are to:

- Review evidence collected through internal monitoring processes to assess whether the Challenge is on track for delivering the expected benefits.
- Highlight areas of policy or action where specific adjustments could be made to the Challenge to increase the likelihood of obtaining its intended benefits.
- Review and adjust the evaluation approach as necessary/if required.
- Identify foreseeable issues to the evaluation and appropriate mitigation strategies.

To address the above aims, this report discusses progress in two ways:

1. Through review of the assumptions that underpin the Theory of Change for the programme, produced at the outset of the Phase 2 evaluation. Evidence that the assumptions are coming to fruition demonstrates that the Challenge is operating as intended and is on target to achieve outcomes and impacts.
2. Discussing progress against the overarching Impact Evaluation (IE) questions (detailed in the table below), indicating whether the available evidence to date suggests the Challenge is on track to deliver its expected impacts.

Table 2. Impact Evaluation Questions

IE1: To what extent, and how, did the Challenge achieve its Objectives?
IE2: Did the Challenge result in additional effects, in alignment with the Objectives of the programme?
IE3: Were there any unintended or adverse impacts from the activities of the Challenge that conflicted with the aims of the programme?
IE4: To what extent did the challenge offer good value for money?

Source: Final Evaluation Framework Report March 2021

1.2 Timing of the Challenge relative to this output

This report provides commentary on progress towards IE questions. Full assessment of impact is planned for Phase 3 of the evaluation. Phase 3 is timed to enable inclusion of competitions and projects that, at the timing of this report, have yet to finish. Table 3 provides a summary of the original SSPP delivery schedule:

Table 3. SSPP delivery schedule

SSPP Competition	Status (Complete/Ongoing)	Completion date
Feasibility Studies for Demonstrators (FS4D)	Complete	November 2020
Feasibility Studies & Industrial Research (FS&IR)	Complete	October 2021
Future Plastic Packaging Solutions (FPPS)	Complete (NB. This competition was still in progress at the time interviews were conducted for the interim evaluation as such all data compiled on completion were not available to feed into this report.)	October 2022
Demonstrators Round 1	Ongoing	November 2023
Demonstrators Round 2	Ongoing	December 2024
Enabling Research (ER)	Ongoing	January 2025
Business Led Research and Development (BLR&D)	Ongoing	February 2025

Source: Challenge status report 2021 (Please note: this is correct as of the status report 2021 publication date, however completion dates may change as the Challenge progresses; for example, where individual projects apply for an extension).

As can be seen in Table 3 above, three of the seven competitions have concluded, with Demonstrators Round 1 (D1) expected to finish in November 2023 (based on dates reported in the Challenge Status Report 2021), followed by Demonstrators Round 2 (D2) in December 2024, Enabling Research (ER) in January 2025, and Business Led Research and Development (BLR&D) in February 2025.

1.3 Research approach

To collate the evidence needed to comment on the progress of the Challenge against the Theory of Change and the IE questions, Winning Moves have:

- Revised the programme logic for the Challenge to ensure it reflects delivery to date and expanded on this output to produce a Theory of Change for the Programme outlining the rationale, external factors and assumptions that underpin the logic for the programme.
- Conducted a review of evidence collected through UKRI and shared with Winning Moves including:
  - Review of benefits realisation data summaries for Feasibility Studies & Industrial Research and Feasibility Studies for Demonstrators (which are compiled on completion of the competition).
  - Review of Monitoring delivery and outcome data on government and pledged investment as of October 2022 and review of project closure forms where available and shared with Winning Moves.
- Delivery and analysis of an online survey issued to successful and unsuccessful project applicants to collate and capture progress against performance indicators, final responses included surveys from 24 successful applicants and 35 unsuccessful applicants:

Table 4. Online baseline surveys issued and responses received.

SSPP Competition	Online survey invitations issued to successful applicants	Successful applicant completions	Successful applicant response rate	Online survey invitations issued to unsuccessful applicants	Unsuccessful applicant completions	Unsuccessful applicant response rate
Feasibility Studies for Demonstrators (FS4D)	4	1	25%	4	2	50%
Feasibility Studies & Industrial Research (FS&IR)	5	2	40%	15	2	13%
Future Plastic Packaging Solutions (FPPS)	14	6	43%	55	12	22%
Demonstrators Round 1	2	0	0%	5	0	0%
Demonstrators Round 2	5	2	40%	3	0	0%
Enabling Research (ER)	10	9	90%	18	9	50%
Business Led Research and Development (BLR&D)	10	4	40%	35	10	29%
Total	50[1]	24	48%	135	35	27%

- Tranche 1 semi-structured interviews with SSPP stakeholders and wider stakeholders.
- Tranche 1 semi-structured interviews with SSPP project applicants, where we spoke with 52 project leads, who represented sixty-seven projects, broken down by competition in the table below. More resource was used to secure interviews with successful, unsuccessful and withdrawn applicants, hence although all were approached the response rate is lower for ineligible applicants. In addition to these, 5 interviews were completed with organisations delivering the Core Programme.

[1] There were 57 successful projects at the interim stage, but not all were sent an invitation to complete the online survey. For four projects the lead applicant had multiple projects and completed the online survey about one of their projects but not all. One applicant with multiple projects never confirmed with Winning Moves which project/s they would complete the survey for. Two Demonstrators Round 1 applicants were not sent an invitation to complete the survey on request from UKRI.

Table 5. Number of semi-structured interviews completed by competition and status[2].

Competition	Successful			Unsuccessful			Ineligible			Withdrawn		
	Population	Interviews achieved	Interview coverage	Population	Interviews achieved	Interview coverage	Population	Interviews achieved	Interview coverage	Population	Interviews achieved	Interview coverage
Feasibility Studies for Demonstrators (FS4D)	6	3	50%	6	3	50%	5	0	0%	2	1	50%
Feasibility Studies & Industrial Research (FS&IR)	4	4	100%	21	4	19%	14	0	0%	2	1	50%
Future Plastic Packaging Solutions (FPPS)	14	5	36%	62	4	6%	14	0	0%	2	2	100%
Demonstrators Round 1	2	2	100%	5	0	0%	2	1	50%	2	0	0%
Demonstrators Round 2	5	3	60%	8	4	50%	1	1	100%	0	n/a	n/a
Demonstrators Round 2 EOI	16	n/a	n/a	8	n/a	n/a	19	1	5%	0	n/a	n/a
Enabling Research (ER)	10	8	80%	18	3	17%	0	0	n/a	0	n/a	n/a
Business Led Research and Development (BLR&D)	13	6	46%	46	10	22%	24	1	4%	0	n/a	n/a
Total	70	31	56%[3]	174	28	17%[3]	79	4	5%	8	4	50%

[2] Population data is based on application forms shared with Winning Moves for review at the time of fieldwork. Numbers may change over time, for example, additional applications may withdraw later in the process.

[3] Response rate excludes the Demonstrators Round 2 EOI applications from the population as these are covered under Demonstrators Round 2.

In addition to the above, there are two online surveys not included in this interim report due to low response rates. These surveys included one issued to UK Circular Plastics Network (UKCPN) members and one issued to UK Plastics Pact members, to explore respondents' awareness and understanding of the SSPP Challenge and how its competitions and activities align with wider issues relating to plastics packaging, and the plastics sector more generally. The potential for a low response rate was discussed at the outset of survey development. This discussion was based on previous online survey response rates achieved with these audiences. It is therefore, advised that consideration is given to carrying out interviews over the telephone in the next phase of the evaluation to gain this feedback.

2 Progress against Impact Evaluation questions and targets

2.1 Introduction

This section looks at each of the Impact Evaluation questions and sub-questions in turn. The sections that follow outline for each of these questions the:

- The business case objective that the question aligns to (where applicable);
- Analysis of evidence reviewed and assessed;
- Key findings for consideration as the Challenge progresses;
- Considerations for the third phase of evaluation.

The evidence that has been used in assessing progress for each Impact Evaluation question is outlined in Appendix 1.

2.2 IE1: To what extent, and how is the Challenge on target to achieve its Objectives

This section focuses on the progress the Challenge has made in achieving its six objectives, encapsulated in the sub-questions in Table 6 below. Each sub-question is discussed in turn in the sections which follow.

Table 6. IE1 Sub-questions

- **IE1.1 To what extent, and how, did the Challenge unlock a significant increase in R&I spend on new forms of plastic packaging with improved functionality and sustainability?**
- **IE1.2 To what extent, and how, did the Challenge deliver R&I to support more sustainable plastic packaging in line with the UK Plastics Pact targets?**
- **IE1.3 To what extent, and how, did the Challenge increase UK plastic packaging**
- **value chain collaboration on improving sustainability?**
- **IE1.4 To what extent, and how, did the Challenge increase understanding of environmental impacts of existing and new plastic packaging to inform new and improved design, technologies and processes?**
- **IE1.5 To what extent, and how, did the Challenge increase understanding of behaviour on the sustainability of plastic packaging to inform new and improved design, technologies, processes and business models?**
- **IE1.6 To what extent, and how, did the Challenge increase the UK's international recognition and an increase of international finance (export and investment)?**

Source: Eunomia Final Evaluation Framework Report March 2021

For a number of objectives, it is only possible to comment with confidence on projects within competitions that had completed at the time of conducting the interim phase evaluation, as such they only draw on evidence from:

- Feasibility Studies and Industrial Research (n=5 successful projects).
- Feasibility Studies for Demonstrators (n=6 successful projects).

Throughout this report the source for data presented is indicated alongside sample size.

2.2.1 IE1.1 To what extent, and how, is the Challenge on target to unlock a significant increase in R&I spend on new forms of plastic packaging with improved functionality and sustainability?

To understand progress towards achieving significant R&I investment, the target set out for the Challenge in the business case has been considered alongside IE1.1.

Table 7. SSPP Challenge Objective linked to IE1.1.

To unlock a significant overall increase in R&I spend (toward UK target of 2.4% of GDP) on new forms of plastic packaging (designs, materials and technologies) with improved functionality and sustainability'. Target – £60M government investment matched by at least £149M of industry co-investment, with a leverage target of 1:3 for demonstrators.

Source: Smart Sustainable Plastic Packaging ISC Wave 3 Business Case V3

Total investment in innovation or research impacted by the Challenge can be broken down into the UKRI grant awarded and total co-investment. The total co-investment in research and innovation made by an entity or entities over a period of time or in a sector may accrue from a variety of research and innovation projects. For this reason, the accrued investments are considered as different 'forms' of co-investment and are defined by their timing, or relation to projects which have attracted grants. Definitions for types of investment including these specific forms of co-investment are included in the table below. All forms of co-investment are considered in understanding progress of the Challenge against the £149m industry co-investment target and 2.4% of GDP target.

Table 8. Definitions for investment type.

Total investment in innovation or research area impacted by ISCF Challenge	UKRI		**UKRI grant**	Grant awarded by UKRI to cover eligible project costs.
	Total co-invesment		**Pledged co-investment (Form 1)**	Investment (in terms of eligible costs) a grant recipient declares it (and collaborators) plans to make on R&D activity part-funded through an ISCF Challenge programme, in line with ISCF business cases/project plans. Declaration of this pledge is made by signing the Grant Offer Letter (GOL).
			**Accompanying co-investment (Form 2)**	The extra public (but non-UKRI) and non-public investments in ISCF-funded R&I activity over and above those which are considered eligible costs as part of the grant subsidy. This may include further costs outlined in the business cases/project plans for that activity, made in order to achieve the agreed output or outcome, but which are not part of the grant subsidy. The accompanying co-investments may be seen as: (1) Accompanying Public Co-investment - from other public funded sources e.g. another government department (note: these are highly likely to count as state-aid - but it is assumed that it is the grant recipient's responsibility to manage state aid/subsidy regime implications). (2) Accompanying Private Co-investment - from private sources e.g. the grant recipients, banks, venture capitalist, angel investors etc (note: these do not include co-investment 3rd sector organisations (not-for-profit). (3) Accompanying TSO Co-Investment - from 3rd sector organisations (TSO). See below for link to NAO description of TSO).
			**Aligned co-investment (Form 3)**	The investment in a technology/research area thematically aligned to, and evidently prompted by, ISCF-funded R&D activity(ies), e.g. as a result of increased confidence in the area created by the policy focus and ISCF Challenge an organisation starts a second related research project with no grant from the ISCF. As with Accompanying Co-investment this may be further broken down into Aligned Public, Private or TSO Co-investment.
			**Follow-on co-investment (Form 4)**	Investment to take to market, or exploit, outcomes from ISCF-funded R&D activity. Often involves combining with other intellectual property or technology to achieve commercial product. As with Accompanying Co-investment this may be further broken down into Follow-on Public, Private or TSO Co-investment. HMRC guidance relating to R&D Tax credits may prove useful.

The number of projects funded as of November 2022 is shown in the table below by competition.

Table 9. Breakdown of projects by competition.

Competition	Number of projects
Demonstrators Round 1	2
Demonstrators Round 2	4
Core programme (including Catapult Activity for BPF training and KTN Activity for the Circular Plastics packaging Network)	5
Feasibility Studies and Industrial Research (FS&IR)	5
Future Plastic Packaging Solutions (FPPS)	14
Smart Sustainable Plastic Packaging Business-led R&D	13
Feasibility Studies for Demonstrators	6
Enabling Research	11

Source: UKRI grant and Pledged co-investment data for November 2022 supplied by UK Research and Innovation

The below quantitative analysis outlines the current level of investment as recorded by UKRI. The figures are based on all data available as of November 2022. At this time the Challenge had committed 83% of UKRI public grant funds and achieved a level of industry co-investment beyond the £149m target, equating to 140% of the target. This achievement has been driven by a large sum of follow-on investment achieved through Demonstrators Round 1.

£50.02m

UKRI grant

£81.96m	£15.09m	£0m	£112.86m
pledged industry co-investment	accompanying co-investment	aligned co-investment	follow-on investment




Total co-investment: £209.91m (140% of £149m target)

0.47%

investment

in R&D

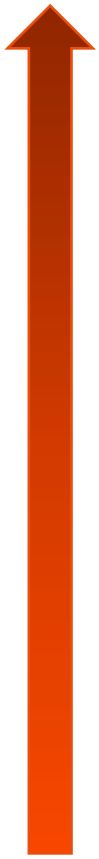
relative to 2.4% GDP

Source: Co-investment data for November 2022 supplied by UK Research and Innovation covering Indicators 1,2 and 5.

As shown below, different competitions have achieved varying leverage. The objective to ensure £3.00 of leveraged investment per £1.00 government investment for demonstrators was exceeded in Demonstrators Round 1, the high ratio achieved is driven by follow-on investment achieved for this competition (form 4 co-investment). To date, the ratio for Demonstrators Round 2 is below the objective achieving £2.2 per pound, but further follow-on investment may be made as more time elapses.

Table 10. Leverage ratio achieved, calculated as total co-investment (forms 1-4) divided by UKRI grant.

Competition	Leverage achieved (£ co-investment per £ UKRI grant)
Demonstrators Round 1	16.2
Feasibility Studies and Industrial Research	4.7
Demonstrators Round 2	2.2
Core programme	1.5
Future Plastic Packaging Solutions	0.6
Business-led R&D	0.6
Feasibility Studies for Demonstrators	0.5
Enabling Research	0.2



Source: Co-investment October 2022 by project supplied by UK Research and Innovation based on 63 successful projects.

The online survey issued to projects also sought to capture evidence of aligned co-investment[4]. Of the 24 projects surveyed, nine reported that they expected aligned co-investment where those giving details described use of technologies developed in related research projects and with new collaborators. It is expected, therefore, that further investment of this type will be realised when more projects have reached project closure.

[4] The interim survey asked whether there had been or if there was planned aligned co-investment and the nature of this investment but did not request the value at this stage.

Evidence from qualitative interviews indicates SSPP Challenge funding has been critical in encouraging and supporting R&I activities aimed at developing new forms of plastic packaging

The first Impact Evaluation question focuses specifically on the role and impact the Challenge is having in developing 'new forms of plastic packaging, with improved functionality and sustainability'. The scope and coverage of this evaluation question is quite broad and reflects the Challenge's interpretation of new forms of plastic packaging. For example, qualitative interviews conducted include projects in the following areas:

- the research and development of new plastics or polymers, with the aim of reducing the use of, and reliance on, fossil fuels;
- the identification of plastic alternatives that can be used in food packaging;
- developing processes that convert or transform waste plastics, allowing them to be used in new plastics or other materials, and which contributes to the Plastics Pact target of 30% recycled content;
- developing products and materials (e.g. resins) that can be added to existing plastics to improve sustainable and functional properties.

There are numerous examples of funded projects, across all competitions, and at different scales and stages of development, that are contributing to one of more of the above areas. Indeed, only a small proportion of the projects have sought to develop entirely new plastics, with much of the emphasis placed on plastic alternatives and the recycling and re-use of existing plastic.

As shown in the investment analysis above, the SSPP Challenge has invested significant sums of government awarded funding into competitions and projects that are in the earlier stages of research and development and that are aimed at developing new polymers or plastic alternatives. Approximately 40% of this investment has been targeted at lower Technology Readiness Levels (TRLs) and developmental/proof of concept activities, investment which has encouraged co-investment from academic institutions and private sector partners, that would otherwise not have been forthcoming:

> *'I think that it would have been difficult to fund it, I think because it is quite low TRL, it is an early-stage project. [organisation name] was involved in the application. The main focus was on whether it would be useful, there is no point doing research into something that potentially has no potential'.*

> *'The additional technology, investment in the process and analytical capabilities to demonstrate the food grade capability wouldn't have been done without the funding. It was critical in moving it from an investment case which would have been reasonable but wouldn't have advanced the environment to what will be a world leading facility as we go live'.*

As the above quotes show, SSPP Challenge funding has been crucial in reducing the inherent financial and resource risks associated with research and innovation and proof of concept activities, and has enabled projects to go ahead and progress, that would have been deemed too risky by lead organisations and their public/private sector partners.

Among the projects interviewed, there were examples of research and development in all four of the above areas.

Several projects focused on developing new plastics, or plastic alternatives, including polymers produced by, or derived from living organisms, such as plants and microbes, rather than from petroleum. SSPP has funded projects that are deriving materials from both plants and photosynthesising bacteria:

> *'Our project is looking to substitute or displace traditional synthetic materials, particularly those used in food packaging'.*

> *'One of the academics worked a lot with a bacteria called cyanobacteria, which are photosynthetic bacteria that use sunlight as a carbon source to grow. The material that these cyanobacteria naturally produce, called exopolysaccharide, can potentially be used in a plastic-type packaging application. We need to do more typical academic analysis of it before growing enough to put it into an application and blend it with other biopolymers'.*

Interview respondents stated that some of these polymers have advantages over 'traditional' plastics as they are renewable, meaning they do not use fossil fuels, they can be produced using lower carbon intensive processes, and they can be biodegradable/recyclable:

> *'Would it be better that plastic is something that would be compostable, that maybe you could dispose of with food waste and that could generate energy or it could go to compost?'*

> *'I think the biggest one for us at the start was the reduction in plastic waste because we were thinking about the compostability of our materials, the fact that they can be degraded in industrial composting facilities and that's something that can't be done with conventional films'.*

In addition to the above projects that we interviewed, there were others researching the functionality and use of alternatives to plastics, including a company trialling the industrial scale use of a seaweed-based alternative to plastic laminates in the paper and board industry, that could be applied to food packaging.

Some projects, including a large-scale demonstrator, have developed new processes that can 'recycle' plastic and convert it into a product that can be incorporated into existing plastics, thus contributing to the Pact target of 30% recycled content:

> *'Our project was split into two parts, the first was very much desk-based, presented with the theory of something that can turn waste plastics into chemicals. We did a desk-based technical, commercial, due diligence assessment. We got to a position where on paper we thought it looked quite interesting. The second project is taking that learning and designing the first sort of demonstration facility where we can actually test the performance against the theory'.*

The Challenge also funded projects that are researching materials and products that can improve the sustainable and functional properties of existing plastic food packaging. For example, there is a project researching the use of graphene in the production of multilayer films, and another exploring the role that an adhesive material or resin could play in improving the functionality of packaging:

> *'As a single sheet, graphene is completely gas impermeable, apparently, so we are looking to exploit that property and use it as an additive in as many applications as we can. At present, we are looking at taking a nano-material film, so just a single layer of plastic, and adding the nano materials onto that to ensure that it has the barrier performance that you need and that you usually get by laminating up to 15 layers of plastic together'.*

> *'So, essentially [company name] are an organisation that have developed a totally natural adhesive material, a resin. So, the first application was just to see if we could manufacture something that was just like plastic, it looked like plastic, performed like plastic, from waste materials, using [product name] as a resin. We managed to prove that we could make materials from the waste materials that are left and that are often burnt or sent to landfill. The next stage is to get more interest and develop the concept further'.*

With reference to TRL, the above examples are at an earlier stage of development, are laboratory based, and are exploring whether the materials can be used in food packaging or to transport products. A big question for these projects is functionality and the suitability of their materials for use as food packaging. However, SSPP has also funded demonstrator projects, exploring the suitability of materials for food contact at a far larger scale, which are far closer to commercialisation and that can make a more immediate contribution to Plastics Pact targets:

> *'The concept is to make a PP grade suitable for plastic packaging which is for contact sensitive applications. We designed the plan from the ground up and applied for the grant to support the investment decision and to convince the US that it was the right investment to make and to help us with the development of this final food grade material'.*

> *'It fits in really well which is why we were successful in the application. Recycled content is one of the Pact objectives which is one of the key deliverables of this funding round. You can't put plastics back into food grade packaging unless you have food grade plastic which we don't have at the minute and this project is there to deliver on that'.*

While there is a later section that focuses on additionality, in interviewing the above projects, all project leads stated their research and scale-up activities would not have been possible without the contribution of SSPP

funding. Challenge funding has been critical to de-risking activities, attracting co-investment and encouraging these projects to pursue material innovations that would not have been possible otherwise.

Project closure interviews aim to capture an understanding of movement in Technology Readiness by asking the state of projects at the beginning and at the end of the project using the following TRL scale:

Table 11. Technology Readiness Level (TRL) scale capture in project closure forms.

1	**Basic Principles have been observed/formulated**
2	**Developing hypothesis and experimental designs**
3	**Specifying and developing an experimental Proof of Concept (PoC)**
4	**PoC demonstrated in test site/initial evaluation of costs and efficiency produced**
5	**Technology /process validated in relevant environment**
6	**Technology /process validated in operational environment**
7	**System complete and qualified**
8	**Product/technology in manufacture/process being implemented**
9	**Product/service on commercial release/ process deployed**
NA	**Dead end reached**

Source: SSPP PCF raw data to October 2022.

A total of 19 projects have completed this assessment to date, with 31 individual respondents including collaborators and leads. Individual respondents within a project respond referring to their specific element of the project and as such responses within a project can differ. Overall:

- One respondent felt they had maintained their TRL by the end of the project.
- Two respondents reported they had dropped down the scale.
- Two respondents reported they had reached a dead end.

The remaining 26 reported that they had progressed, summarised in the graphic below. As shown below, there is evidence of projects not just of movement from lower level TRL levels to high levels, but of progression within the lower levels, for example, four respondents reported progression from level 1 to level 4.

Respondent	Starting level	TRL Progression								
		1	2	3	4	5	6	7	8	9
1	1									
2										
3										
4										
5										
6										
7										
6	2									
9										
10										
11										
12										
13										
14										
15	3									
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26	7									

Figure 1. TRL progression as captured in project closure forms.

Source: SSPP PCF raw data to October 2022 supplied by UK Research and Innovation (n=26 respondents reporting progression).

Key Findings:

At this interim phase, the Challenge has already exceed the £149m co-investment target (140% of target), with Demonstrators Round 1 playing a key role in this achievement. The data analysed provides a snapshot in time and should be updated in the next phase of the evaluation.

SSPP has played an important role in encouraging R&I activities through investment in early stage, low TRL and proof of concept activities that would have otherwise not been taken forward. Evidence collated at project closure to date shows progression through TRL levels over the course of the project lifetime. This includes projects where focus is on new forms of plastic packaging, enabling existing polymers to be used in different ways. These projects have resulted in materials that, in the main, are renewable or recyclable, and functional, including some that will be used in food packaging in years to come.

Considerations for future evaluation:

The quantitative assessment presented is currently made based on all funded projects, to understand progress towards the Target underpinning this Evaluation Question. For Phase 3, the evaluator should consider contributions to R&I spend on new forms of plastic packaging with improved functionality and sustainability specifically in line with the Impact Evaluation question. To do this at the outset of Phase 3, UKRI and the evaluator should ensure an agreed definition is produced for functionality and sustainability and if required each project is subsequently assessed for their contribution to these two goals.

It will also be important to secure a larger sample size to be confident in estimates of accompanying co-investment and aligned co-investment, although the figures presented here are conservative as they are based on a sub-sample of projects. Given the particular importance of these figures to evaluating the impact and value for money of the SSPP Challenge, we recommend UKRI continues to collect these figures in project closure interviews and ensures a comprehensive a set of data as possible are available for the final evaluation.

2.2.2 IE1.2: To what extent, and how, is the Challenge on target to deliver R&I to support more sustainable plastic packaging in line with the UK Plastics Pact targets?

The Challenge set out to deliver R&I spend in line with the UK Plastics Pact as outlined in the Business case objective outlined below.

Table 12. SSPP Challenge Objective

To deliver R&I to support more sustainable plastic packaging in line with the UK Plastics Pact targets.
Target – measurable progress towards achieving the UK Plastics Pact targets (100% reusable, recyclable, compostable, 70% effectively recycled or composted, eliminate problematic or unnecessary single-use, 30% average recycled content).

Source: Smart Sustainable Plastic Packaging ISC Wave 3 Business Case V3

UKRI have completed a qualitative assessment on the extent to which projects awarded funding have potential to contribute to the UK Plastics Pact targets coding them as low, medium, and high contribution. The below shows the outcome of this coding and total project value of those contributing to each target at the interim evaluation phase. In interpreting these findings, the reader should note:

- The assessment made is qualitative without agreed definition of what a low, medium, and high contribution should look like. For this reason, if a different individual were to complete the assessment it is possible that the resultant coding may differ.
- The coding has been carried on application forms, and a more robust assessment should be conducted looking at the impacts each project has made following completion or after further progress has been made.
- Each project can contribute to more than one target and as such numbers should not be summed across the four Plastics Pact targets.

Table 13. Qualitative assessment of target contribution based on application forms.

Qualitative assessment of target contribution based on application forms				
THE UK PLASTICS PACT targets	**TARGET 1** Eliminate problematic or unnecessary single-use packaging.	**TARGET 2** 100% of plastics packaging to be reusable, recyclable or compostable.	**TARGET 3** 70% of plastics packaging effectively recycled or composted.	**TARGET 4** 30% average recycled content across all plastic packaging.
Number of projects				
HIGH	**3**	**7**	**6**	**0**
MEDIUM	**10**	**18**	**14**	**12**
LOW	**7**	**18**	**16**	**7**
TOTAL	**20**	**43**	**36**	**19**
% of total projects awarded to date coded as contributing to target (n=59)	**34%**	**73%**	**61%**	**32%**
Value of projects				
Total project value £	**£30.7m**	**£78.1m**	**£98.2m**	**£66.0m**

Sources: (1) Benefits mapping of 61 successful projects supplied by UK Research and Innovation against Plastics Pact targets indicating a low, medium or high contribution[5]. Data covers Indicators 39-42. Two Demonstrators Round 1 projects were removed from the original analysis as they did not progress (2) Project value derived from co-investment figures supplied for October 2022 from Monitoring delivery and outcome data summed by contribution to Plastics Pact targets based on benefits mapping. Data presented includes the 57 successful projects included in the interim evaluation. Data covers Indicators 6-9. Note: Figures presented cannot be summed across UK Plastics Pact Targets as individual projects can contribute to more than one target.

As shown above, there is substantial value in projects with potential to contribute to the UK Plastics Pact Targets, with project value highest for those with potential to contribute to Target 3, ensuring plastic packaging is effectively recycled or composted. That said, a higher number of projects have potential to contribute to Target 2 for 100% of plastic packaging to be reusable, recyclable, or compostable. It follows, it will be important

[5] Sample size by competition: Core programme: n=2; FS&IR: n=5; FS4D: n=7; Demonstrators Round 1: n=2; Demonstrators Round 2: n=5; FPPS: n=15; Enabling Research: n =10; Business-led R&D: n=13.

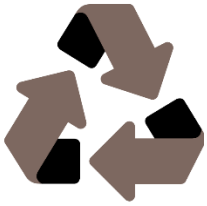
in the eventual impact evaluation to capture actual achievements (i.e. in terms of tonnages) towards reaching these targets. It will also be important to assess which projects are likely to contribute to targets in line with the 2025 timescale of the UK Plastics Pact, as it is likely that although many are in line with the aims of the UK Plastics Pact, the impacts of these projects may be realised beyond the lifetime of the agreement. A breakdown of contribution by competition is shown in the appendix.

Examples of projects that have potential to make at least a medium contribution to each of these targets are shown below:

Table 14. Project examples contributing to Plastics Pact targets.

THE UK PLASTICS PACT Targets		Project Examples
TARGET 1	Eliminate problematic or unnecessary single-use packaging.	A project to create an Open Data Standard (ODS) combined with track & trace technology to make it easier for businesses of all sizes to adopt reusable packaging in place of single-use plastics. (Feasibility Studies and Industrial Research) A project to explore the feasibility of reusable packaging in the supply chain, leveraging existing logistics infrastructure to move bulk products in a 100% circular system in order to service bulk dispensers in-store. (Feasibility Studies for Demonstrators)
TARGET 2	100% of plastics packaging to be reusable, recyclable or compostable.	Adoption of a re-usable bottle-for-life and promoting the usage of refills of personal care goods (shampoo, conditioner, detergents) and other fluids (cleaning liquids). (Future Plastic Packaging Solutions) A process that uses thermal cracking to recycle a wide range of plastic waste that cannot be recycled by conventional methods. The process is incorporated into machine designed to process 7,000 tonnes per annum of hard-to-recycle mixed plastic waste, producing 5,000 tonnes per annum of a new valuable hydrocarbon oil, which has multiple uses including replacing crude oil in plastics production, allowing plastic to be recycled an unlimited number of times. (Demonstrators R1)
TARGET 3	70% of plastics packaging effectively recycled or composted.	A 20,000 tonne per annum capacity demonstration plant that will convert end of life plastic into hydrocarbon feedstock (waxes, oils, naphtha) to be used to produce new plastic and other chemicals, recycling the chemical molecules contained within plastic. (Demonstrators R1) A project to demonstrate a mechanical recycling process to produce food-grade recycled polypropylene designed for integration within existing waste streams and infrastructure, relying on a state-of-the-art combination of online sensor technologies coupled with machine learning algorithms to sort the infeed into food/non-food-contact materials. (Demonstrators R2)
TARGET 4	30% average recycled content across all plastic packaging.	A feasibility study into use of a mechanical process which will allow most post-consumer films to be suitable for recycling. As a result, a large volume of waste film which was previously sent to landfill, incinerated or lost into the environment will be recovered and could be reused in new packaging applications. (Feasibility Studies for Demonstrators)

One area where there is most likely to be impact against Plastics Pact targets is through projects that have been successful in the SSPP Demonstrators Rounds 1 and 2 competitions, where the funds have been allocated to build fully operational plants or processing facilities. Of the seven[6] successful Demonstrator projects, five are focused on building the UK's recycling capacity for plastics, and should they be successful will collectively increase the UK capacity to recycle by 144,000 tonnes per annum. This is based on the initial demonstrator plants and does not consider the potential capacity should demonstrators be rolled out.



Mixed plastic waste	36,000 tonnes
Polypropylene (PP)	48,000 tonnes
Mineral Filled PP	25,000 tonnes
Polyethylene terephthalate (PET)	35,000 tonnes

In addition to the above, the Core Programme includes a project that will begin to address the infrastructure needs to collect flexibles kerbside and therefore has the potential to unlock further impact in future.

The interim evaluation online survey also attempted to capture data on whether any impacts contributing to targets had been realised to date; however, it should be highlighted that:

- This is based on a reduced sample size compared to the population.
- Findings and direct feedback received indicate that in future this data may be better captured in a conversation rather than through an online mechanism as it allows better tailoring of questions to the specific project. As a minimum, we would recommend that any future online surveys are better tailored through review of indicators by project, only requesting the data for indicators that are determined relevant to each project and where it is likely impact will have been realised at the time this information is requested. An overview of the 24 successful projects completing the survey and the target they contribute to is shown in the table below.

[6] Excluding two successful Demonstrator Round 1 projects that later withdrew.

Table 15. Projects completing an online survey coded as contributing to each target.

THE UK PLASTICS PACT targets	TARGET 1 Eliminate problematic or unnecessary single-use packaging through redesign, innovation or alternative (reuse) delivery model.	TARGET 2 100% of plastics packaging to be reusable, recyclable or compostable.	TARGET 3 70% of plastics packaging effectively recycled or composted.	TARGET 4 30% average recycled content across all plastic packaging.
Number of projects completing an interim evaluation online survey coded as contributing to each target[7]	9	19	15	7

Source: Online survey of successful projects (n=24)

None of the projects completing an online survey had removed single use plastics from the market at this time. Two projects reported replacing plastic packaging with reusable plastic where:

- One cited a replacement an introduction of 1000 kg of reusable plastic in place of packaging that was not reusable.
- One reported the introduction of circa 400 reusable containers.

One project reported the removal of 123 tonnes of plastic packaging from the market entirely.

Other specific examples of contributions to the Plastics Pact targets can be gleaned from qualitative interviews with projects. The process evaluation report, which forms a related strand of our Phase 2 work, discussed the SSPP project portfolio, and concluded that funding was carefully and intentionally aligned to the Plastics Pact targets. Project leads felt that the scope of SSPP remains broad and, as evidenced in the tables above, covers a diverse range of projects, but that an appropriate balance had been struck with targeting funding at several prominent areas, relating to reuse, recycling, and the reduction of plastics.

> *'You have got to make choices about the breadth of projects you fund, and over what period you expect pay-off. We wanted to look at things that were close to market and that could attract co-investment'.*

> *'I mean, where do you draw the line? Plastics is a huge problem and plastics packaging is a key contributor to that problem. We had to draw a line in the sand and say this is where we focus the money. We have a set amount of money so let's not try and be all things to all people, lets focus on a handful of issues where we can maximise impact'.*

Further evidence from qualitative interviews on the contribution that the Challenge is making, and will continue to make, to Plastics Pact targets is summarised below.

SSPP's dual focus on reuse and refill, as well as recycling

As one respondent put it when asked to position SSPP within the wider context of plastics,

> *'The recycling infrastructure has been developing for more than 20 years in the UK, whereas re-use hasn't. The SSPP Challenge has, to my mind, included a more balanced view of what can contribute to sustainable plastics and the reduction of single use and problematic plastics, it has focused more on re-use and refill alongside recycling'.*

[7] Based on qualitative coding of application forms.

While reuse and recycling complement each other, projects focusing on the former were keen to point out that re-use is different and has been 'misunderstood' by UKRI up to now:

> *'You could say that the end goal is answered by re-use or answered by recycling, but they are quite different approaches once you actually get into them. I think we [as a project] are specialist in reuse and saw the funds as being focused on how to reduce plastic packaging and, hopefully, prevent it entering our waste streams and then our natural environments'.*

> *'In the past, I have found re-use to be generally a bit misunderstood and it is not prioritised to the same extent as other areas, principally, recycling'.*

The SSPP Challenge has now recognised this difference and the complementary contributions that reuse and refill, and recycling can make to more sustainable plastics, and has funded projects that can improve the infrastructure and behaviour changes needed to support re-use and refill at an impactful rather than 'piecemeal level'.

In mirroring the projects looking at new materials development, re-use and refill projects have focused on different types of packaging and on different parts of the supply/value chain. For example, there are feasibility and demonstrator projects that have been included in conjunction with supermarkets and large retailers, aimed at encouraging refilling of both non-plastic and plastic packaging through provision of food and drink 'dispensers'.

> *'We had different sales initiatives, we were selling milk so consumers could transfer it into a 1 litre glass bottle, use it, clean the bottle, come back and refill it in order to save plastic. That went well and got me thinking, could we go from small shops to large supermarkets? I wondered how this would work in supermarkets. The Plastics Pact had 3 aims on it and ours fitted 100% with the overall aim of reducing plastic. That is why it fitted'.*

> *'We used the outcomes of an initial project to apply for the Demonstrator, which is what we are working on now. We are doing that by developing a new supply chain vessel that will sit behind the refills that go into store. We no longer own our own stores; we help other business switch from single use to reusable packaging. The trial needs to be the size that it is, we have to work with several retailers, since, we are trying to reach different demographics, locations, and store types'.*[8]

There have also been projects focused on the consumer that aim to incentivise re-use, refill and return of plastic food packaging.

> *'The [project name] plastic collection impact loyalty programme has a dual emphasis on re-use and recycling. We do this through various products, including the reusable bottle that we created that collects plastic for each of its purchase. So, their refill is not only moving away from single use plastic there and then, but it also enables and triggers plastic collection around the globe itself and that is completely funded by the partner organisations'.*

Lastly, there is a third strand of projects that address the problem of chemical contamination by cleaning packaging and containers, and making them safe and ready for re-use:

> *'The project has included a tablet that goes in [to the container] and is dissolved. It cleans the bottle so it can be re-used. The project is about re-use of bottles for personal wash and hygiene care'.*

SSPP contributing to Plastics Pact target of 70% of plastics packaging effectively recycled or composted.

As shown above, almost two thirds of funded projects are directly contributing to the Plastics Pact target of 70% of packaging being effectively recycled, reused or composted. The structure of the Challenge, with an emphasis on research and larger-scale demonstrators, has allowed a diverse range of projects to be funded that use different mechanisms to facilitate the identification, categorisation and recycling of different materials, and projects at different scales from feasibility through to full commercialisation and industrial use.

One issue that serves as a barrier to both consumer engagement with recycling, and effective sorting of plastics in recycling plants, is identification of plastics and what can and cannot be recycled. SSPP has funded both

[8] Any capacity from this project is included in the above estimate of demonstrators.

feasibility studies and demonstrators that are developing technologies and processes that can identify plastics, categorise them according to their recycling 'value' and even start to transform them into new plastic products.

Looking first at identifying plastics, SSPP has funded 'smart AI projects', also discussed later in Section 2.3.3, that are trialling the use of technology to identify and classify plastics that pass-through recycling plants/facilities. These technologies will allow plastics to be more accurately and efficiently separated into recyclable and non-recyclable materials. They are also being used to make it easier for consumers to categorise, separate and recycle their household waste, which contributes to behavioural change as well as overall recycling rates.

At the other end of the Technology Readiness Levels (TRLs), the Challenge has also funded demonstrators that are testing new recycling processes at an industrial and commercial scale, including a recycling plant that incorporates multiple stages of the recycling process in one place.

> *'We are taking a mixed waste, the waste coming out of sorting plants, include has a large volume of flexible plastic in it. We then go through a process where we separate that flexible plastic out. We then add more value to it, we take it through several other stages. Part of what we are trying to do is basically pick up two or three parts of the overall supply chain that you would normally have included having to collect then handle then compress and reform flexible material back into pellets to go back into the supply chain'.*

As presented in Section 2.2.1 there is evidence from project closure forms that corroborates this, with one respondent reporting movement from TRL 7 to TRL 8 over the lifetime of their project. In addition, four respondents completing project closure forms report they are now at TRL 9 having started at level 1 or 2.

Based on discussions with the project leads, SSPP funding has proven critical in securing the necessary co-investment and private sector engagement to progress the demonstrators, specifically the capital investment needed to build the plants. The scale of investment secured in demonstrators is evidenced in form 4 co-investment discussed in Section 2.2.1, where Demonstrators Round 1 alone has secured over £112.86m of follow-on co-investment.

> *'I can't tell you how much that Innovate grant delivered onto us, it gave us the kickstart to really get going and build this thing rather than keep talking about it and, dare I say, use up money talking to people. The Innovate project became the drum beat to the commercial build and enabled us to get further funds from other investors, they could see we were on the march. Without it, we would have had to do a scaled down version of the project and would have likely ha d to pursue other avenues of funding'.*[9]

In developing recycling plants/facilities that incorporate multiple stages of the recycling process, the above demonstrators are also contributing to the Plastics Pact target to include 30% recycled content in new plastic products and packaging.

Incorporating recycled plastics into new materials and products at an earlier stage of research and development

Although not as central to the SSPP Challenge as recycling and re-use/refill, almost a third (32%) of funded projects are researching different ways of incorporating waste plastics and recyclable plastics back into new plastic products. The inclusion of recycled plastic into new products is a 'newer' area with projects principally funded through the Enabling Research competition. These include feasibility studies in the areas of chemical recycling and biopolymer conversion of waste plastics, and research to understand how different recycling processes change the characteristics and functionality of plastics and how this knowledge can influence the inclusion of recycled materials in new bottles.

> *'We are a microwave engineering company seeking to find applications for the use of microwave technology and we essentially acquired a very early-stage reactor that we tried to use microwaves to pyrolyze and process plastics. The thrust of our project is to chemically recycle the plastic, given the fact we are developing the technology to do that, it is by definition not mature technology so the impact we have had is yet to be established. It is an experimental process of turning plastic back into use'.*

[9] Any capacity from this project is included in the above estimate of demonstrators.

'We have sort of grown the innovations department and now we are looking at biotechnology to convert waste streams into biopolymers. It is basically creating a biopolymer that can be converted into films, specifically for the use of multi-layer packaging. The difficulty with multi-layer packaging is the inclusion of the different layers in the packaging it is very hard to recycle. Our project fits into this space'.

'But actually, there's not really much understanding of what changes in that recycling and mechanical recycling. So, we're interested in that understanding what's happened and what's changed the plastic. And then as you said, how we can change the formulation of the plastic additives blend, maybe look at process washing to improve the property. So, we're very much focused on understanding the plastics properties with the data science perspective, so big data looking at loads of different characterization elements'.

The outputs and outcomes of the above projects will need further investment and development before they will directly contribute to the Plastics Pact target, and any assessment of impact may need to form an element of the next evaluation phase.

Elimination of problematic or unnecessary single use plastics viewed as a cross-cutting target relevant to all projects?

While the above table identifies a third of projects as directly contributing to the elimination of problematic or unnecessary single use plastics, discussions with several projects leads positioned this target as one that *'pervades most of the projects that SSPP is funding'*. In the main those that held this opinion were not referring to the specific list of problematic plastics identified by the Plastics Pact[10] and so felt the scope of projects that would contribute to the target directly was broader than it is.

'I don't really see this target as separate from the others. Whereas recycling, reuse and inclusion of recycled content all have their own projects, isn't elimination of problematic plastics touched on in all the projects that are funded?'

'Isn't elimination of problematic and single use plastics the driver behind the SSPP Challenge as a whole? Whether you are recycling plastics, developing new biopolymers, like us, or promoting behavioural change round re-use and refill, isn't the end game about reducing our reliance on, and use of, problematic and single use plastics'.

Key Findings:

The portfolio of successful projects funded show potential contribution to all four UK Plastics Pact targets based on review of project descriptions and interview evidence relating to project progress. Demonstrator projects alone are set to increase the UK's recycling capacity for plastic packaging by at least 144,000 tonnes per annum and should be realised within the lifetime of the UK Plastics Pact. Further, a project to introduce kerbside collection of flexibles is crucial first step in establishing collections infrastructure.

It will be important to consider which projects are likely to contribute to targets in the lifetime of UK Plastics Pact, set to conclude in 2025 as although some projects are aligned to targets, impact may not be realised for some projects in time to contribute to targets. Wider innovations, where successful, will provide potential alternative packaging solutions that also contribute towards targets, though it remains to be seen how far these will be commercialised within the lifetime of the UK Plastics Pact.

Contribution to UK Plastics Pact targets is supported through qualitative interview with successful projects that are contributing to these targets. It will be important to continue to monitor the successes and learnings from these projects.

[10] The Plastics Pact Single Use Plastics targets only applies to specified 'problematic plastics'. There were originally 8 'problematic plastics' identified, including disposable cutlery and PVC packaging. This list has been expanded with the inclusion of a further 6 'new problem plastics set for elimination'. https://wrap.org.uk/resources/report/eliminating-problem-plastics

Considerations for future evaluation:

It will be important to quantify contribution to targets in the final impact evaluation, but also to consider where projects have resulted in learning that prevents further resource spent on ideas that have proven unsuccessful. A review of project contribution to targets should be made as further time elapses and more is known about the impact of each project. Any assessment of this type should be carried out with an agreed definition of what contribution to a give target should look like.

The interim online survey results suggest that projects find it difficult to give quantitative data on the impact of their project. In some cases, this is likely a result of projects not progressing far enough to supply this data, but Winning Moves would recommend:

> A full review of each indicator against project description prior to commencing fieldwork to inform future data capture, ensuring projects are only asked for data relevant to their project.
> Consider capture of quantitative data through telephone interview to enable tailoring of questions to each project and to ensure correct interpretation of indicators data required from applicants.

2.2.3 IE1.3 To what extent, and how, is the Challenge on target to increase UK plastic packaging value chain collaboration on improving sustainability?

Collaboration is assessed as part of UKRI's benefits work tracking against KPIs. As such, it has been assessed through interviews conducted by UKRI for two competitions where all projects awarded funding have completed and submitted project closure forms (PCF). At the outset of the Challenge, the business case set out the following target:

Table 16. SSPP Challenge Objective

To increase UK plastic packaging supply chain collaboration on improving sustainability
Target – Minimum of 10 significant multi-stakeholder CR&D projects delivered.

Source: Smart Sustainable Plastic Packaging ISC Wave 3 Business Case V3

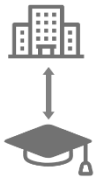
We have based our assessment of progress on all collaborations initiated or enhanced, and whether these have been between different types of organisations and between different points of the value chain. To understand how this meets the Target underpinning this objective, for the next phase of the evaluation a definition of what constitutes 'significant' needs to be agreed.

Based on the two competitions for which collaborations have been assessed, 26 collaborations have been recorded as initiated or enhanced through projects delivered under the Challenge.

26

collaborations initiated or enhanced

8



Between Industry and Academia

Feasibility Studies and Industrial Research:

20 collaborations including 6 between industry and academia and 3 between SMEs and large organisations

4

Between SMEs and Large organisations

Feasibility Studies for Demonstrators

6 collaborations including 2 between industry and academia and 1 between SMEs and large organisations

Source: Benefits realisation data collated for Feasibility Studies and Industrial Research (n=5 successful projects) and Feasibility Studies for Demonstrators (n=7 successful projects) covering Indicators 20-21.

Further evidence of collaboration was also gathered through qualitative interview, as expanded on below.

Supply chain collaboration

Given the importance that SSPP has placed on the establishment and continuation of collaborative relationships, and the fact that projects under two competitions had to demonstrate their academic and/or private sector collaborations to be eligible for funding, there are two Impact Evaluation questions that assess the Challenge's influence in this area. This first question looks at how collaborative relationships have been established and have developed because of project development and delivery. As suggested above, our assessment of project-level collaboration covers academic collaboration both within, and between, universities and research institutions and collaboration with the private sector and industry.

As detailed in our accompanying process evaluation report, there was widespread agreement among the Challenge Team, wider stakeholders, and successful projects, that the SSPP Challenge has been effective in brokering and developing relationships within and between academic institutions and between these institutions and the private sector. As several wider stakeholders argued:

> *'Collaborative relationships in areas of innovation and product development are difficult to broker. Universities are rightly concerned about issues relating to intellectual property and are reticent to share information and knowledge outside of their institution or their accepted intellectual or research community.'*

> *'Universities tend to work in silos and, very often, don't even engage with experts and researchers from other departments in their own institution. SSPP has recognised the importance of collaborative relationships in progressing projects and moving them through the commercialisation process from concept to widespread use'.*

Collaboration within and between academic institutions

Through our engagement with projects, we have identified numerous examples of how the SSPP Challenge has actively encouraged collaboration, whether it be through the application process, or through delivery:

> *'I'm working with academics in my own university, who I'd never worked with in any capacity before. So, [individual name], who's co-lead with me. I'd never worked with before, so she's in a different area. She's in org studies, so not in the same department as me. We are also working with other departments in the university, including with [individual name] in Chemistry. So, definitely this process (applying and receiving SSPP funding) has helped*

develop interdisciplinary connections and I think also this process has opened up new partnering with external partners'.

The above quotes exemplify relationship development within universities; however, there are also numerous collaborations that have been strengthened between institutions; collaborations that have brought together individuals and departments with different and complementary specialisms and areas of interest. The use of the word *strengthen* is intentional here as many of the relationships described already existed before the funding call.

'The collaborations with [UK university] were pre-existing before the project. [Project lead] has a current R&D goal of the development of another range of novel biopolymers and this EPS project was something we were interested in to get a competitive edge and to strengthen our relationships'.

'One of the things we're quite keen on was utilizing all the skills the different university partners, because we have got, the design department, a focus on sustainable manufacturing, we've got materials and chemistry and polymer chemistry'.

In an extension to the inter-institutional and inter-disciplinary collaborations described above, some projects have also established links with R&D centres, involving other academic institutions and industry:

'The original phase of this project, you can categorise as achieving a proof of concept and in the particular round we worked with [waste handling material recycling facility] for quite a long time, the reason is we are trying to solve their problem which is how do they dispose of their problematic film and flexible mainly single use plastic packaging. We also had links into the [partner organisation], they are trying to understand how to apply recycling process. They create a link between what's happening in the lab and industry, they want to help people accelerate from one point to the other.'

Additionally, there are two projects, funded under the Core Programme, which are seeking to influence the decisions of plastics producers, via training and development, and key stakeholders, namely academic institutions, and the private sector, through establishing standards for collaborative relationships.

Establishing links with the private sector to support scale-up and commercialisation activities

For projects funded under the Enabling Research competition, development of collaborative relationships has been less about directly supporting project delivery and more about the next steps in their journey towards commercialisation, including scaling-up and testing outcomes for their funded activities. The scientific and technical elements of their project required specialist knowledge and expertise that the SSPP Challenge Team and Innovation Leads would not have known about:

'We didn't receive much support from SSPP in developing links with our academic colleagues in other institutions. This project is highly scientific, at the cutting edge of current science. It is also very technical and there were probably only a handful of people in the country capable of supporting this idea and taking it forward'.

'All our collaborative relationships with [UK university] have existed for many years. We knew immediately who to go to with the idea and had agreements in place before we applied for the funding'.

However, where SSPP has been very supportive is in developing links with private companies that have the financial resources and personnel to progress new products, materials, technologies or designs and take them from the laboratory and into the market. Several projects with Enabling Research, BLR&D and the Demonstrators, have praised the roles of Innovate UK KTN and the Innovation Leads in brokering links with companies in the private sector:

'[Individual name] at UKCPN and our innovation lead, have both played important roles in identifying potential private sector companies who may be interested in scaling-up our activity'.

'We formed a very good relationship with the project lead, [Individual name] and, through SSPP, they have been trying to get us some external engagement from industry. [Individual name] has brokered early conversations with various end users. This relationship is proving to be invaluable in making industry links. I don't think we would have known who to approach without her help'.

'[Individual name] has been excellent in terms of making introductions. But UKRI is just a name really, unfortunately, I don't know if they're supposed to be active and how it all translates, whether [Individual name] is

deemed to be UKRI. It's just been him really. He seems to have a keen interest in what we're doing and has passed on any enquiries or opportunities. I think he's the Innovation Lead for our competition'.

Key Findings:

There is clear evidence that there is collaboration across the value chain, however future assessment should be made once all projects have conducted a project closure interview, as these collect information about the extent to which relationships existed prior to the Challenge. This will help to understand whether collaborations are above and beyond what may have occurred otherwise.

Considerations for future evaluation:

Given collaborations are covered in detail through benefits work, they have not been covered through any primary research conducted by the evaluator at interim phase. To date, Winning Moves has not seen data capturing the number of collaborative projects between organisations that had not previously worked together (Indicator 22), but it is our understanding that this is captured through project closure interviews. These data will need to be analysed as part of future evaluation work.

To understand whether collaboration evidenced to date (and in future) meets the Target underpinning the objective associated with this Impact Evaluation question, a definition of what constitutes 'significant' needs to be agreed between UKRI and the Phase 3 evaluator.

2.2.4 IE1.4 To what extent, and how, is the Challenge on target to increase understanding of environmental impacts of existing and new plastic packaging to inform new and improved design, technologies and processes?

The objective underpinning this research question is shown below:

Table 17. SSPP Challenge Objective linked to IE1.4

To increase understanding of environmental impacts of existing and new plastic packaging to inform new and improved design, technologies, and processes
Target – Development of new/improved standards for plastic packaging e.g. recyclability, biodegradability, composability.

Source: Smart Sustainable Plastic Packaging ISC Wave 3 Business Case V3

Projects were coded to indicate those that had a focus on understanding environmental impacts, with seven project descriptions aligning with this indicator.

Examining the seven projects focused on understanding environmental impacts, five completed an online survey. None of those completing the survey had patents in progress or accepted but a number had produced academic papers. Currently, it is not known if the papers cited have focus on understanding environmental impacts, but those with projects coded as contributing to this aim report three papers accepted for publication and 13 papers published.

7 projects with focus on understanding of environmental impacts

with total project value

£7.6m

Awarded government investment and pledged co-investment combined

Source: Indicator data input into the Baseline Model

It is important to recognise that there are projects where understanding is not a core focus but where elements of work e.g. life cycle assessments will contribute to understanding of environmental impacts and will inform new and improved design, technologies and processes.

Evidence of this was captured during qualitative interview and is described below, but with this in mind we would recommend coding is revisited at project closure indicating where each project has contributed to understanding of environmental impacts.

Environmental impacts underpin the rationale and core outcomes from SSPP. As such, they can be viewed as a cross-cutting theme of the Challenge. Our interim assessment of how, and to what extent the SSPP Challenge is increasing understanding of environmental impacts existing and new plastic packaging, has identified two areas where its influence can be seen.

1. **Supply chain and end users are becoming more aware of, and interested in, environmental impacts**

The process evaluation report discussed the importance of the Blue Planet 2 television series in raising public awareness of the role that single use plastics were playing in the destruction of the planet's marine environment. It was widely agreed that the series had entered the public consciousness and had provided an opportunity for a Challenge like SSPP to garner interest, gain momentum and affect real change in the production, reuse and recycling of plastics.

This momentum has been carried forward in the projects that have been supported and the role that they are now playing in continuing to raise awareness and understanding of environmental impacts, not only among the public as consumers, but also among retailers, big brands, and plastics manufacturers.

> *'There is a huge amount of consumer demand for shopping with less packaging, and for retailers and brands to solve this particular problem. It is unfair for this to be down to the consumer, there needs to be a systemic change, and needs to be down to retailers, brands, and government to do this. Our project, and the wider SSPP Challenge, is helping to address this demand'.*

> *'I think it [the environmental impact of problematic and single use plastics] is becoming more and more important. So, companies are having more pressure put on them, especially the big companies, by the government. The plastic*

packaging tax has come into force, etc. People are much more concerned about where their products come from, how they are made which is all putting more pressure on the industry too. This is why projects like ours will become more and more important'.

In addition to the above impacts on consumers and various parts of the plastics supply/value chain, individuals involved in delivery of the projects are becoming more attuned to the environmental impacts of what they do:

'I've become increasingly aware about the carbon issue as well, which is, you know, our materials are essentially net carbon neutral because we're taking plant material where the carbons already been locked up and turning it into another carbon material'.

2. **Importance of environmental impact exemplified by Challenge Team's decision to include targeted question in application:**

This last point about awareness of environmental impacts within the projects themselves, is further exemplified by the Challenge's decision to include environmental impact questions in the application process. These questions, which formed an additional requirement under the large-scale demonstrators and BLR&D competitions, were aimed at encouraging project applicants to consider not only how their project might address a specific environmental issue, but how its implementation and delivery might impact on the environment, whether positively or negatively.

'Compared to other approaches, ours has a very low carbon intensity. What the application gave us was the opportunity to explore that environmental impact and discuss it in more detail. I think it made us more aware of, and think about, the environmental impacts of what our project did'.

'Although we were successful, we found drafting the response to the environmental impact section difficult. I can see the point of it from UKRI's perspective though. We had to really think about both the positive and potentially negative environmental impacts of our project and, I suppose, whether we were delivering more positive than negative impact'.

'For us, the environmental impact of the larger projects was important, hence the inclusion of these questions. Projects must think about, and clearly demonstrate the impacts of the projects. To my mind it was an important question to see how considered and thought through their bid was and it allowed us to identify projects that were perhaps, less developed or slightly ill-conceived'.

For some projects, the environmental impacts of their new product, material or process, or of the delivery of the project itself, may not be measurable for some time and, as with many of the other Impact Evaluation questions, will need to be re-visited in the Phase 3 Impact evaluation.

Key Findings:

There is evidence of projects with the specific aim of improving understanding of environmental impacts. Some papers have been published already with further papers expected. A full review of these papers, and other evidence disseminated by SSPP projects will be needed in Phase 3 of the evaluation to ascertain whether and to what extent they advance understanding, or influence new and improved design, technologies and processes.

Considerations for future evaluation:

A clear definition of what constitutes a project contributing to understanding environmental impacts should be agreed with UKRI, as it could be interpreted either as core focus or may be broader and apply to more projects than indicated in this interim update.

2.2.5 IE1.5 To what extent, and how, is the Challenge on target to increase understanding of behaviour on the sustainability of plastic packaging to inform new and improved design, technologies, processes and business models?

Table 18. SSPP Challenge Objective

To increase understanding of behaviour on the sustainability of plastic packaging to inform new and improved design, technologies, processes and business models
Target – UK Plastics Pact target 70% of plastic packaging effectively recycled or composted.

Source: Smart Sustainable Plastic Packaging ISC Wave 3 Business Case V3

Projects were coded to indicate those that will improve understanding of consumer behaviour associated with using more sustainable plastic packaging, with 19 project descriptions aligning with this indicator.

Examining the 19 projects focused on understanding consumer behaviour, 11 completed an online survey. None of those completing the survey had patents in progress or accepted but they had produced academic papers. As described in the previous section, at this time details of the individual papers are not known and they have not been assessed to understand if they are related to consumer behaviours, but projects coded as improving consumer behaviours reported three papers accepted for publication and 14 papers published. Given projects have multiple focus, some of these papers do overlap with those reported in the previous section on understanding environmental impacts.

19 projects
have a focus that will improve understanding of consumer behaviour associated with using more sustainable plastic packaging

with total project value
£32.9m
Awarded government investment and pledged co-investment combined

Source: Indicator data input into the Baseline Model

The previous question touched on the impact that the SSPP Challenge is having in relation to supply chain and consumer understanding of environmental issues and environmental impact. To some extent, it is this increase in understanding, and the need to raise awareness of the detrimental environmental impacts of single-use and problematic plastics, which is also driving behavioural change and changes in public and industry perceptions round the use of plastics in food packaging.

Assessing the impact of SSPP on behaviour, behavioural change, and decision making in relation to plastics, requires a focus on three project-level influencers. Firstly, there are those projects that SSPP has funded as behavioural change projects, whose primary objective is to influence behaviours of consumers and other specific parts of the plastics value/supply chain. Secondly, there are projects that recognise the importance of behavioural change to their success, for example consumer buy-in and take-up of a new initiative or new/replacement material.

SSPP Challenge actively promoting the use of behavioural science and behavioural change research in supporting decisions about plastics production, use and reuse

The SSPP Challenge directly funded six behavioural change projects, with the aim of influencing consumer and supply chain attitudes and behaviours towards plastics and their use in packaging. As discussed in the process evaluation report, the SSPP Challenge team, together with many of the projects, were encouraged to see

behavioural change projects being funded and cited two reasons for why their inclusion is important. Firstly, many see positive behavioural change as underpinning the future direction of the plastics industry and as the catalyst for influencing the production of plastics alternatives and for embedding recycling, reuse and refill into the supply chain:

> *'We are already seeing a significant change in how consumers view the manufacture, use and disposal of plastics. This change, which, for me, is characterised by greater concern for the environment and higher levels of recycling and re-use is starting to have an impact on supply chain behaviours. Producers and big retail brands are starting to listen, but we need to do more to encourage a bigger change in what they are doing'.*

Secondly, with attitudes towards plastics changing, there was widespread agreement among interview respondents that more behavioural research is needed to understand how these changes might affect the plastics supply chain. Other industries have recognised the importance of behavioural science in shaping product and service decisions, however, use of behavioural science in the plastics sector is not as advanced:

> *'Now, one of the difficulties we know here is that requires a degree of behavioural change, and I don't think it's as well developed as the other areas. The only thing we know about behavioural change in resource efficiencies, [is that] everything we've tried so far has failed, so you can't actually put your finger on what works'.*

Project leads for the behavioural change projects have seen academics, retailers and plastics manufacturers show a real interest in their research. Earlier sections of this report have highlighted the importance of big data and sharing knowledge across the supply chain, and the behavioural change projects have sought to share their findings and help academics, retailers and plastics manufacturers to interpret them:

> *'This is a consumer project. But additionally, we have the supply chain stage where we were trying to understand supply chain perspectives on the consumer attitude behaviour gap. So, we're trying to work with retailers and multi-tier supply chain actors to see how they understand it and their discourses around it and what evidence they have drawn on to make their conclusions about what consumers are doing and why they are doing it'.*

> *'Academic audiences really want to know about what we've done. We've had a lot of approaches for a guest speaker slot at conferences and seminars, that kind of thing. They really want to know about it and they're really keen to get concrete consumer findings because they don't tally with necessarily, you know, our commercial partners might be thinking about consumers'.*

In addition to funding specific projects with behavioural focus, the Challenge organised and chaired behaviour change sessions at Global Research & Innovation in Plastics Sustainability in 2021 and 2022 (GRIPS and GRIPS2022), a conference, exhibition and showcase for the sector.

Projects recognise the importance of positive behavioural change to the success of their activities

While there are six projects that were identified and funded as behavioural change projects, as the above data details, there are a further 13 projects that have a focus on changing perceptions, attitudes, and behaviours as a core outcome. Indeed, more than three quarters of the projects we interviewed referenced the importance of behavioural change to the success of their work. Several re-use and refill projects were clear that their interventions into the market would only succeed with buy-in from consumers and from industry.

> *'All the projects that SSPP are funding will impact our relationship with plastics. Indeed, much of their success will depend on whether the industry and the public agree with them, support them, and start engaging with them. It was absolutely right that SSPP set aside funding for behavioural change projects and more of this type of research and public engagement needs to happen if further changes and developments are to be made'.*

> *'There is a huge amount of consumer demand for shopping with less packaging, and for retailers and brands to solve this problem. It is unfair for this to be down to the consumer, there needs to be a systemic change, and needs to be down to retailers, brands, and government to do this. That said, in supporting refill initiatives, supermarkets will need to see positive engagement from consumers if they are to further invest in and expand these activities'.*

Projects were clear that consumers must actively change how they shop and how they engage with their use of plastics, but that industry and the supply chain must play their part in making it easier for consumers to proactively elicit long-term change. As one project put it,

> *'There needs to be a systemic change in the way people think about the issue. Series like Blue Planet 2 are great in raising awareness of the problems that plastics are causing to the environment, but if people forget their reusable*

bags or containers then nothing will change. While the onus is on consumers to change how they act, the onus is on us as researchers and part of the supply chain, to make it easier for them to make this change. We can't be putting obstacles in their way. Change will only happen if it comes with ease and convenience'.

Core programme trying to influence the behaviours and decisions of the plastics supply chain

Alongside the competitions, where organisations had to bid for funding, the SSPP Challenge also supported six projects under the Core Programme. These projects are hoping to remove some of the longstanding barriers that are currently preventing the plastics packaging supply chain from working collaboratively to address single-use and problematic plastics. There is one project under the Core Programme that, if successful, could have a longer-term positive impact in the interactions between and decision taken by different parts of the supply chain. The British Plastics Federation (BPF) have been approached to develop online courses on designing and manufacturing sustainable plastic packaging products. As detailed in their business plan:

'The funding will be used to develop online training courses. These courses will be targeted at decision-makers in the supply chain, to fill current knowledge gaps and improve skills development. [Project lead] has identified two stakeholder groups where knowledge is lacking: the first are packaging designers, and the second are stakeholders who are not designers, but are involved in packaging development'.

The design course is aimed at equipping designers and manufacturers with the technical knowledge and skills necessary to make sure packaging designs are more sustainable. Designs will need to consider recyclability, re-use and material weight. The Supply Chain course, for non-designers *'is for decision makers across the supply chain. It will help them understand the impact of their input into the packaging development process, and to enable them to make more sustainable decisions'*.

This course is making designers, manufacturers and the wider supply chain think differently about their day-to-day work and recognise the impact that their decisions have on the functioning of the plastics industry and on the way end users engage with their products.

Key Findings:

Substantial investment has been committed to projects which include consideration of consumer behaviour, including projects for which this is their core focus. With papers in progress, further papers expected and feedback from qualitative interviews that there is already significant interest in some of the emerging findings, the Challenge is likely on target to improve the knowledge base. The extent to which these projects go on to inform new and improved design, technologies, processes and business models will need to be assessed at a later date.

Considerations for future evaluation:

In the next phase of the evaluation, Winning Moves recommends the evaluator works with UKRI to draw out and summarise key insights arising from the SSPP Challenge about consumer behaviour. The purpose of this exercise would be both to better understand the difference the Challenge has made, but also to ensure these insights are shared in maximising the impact of these efforts.

Additional work should be carried out to review and code publications cited by projects to understand if they contribute to the understanding of consumer behaviour.

2.2.6 IE1.6 To what extent, and how, is the Challenge on target to increase the UK's international recognition and an increase of international finance (export and investment)?

The Impact Evaluation question on the UK's international recognitions links to the following SSPP objective on export sales.

Table 19. SSPP Challenge Objective

SSPP innovation recognised internationally as a UK strength, and source of export growth and inward investment.   Target – an increase on the current baseline of export sales.

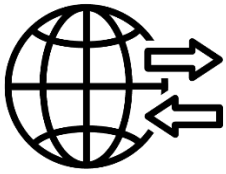
Source: Smart Sustainable Plastic Packaging ISC Wave 3 Business Case V3

The interim phase of the evaluation has not made a full assessment of export sales, and further data will need to be collated in the final phase of the evaluation. Benefits work conducted by UKRI for completed competitions showed that for:

- Feasibility Studies and Industrial Research (n=5 successful projects): all five projects had long term plans for overseas products, processes or services with two overseas spinouts planned and three overseas licensing agreements planned.
- Feasibility Studies for Demonstrators (n=6 successful projects): two projects planned to produce and sell the product or service using contracted manufacturers overseas and two overseas spinoffs were planned.

Project closure forms for these two competitions indicate that additional revenue was reported by nine of 14 completed projects. Of these nine, six reported that part of this additional revenue came from exports of new products and services achieving:

£7.2m



Total export sales achieved to date

Source: Monitoring delivery and outcome data: Project Closure Forms for Feasibility Studies and Industrial Research and Feasibility Studies for Demonstrators.

Although there was no direct foreign investment into UK plastic packaging innovation and research reported for these two competitions, one of the 24 successful projects completing the online survey reported they had received direct foreign investment into their project:

£7m

inward investment received at project level

Source: Source: Online survey of beneficiaries (n=24 successful projects; with one reporting foreign investment) covering Indicator 13

One indicator that UKRI are using to assess impact in terms of international recognition is dissemination of findings through the publication of academic papers and journal articles, and through speaking at events. As shown below the sub-sample of successful projects completing the online survey have reported both publications and communication of their findings through presenting at events.

5	16	128	37
academic papers accepted for publication	academic papers published	UK events where beneficiaries had a speaking slot	international events where beneficiaries had a speaking slot

Source: Online survey of successful projects, (n=24).

Further details on academic papers and journal articles were captured through qualitative interview with successful projects. Stemming mainly from the Enabling Research projects, several university project leads have already published, or are intending to publish, academic papers documenting their projects and key findings. Currently, many of these projects are only midway through delivery and have not reached a point where the science has been proven and where discursive or factual papers could be drafted. However, as the quotes below suggest, work on academic dissemination has started and some projects have an ambitious number of papers they are hoping to publish:

> *'At the moment, we don't have any papers published directly from the project, so that is something that we're working on. I mean, we've been focusing so much on the other dissemination routes…I mean of course we want to get papers out because we're scientists and we need to publish, but that hasn't been the main focus of our work up until now'.*

> *'So far, there's one published, and the conference papers as well. See, I think we had three conference papers. And there's another one that's being written. I would say by the end of the project we would probably expect about five or six papers. We are roughly looking at probably one to two per work package, and there's five work packages and the 5th work package is an oversight one. It will have its own publication, so it's something like that'.*

> *'There'll be three to six, I'd say. The other thing that I've written is what's called a perspective. So, I was invited by an [plastics journal] to write a piece about the value of design research for polymer research, so I've written that, and I have now published a journal article that is all about the value of design in this space. We are challenging the chemists to think about problems in different way, so we have got another paper that I'm supposed to be proofreading today, which is about the barriers and opportunities for industry to engage in reusable plastics. We've got a general paper there'.*

> *'Probably 2 science team papers. One material science themed paper, one economics theme paper and then an overarching piece which I think is going to be best delivered as a white paper. So maybe five more'.*

Key Findings:

Assessing the impact of the SSPP Challenge on the UK's international recognition is difficult to assess at this early stage. However, there is already evidence of dissemination of project findings through academic papers and presentations at both UK and international events.

For completed projects and competitions, there are plans for overseas products, but for some it is too early to quantify what this may realise in terms of sales. Additionally, the online survey has captured one example of inward investment, providing early signs of progress towards this objective.

Considerations for future evaluation:

Obtaining investment data from a larger sample of projects will be important to be more confident in the estimate, although the data reported at this interim phase is conservative as it draws on a sample of the population of successful projects.

As further time elapses, further assessment of export sales from projects funded by the Challenge should be made, as in the main it has been too early to assess this at this interim phase.

2.3 IE2: Is the Challenge on target to result in additional effects in alignment with the Objectives of the programme?

A key measure of impact is understanding the 'counterfactual' or what would have happened to projects in the absence of funding through the SSPP Challenge. Funding can have impact in terms of the scope and scale of projects, and the speed of their delivery. If projects have only progressed as a direct result of the funding, then additionality is 'total'/100%. However, funding can also bring forward delivery of projects, expand the scale and breadth of activity, and increase the speed at which projects can be delivered out outcomes/achievements realised.

In identifying and considering additionality, the following two questions were asked of all project applicants interviewed, including unsuccessful, ineligible, and withdrawn projects:

- What would have happened in the absence of SSPP funding?
- Which of the following best reflects what your position would have been had you not received SSPP funding:
    - the project would not have happened without SSPP funding
    - the project would have happened, but SSPP funding had a significant impact on development and delivery
    - the project would have happened anyway and SSPP only had a slight impact on development and delivery
    - the project would have happened without SSPP funding and would have been developed and delivered in the same way.

Based on our discussions with project applicants, SSPP funding has had a significant impact on the implementation and delivery of projects, with many successful projects stating that their projects would not have gone ahead without the funding.

The table below provides a breakdown of 'additionality' by each of the applicant types.

Table 20. Summary of additionality by applicant type

Additionality category for successful projects	Successful Projects	Additionality category for unsuccessful/withdrawn projects	Unsuccessful projects	Withdrawn
Project would not have happened without funding (Number of projects interviewed)	13	Project has not progressed at all	11	3
Project would have happened, but SSPP funding had a significant impact (Number of projects interviewed)	12	Project has progressed but more slowly	2	-
		Progressed but at a different scale	1	1
Total projects where counterfactual data were captured	**25**	**Total projects where counterfactual data were captured**	**15**	**4**

Source: Winning Moves qualitative project interviews

Further to the above, project closure forms also seek to capture evidence of additionality, of the 38 project closure forms available at the time of analysis, eight were not interviewed as part of the qualitative interviews. Three of these gave a response on whether the project would have gone ahead in the absence of funding – and all three felt the project would not have gone ahead.

Approximately half of successful projects would not have gone ahead without SSPP funding

For half of the successful projects, where counterfactual data were captured, project leads stated that their activities would not have gone ahead without the available SSPP funding. As the quotes below suggest, there were several reasons why SSPP funding has proven to be so important in allowing these projects to progress.

- ***Increasing project scale and scope:*** Several project leads stated that their projects would not have gone ahead without SSPP funding as they would have been unable to internally fund the scale-up of activity needed to make it viable:

  'I think that we could still have done the feasibility study but not to the scale and the depth that we did it. I don't think that this project would exist without the D2 funding. We would not have been able to, the demonstrator trial needs to be the size that it is to be a demonstrator, we have to work with multiple retailers, because we are trying to reach multiple demographics, locations, types or store etc. Possibly we would have gone to look for funding elsewhere'.

- ***SSPP funding encouraged and facilitated attraction of private sector investment needed to develop and deliver projects:*** Smaller organisations, and those working on lower TRLs projects focused on proof of concept, would not have had the funding necessary to deliver the project internally. SSPP funding was critical in showing support for their idea which, in turn, encouraged the private sector to invest the much-needed scale of funding:

'For the successful project - the funding was actually critical for us. We were looking for any indication that what we were doing was going to be fundable. So, the SSPP fund that we won, although it wasn't much, around £25,000, it was so important for us as it let us raise the other £125,000 of additional capital'.

'I think that it would have been difficult to fund it, I think because it quite low TRL, it is an early-stage project. [Project lead] was involved in the application. The focus was on whether it would be useful, there is no point doing research into something that potentially has no potential'.

Successful projects optimistic about the continuation of activities but SSPP allowed faster development and larger scale

The other half of successful projects stated that their activities would have probably gone ahead, but SSPP funding was important in bringing forward the timetable for delivery and/or in ensuring the scale and scope of the project was maintained:

'I hope that we would have still maintained some activity, but honestly without the SSPP funding, we wouldn't be anywhere close to where we are now. I mean, just having the three postdocs on the project doing the work'.

'So, as I said, the other funding route would have been the Engineering and Physical Sciences Research Council, and they would just have standard calls out. It would probably have been focusing even slightly more on the fundamental side of things and we wouldn't have been able to develop the collaborative links that we have in place now'.

'I hesitate to say it would stop entirely because we clearly see the commercial benefits of the successful project, but it is fair to say that the company itself has already injected a significant amount of capital into the process over the years and I suppose it comes down to a threshold, below a threshold even though the company is willing to inject an amount of money. SSPP funding allowed us to pursue an avenue of research that we might have been reticent to fully fund'.

Findings from unsuccessful projects further evidence the importance of SSPP funding in enabling activities to progress

Further evidence of the importance of SSPP funding to project progress can be seen in the counterfactual data collated from unsuccessful projects, with 11 of the 15 (where counterfactual data were requested) stating that the project concept has had to be altered and/or the level of activity scaled down, while the securing of alternative grant funding or private sector investment from elsewhere has proven particularly challenging:

'Well, we haven't got any funding to pursue that packaging part of the agenda at all. We are continuing to develop the sensor technology because we've got funding through EPSRC on the quantum technologies side, and we are beginning to have dialogue about how to use the technology environmental sciences, but it's now no longer to do with plastic packaging'.

'We have scaled it down and are opening an inoculation plant but, without the framework consortium of the anaerobic digestion and [proposed partner] and [proposed partner], because we couldn't afford to do it'.

'We put the project on a back-burner and moved to another project that was more client-driven, rather than R&D driven which was the purpose of the project with Innovate UK'.

As shown in the table above, evidence does suggest that successful projects were more optimistic about the likelihood they would have been able to progress without funding. It is however difficult to know what may be driving this, for example, it is possible that their success in applying to the Fund has influenced their belief in the project's viability without funding.

Further work on additionality and the contribution that the SSPP Challenge made to the success of projects, will need to be completed during the next phase of the Impact Evaluation.

The online survey with unsuccessful applicants provides evidence on the ability of projects to progress in the absence of funding from the Challenge. Of the 35 unsuccessful projects completing the survey:

- 14 projects went ahead, although for ten this was at either at a reduced scale, at a slower time scale and/or with altered scope.
- 21 projects were unable to progress without Challenge funding.

A breakdown of responses received from unsuccessful applicants is outlined below. The results from unsuccessful projects are based on a different sample size to those presented from qualitative feedback, but supports the earlier finding that many have not progressed in the absence of Challenge funding.

Online survey data are based on a small sample size but if representative, indicates that for every ten projects applying to the SSPP Challenge:

- Six would not have gone ahead at all in the absence of the Challenge,
- Three would have gone ahead to some extent, but may be at smaller scale, revised scope or slower,
- One would have been able to process as planned.

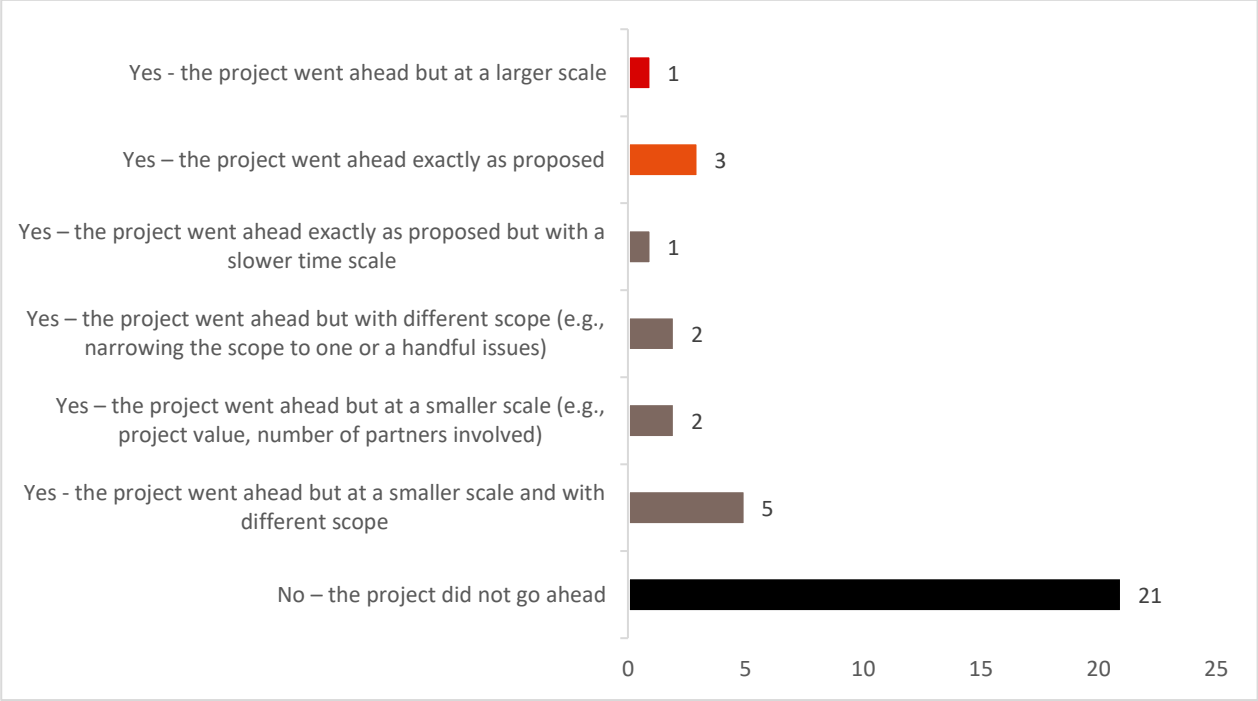


Figure 2. Status of unsuccessful projects completing the online survey; when asked of the project went ahead without Challenge funding (n=35)

Tracking the eventual impacts of unsuccessful projects that do go ahead as an indication of what may have happened in the absence of the fund should continue in the final phase of the evaluation. When asked how these projects were able to fund their projects:

- Four received alternative funding from UKRI including Smart Grants, the Edge program, Sky Ocean Ventures and Women in Innovation.
- Two had accessed internal funds, with one supplementing this with an alternate grant.
- Two accessed funding from industry.
- The remaining six cited specific funding including major brands such as Lidl and other funds including the Google.org Impact Challenge on Climate[11], BBSRC White Rose[12] and Mid Wales Challenge Led Launchpad - Contracted R&D[13].

[11] https://impactchallenge.withgoogle.com/climate2022/about
[12] White Rose Mechanistic Biology DTP (whiterose-mechanisticbiology-dtp.ac.uk)
[13] Mid Wales Challenge Led Launchpad | AberInnovation

Of the 14 that progressed, ten confirmed they did so with the organisations they had originally collaborated with on the application form. Of these, nine also developed additional collaborations, not named in their applications to the SSPP Challenge.

Key Findings:

SSPP Challenge funding has been critical in allowing projects, particularly those earlier stage, lower TRL activities to go ahead. Funding has de-risked research for smaller organisations that don't have the resources to fully fund activities.

SSPP funding has also served to 'endorse' research concepts and their support has actively encouraged involvement and significant investment from the private sector.

Successful projects reported they either could not progress without funding or may have had to progress at reduced scale in the absence of the fund.

Evidence collated from unsuccessful projects shows the impacts of SSPP funding with almost three quarters of unsuccessful projects interviewed in the qualitative interviews stating that they have had to suspend or 'moth ball' their planned projects due to a lack of financial resources or alternative funding. Similarly, online survey results show that 21 out of 35 unsuccessful projects completing the online survey were unable to progress their project without Challenge Funding.

Where projects did proceed in the absence Challenge funding, financial backing was achieved from a variety of sources, showing market interest in innovation in plastic packaging and that at least some activity would have happened anyway in the absence of the SSPP Challenge.

Early evidence provides a strong indication of additionality of the programme.

Considerations for future evaluation:

Given the number of projects that have progressed in the absence of Challenge funding, further understanding of the benefits these projects realise in the future will be a useful source of evidence in considering the additionality of the Challenge. It should however be recognised that there are challenges to using the available evidence to draw robust conclusions about additionality. The final evaluation should therefore consider contribution tracing or contribution tracing in building the narrative about the difference made by the SSPP Challenge.

2.3.1 IE2.1 To what extent, and how, is the Challenge on target to contribute to a step change towards a more sustainable value chain (e.g. through thought leadership, trailblazing, reaching critical mass)?

With so many projects ongoing at the time of writing, it is too early to say whether the Challenge will deliver a step change towards a more sustainable value chain – though it is evident, in our view, from review of the specific projects funded by SSPP is that individual projects hold transformative potential if they are successful and go on to be commercialised.

In responding to Impact Evaluation Question 1.3 at the interim evaluation stage, emphasis was placed on the collaborative relationships that were formed between academic institutions, and between academia and the private sector, to support project design, implementation, and delivery.

The emphasis for this question is forward looking and focuses on the extent to which the SSPP Challenge has laid the foundations for the continuation of these collaborations and research and development activities beyond the lifetime of Challenge funding.

In speaking with the SSPP Challenge Team and wider stakeholders, significant importance has been given over to ensuring a longer-term 'legacy' for SSPP and to making sure that the momentum gained, and progress made is not lost, but is built upon.

'Too often these types of programme interventions end abruptly, and the progress made is lost. The funding stops and not enough attention has been given to what happens next. Projects become overly reliant on grant funding and don't consider how their work can continue once the last funding payment hits their accounts'. For us in SSPP, we have used the Challenge to broker relationships and collaborations that we hope will continue for years to come. The private sector is more involved, and the levels of co-investment highlight their interest in what the Challenge has tried to do'.

In assessing the current contribution of the Challenge at this interim stage, we have focused on three topics that were identified through the project interviews. Firstly, returning to the above statement about legacy, we discuss the Challenge's role in developing a community of key players that have been incentivised to take their work forward. Secondly, several projects discussed the importance of sharing data and knowledge generated through Challenge activities and thirdly, how the Challenge has promoted private sector engagement and financial investment, which if continued, will allow further progress towards commercialisation for many projects in the earlier stages of development.

Building a community of individuals and organisations from across the Supply/Value Chain

As one prominent wider stakeholder and representative on the CAG stated:

'The success of SSPP is not solely about what has been delivered in terms of material or process innovation, it is about the legacy that the programme leaves. Has the investment that we have put in given rise to a community that is more expert, and that is more linked together, or did it simply 'pump up' the community and then take the funding away. For me, success should be measured by the relationships that have developed and whether these relationships continue and flourish once this current round of SSPP concludes in 2025'.

This idea of 'community' and the strengthening of inter-disciplinary relationships between academics and between different parts of the value chain, is an important issue for the projects that we spoke with. They have cited not only the importance of relationships formed through their project, but also how the Challenge has facilitated communication and engagement with other projects that have received funding:

'Yes, it was great when I went to the SSPP event to see different stakeholders, and many different companies offering different solutions, sometimes with a very different approach but with the same goal'.

'Certainly, through delivering the project. We've looked at other companies who had received grant funding through Innovate UK that were in the same space and that were complementary to our product'.

For many, the relationships with other projects have already proven fruitful, though project leads would like to see more formalised engagement and communications with other projects that received funding:

'We know of some other projects that are happening, so it would be good to have more networking events with other projects that go through SSPP. They will work towards the same goals so partnering opportunities would likely result from this engagement'.

'I think it would be really good to have a forum for the people on the challenge. So, like I said I have made contact with a couple of people who were relevant to us, and I appreciate, by nature, that there could be some competitor issues there and some people might not want to share everything about their project, but it wouldn't necessarily be about sharing everything to do with your project'.

Projects willing to share data and knowledge to build on the success of their activities and findings

Despite concerns over competitor issues and intellectual property, as touched upon in the previous quote, there is a real willingness among projects to share the data they have collected and to disseminate their findings to the industry and to the public. There is a recognition that real and discernible progress can only be made if the sector works together to address the issues and this can only come if they are more willing to and more adept at sharing data and information with academia and industry:

'Our dream is for this to be industry standard. It has an open-source principle at its heart. So, while there is a period of exclusivity, at the minute, to protect those who put the money up, in the end everybody wins if this becomes industry standard'.

'We are very aware that what we are doing is going to take a lot of consumer behaviour change. We are among the first out there to want to put information out there and communicate, hopefully the success of the project. We

believe in shifting the whole industry forward and not being proprietary about our information and learnings. Within the realms of the commercial sensitivity of our partners, this is down to what the coalition wants rather than just us around how much they are prepared to share'.

'This project fed into our belief that we wanted to do something much more systemic and cross-industry, it became clear that the data piece is completely missing. SSPP funding with the idea of open data, is one of the first building blocks. So, we then of course won it, which kicked off the rest of the journey we are now on'.

The SSPP Challenge Team are working on a Communications Strategy to support and underpin the dissemination of learnings from projects and the projects themselves are developing their own dissemination strategies to share their data and findings. To increase the reach and impact of SSPP, some project leads would like to see UKRI, and partners, develop a programme of events that build on the perceived success of the annual Global Research & Innovation in Plastics Sustainability (GRIPS) Conference and allow for more effective networking:

'We went to a KTN event recently and that was interesting because you meet people. We had a stand with information about what we do, and that allowed us to publicise the organisation to new audiences. More of those events are the way forward'.

So, there was the GRIPS conference, where we have presented a couple of times, and this is really good from an industry perspective, but there is not a lot of science there, we obviously need other scientific conferences as well. More of these kinds of events are key, but ones where you actually get a chance to talk to people informally a bit and try to explain your work in a more accessible way'.

Private sector engagement and investment critical to building on the success of SSPP

As discussed in responses to earlier Impact Evaluation questions, the SSPP Challenge has been designed with private sector engagement and co-investment at its heart. In doing so, the Challenge Team recognised the vitally important role that the private sector will play in being the catalyst for new developments and in progressing research and innovation started through the Challenge:

'The scale of the issue is huge, and it requires engagement from across the supply chain, but particularly from the private sector. The responsibility for investing in new polymers, new technologies and innovations, cannot rest with the research community and smaller, innovative companies. They don't have the financial resources or the scale to commercialise and scale-up their ideas and concepts without support'. That is why private sector interest, engagement and investment is so important'.

Several projects, particularly those focused on reuse and refill, have benefited from support through larger retailers and big brands, where there is significant impact potential:

'We're focusing explicitly on supermarkets and [retailer]. They are one of our partners and their supply chain, and within that we're looking specifically at packaging for sandwiches'.

Projects developing new materials, are engaging with plastics manufacturers, who appear open to the possibility of scaling up new polymer production:

'But one of the things we're also doing is working with [project partner] and other manufacturers of single use plastics and we're having the conversation with them about how do they change their business model, how can they design for reuse instead of single use'

'So, eventually we would try and talk to the companies that we've already been in contact with and say, look, these are the findings, if you want to develop plastics with these things, this is the kind of route that you would need to take or this would be the sort of, design process that you would need to do. And then yeah, obviously we would be wanting to focus on those companies that would be really at that point ready to start developing or manufacturing more of these plastics'.

The demonstrator projects, that have received the largest amounts of SSPP funding and pledged co-investment are using financial injections to expand their activities and support new capital build projects for new plants:

'That first plant is 20,000 tonnes, and we are going to build 3 more lines taking it to 80,000 tonne capacity, but the learning and information we get and ability for people to come see the plant, keep the ties on it and go okay let's see how it works, this is what goes in, this is what goes out, this is marvellous, will underpin hopefully a million tonnes of capacity by 2030'.

Key Findings:

Qualitative evidence shows progress towards a more sustainable value chain. Feasibility studies and several projects under the Enabling Research competition, are keen to use big data and to share useful data with the research community and private sector, to support the continuation of their research. Phase 3 will need to assess to what extent this continues and gather evidence and perspectives on the extent to which SSPP has contributed to this.

There are also projects with 'transformative potential', where the aim is to change how different parts of the supply chain view the production, re-use and recycling of plastics.. Reuse and refill projects are also having transformative potential through encouraging positive behavioural change among retailers, supermarkets and consumers.

Considerations for future evaluation:

For several wider stakeholders, a measure of SSPP's success will be the extent to which a legacy of community and collaborative relationships will continue beyond the Challenge lifetime. SSPP has been successful in developing collaborative relationships with part of the value chain that have previously worked in silos. For example, plastics manufacturers are engaging with waste collection and recycling companies to understand more about how the properties of plastics impact on their ability to be effectively identified, separated and recycled. In addition, academics and big brands are showing heightened interest in consumer behaviour and how findings from these projects can support development of new polymer and processes.

2.3.2 IE2.2 To what extent, and how, can the projects supported by the Challenge be expected to bring about a reduction in the environmental impact associated with plastic packaging, and over what time frame? I.e., impacts beyond the UK Plastics Pact targets.

For the Challenge to influence impacts within the timescale of the UK Plastics Pact, projects would need to be near commercialisation. As outlined in Section 2.2.2, this will include impact from projects that have been successful in the ISCF smart sustainable plastic packaging demonstrators round 1 and 2 competitions, where the funds have been allocated to build fully operational plants or processing facilities. Of the seven successful demonstrator projects, five are focused on building the UK's recycling capacity for plastics, and should they be successful will collectively increase the UK capacity by 144,000 tonnes per annum.

Beyond the UK Plastics Pact, there is potential for projects funded through the Challenge to bring about a reduction in environmental impact associated with plastic packaging, but will largely depend on the success, roll out and commercialisation of projects in early stages of Technology Readiness. These projects include:

- Development of alternative plastic packaging with improved recyclability.
- Development of biopolymers.
- Reuse and refill systems.
- Consumer behaviour.
- Introduction of recycled content.

Key Findings:

With demonstrator projects alone, an increase in UK capacity for recycling will be achieved, reducing the environmental impacts of plastic packaging. Many other projects still in progress will also realise impacts but given their early stage at this time tracking their successes and intention to commercialise will be necessary in Phase 3.

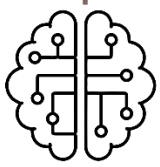
Considerations for future evaluation:

Many projects are not yet at a stage where impact realisation can be quantified. This may also continue to be the case in the final phase of the evaluation. Where possible evaluators will need to understand how best to capture estimates and projections from projects to answer this question.

2.3.3 IE2.3 To what extent, and how, has the Challenge facilitated the innovation of "smart" sustainable plastic packaging? What are the expected benefits of this?

Projects were coded to indicate those that made use of 'smart' technology to improve the sustainability of plastic packaging. This led to 21 projects aligning with this indicator.

21 projects that have made use of 'smart' technology to improve sustainability of plastic packaging



with total project value

£44.1m

Awarded government investment and pledged co-investment combined

Source: Indicator data input into the Baseline Model

Examining the 21 projects making at least some use of 'smart' technology, eight completed an online survey. These projects reported two academic papers accepted for publication, one paper published and one patent in progress. As described for understanding environmental impacts and understanding consumer behaviours, at this time the nature of these papers has not been reviewed and so it is not possible to conclude that they reference 'smart' technology. Further, given projects can have more than one focus, these may overlap with those reported for understanding environmental impacts and understanding consumer behaviour. This is evident in the examples discussed further below where projects may be using smart technology to understand consumer behaviours or to understand environmental impact.

We identified five projects coded as making use of 'smart' technology that were also interviewed qualitatively.

Smart technology to support more effective sorting and recycling of plastic waste

Among those projects that we have defined as 'smart', several of them have focused on the issue of recycling and have researched how the use of technology could make identification, sorting and recycling of plastic waste easier.

> *'We are developing a complete recognition and monitoring system based on AI, and fusing RGB based computer vision with near infra-red spectral imaging. The goal of the project is to develop a new kind of sensor and integrate it into our system, which is based on infra-red vision. This technology will offer much more granularity and support a system which provides full and complete recognition of waste. With this solution around integrated infra-red, the main advantage of this is differentiating between different types of plastic, which is the reason why we need it'.*

> *'The core of the company is we do computer vision applied to the waste industry, so AI and machine learning. We first developed a recycle envision system that identifies waste at an object, item level, it can see if something is a yoghurt pot vs a butter tub and whether it is white PP or PE. We rolled that out for the first year, throughout 2020, and on the hardware side we augmented that with the robotic arm to do the separation of those materials based*

on what the eye was seeing. This SSPP project allows us to cost out the system, see how it works, how much benefit over AI or near infrared are we getting by combining the two. it doesn't go any further than saying what the item is or what brand it is. With the near infrared it will say the material is PP, with AI we will be able to say for example if it was used for food previously, so we can make a pure separation stream of food grade PP'.

These technologies, if successful, and if they are commercially affordable to scale-up and roll out, could result in faster and more efficient identification of higher value recyclable materials, which can in turn support the inclusion of these plastics in new products and move the dial towards 30% of recycled content being included in plastics design and manufacture.

Smart technology being used in reuse and refill interventions

Several SSPP projects centred on encouraging and incentivising consumers to reuse and refill plastic containers for food and drinks. However, there was one project, which came at the concept of refill from a slightly different perspective. The project uses technology, namely an ID code, to collate data on how many times their packaging is reused in the supermarket or retailer. This data could, theoretically, be shared with the sector to support understanding of refill behaviours, including the frequency with which refillable containers are being used and which types of containers are being most used for refill:

'To get around the batch code issue, we needed to make every single piece of packaging matchable to a database, with certain information. Quite quickly the requirements spiralled out of control, it needed to become its own product. This led to the [retailer] readable packaging initiative. It means that all reusable packaging at [retailer] has [project lead]'s ID on it, and each time it gets reused, or something happens to it, it gets another stamp in its passport, we are then able to gather all that data. We would like to be the software system powering these demonstrators for reuse at scale. For us this is a really good example of how a market shift is happening'.

Using technology to understand plastics degradation over time

A third area where technology is being used within SSPP, and which aligns quite closely with the above refill project, is in understanding how reusable plastics degrade over time. Data collected through this trial will show academics what happens, characteristically to the plastics, and how many times the material can be reused before it has become too degraded.

'And then we've got the sort of track and trace sort of nanoparticle fluorescing elements as well, which is quite a novel, doing this sort of nanotechnology stuff. We are looking to understand how plastics fall apart over time, so the technology we are using is helping us to understand the degradation of plastics over time, rather than focusing on understanding the logistics of the packaging'.

The data, if shared with the wider plastics industry, will support the identification of polymers and material combinations that are optimal for reuse and can be reused multiple times before being recycled or appropriately disposed of.

Key Findings:

There are clear examples of both smart technology and smart use of technology being explored through SSPP. The potential benefits of these projects include more effective sorting and recycling, understanding consumer behaviour and understanding environmental impacts.

Considerations for future evaluation:

Winning Moves recommends the evaluator agree a preferred definition of 'smart' and confirm whether the coding of projects against Indicators 12 and 45 currently applied are correct or require revision.

2.3.4 IE2.4 To what extent, and how, has the Challenge benefited the UK plastic packaging and related business sectors and contributed to clean growth? Was the timing or scale of projects improved because of the Challenge intervention?

In the main, it is too early at this interim stage to assess the contribution of SSPP towards clean growth overall; however the demonstrator plants due to increase UK recycling capacity will contribute to clean growth through reducing the amount of material going to landfill and incineration providing capacity for recycling instead. Further, the online survey with 24 successful projects has shown that to date:

- 5 new jobs have been created in the plastic packaging value chain.
- 96 people have been trained or upskilled stemming from SSPP-funded projects.

Key Findings:

In the main it is too early to assess this evaluation question, although the demonstrator projects due to increase UK recycling capacity will undoubtedly lead to clean growth – with plastic packaging sent to recycling instead of landfill or incineration.

Although a sub-set of the population of successful projects, the 24 projects completing an online survey have reported 5 new jobs created and the training or upskilling of 96 individuals.

Considerations for future evaluation:

There will need to be clear definition of clean growth and which projects contribute towards this in the final evaluation so this can be more thoroughly assessed. The evaluator may therefore wish to code projects as contributing to this objective at the outset of the next phase.

2.3.5 IE2.5 Were there any unexpected barriers or facilitators to desired impact?

The barriers discussed below were all unexpected and projects, together with the wider SSPP Challenge Team, had to respond to them and navigate them as best they could. However, it is important to note that none of the barriers discussed were created through the SSPP Challenge and the way it was designed and implemented. They are all barriers associated with COVID-19 or the functioning of the market and its supply chain.

COVID-19 pandemic and impacts on delivery

According to project leads, the onset of the COVID-19 pandemic and related government-imposed restrictions, was the most disruptive barrier to project development and delivery. With the first round of restrictions in place from the third week of March 2020, for approximately seven months, COVID-19 adversely impacted the application process for some projects, but more significantly led to delays in delivery timetables and the need to re-schedule and or re-design delivery of certain activities.

Looking first at the impact on applications, several projects were attempting to draft and submit their applications during the summer and at the time of the severest restrictions. Project teams were unable to meet and had to work on applications remotely. Government restrictions also impacted the Challenge Teams assessment and interview processes, with the latter having to switch to online communications platforms, such as Zoom and Microsoft Teams:

> *'The duration of the call was a real problem. It resulted from when the call was being announced and the timeframe within which the research itself needed to be completed. Now, we have actually seen a 1-year extension to the timetable because of the disruption caused by COVID, so that has given a bit more breathing space…But we didn't know that during the assessment process. It opened in January 2020, and all of the assessments had been completed by the end of September, which is about 3 months quicker than a typical call of that nature. It was also unfortunate that the peer review process took place over the summer holidays, which nobody thanked us for. There were many factors that would really make me not want to do it that way again'.*

Some projects went as far as providing feedback to UKRI and the Challenge Team about the inconvenience that the scheduling caused:

> *'I gave them feedback, when they do their deadlines and timeframes, is to think about how they align this. When we had the two-three months for the feasibility study was the whole of the summer holidays, and a lot of us, as women, were involved in childcare, this disadvantages a women-led project compared to delivering a large piece of work across a period when there are no childcare requirements'.*

Delays and supply chain issues

The imposition of Government-imposed restrictions had a more profound impact on project delivery timetables and on specific elements of delivery. Closure of academic institutions and their research and laboratory facilities meant that face to face engagement was no longer an option and that laboratory testing, and any practical work had to be postponed until restrictions were lifted. This led to some delivery delays:

> *'So, the window for the funding is 3 years and we were told quite explicitly there would be no extension to those three years. We knew that's the ground before we started. I would say it's unfortunate that we couldn't delay the start, so ideally, we'd have probably delayed the start for six months because we were still in the middle of COVID and extended out the back end. So, everyone was remote. We couldn't even get into the labs. Those sort of sort of issues'.*

> *'So, the first barrier was COVID, the plan had been for the three research assistants, to all come to the university and all work together in person, which we couldn't do because of it moving to online. And then I think the other thing has been lots of adjustments to the methodologies. How do you do an ethnography online? How do you adjust all the different things that you would normally do face to face? So, there's just a kind of adjustment to what hybrid version of the data collection things would be like. So, there's been a lot of adjustment to do with the COVID context'.*

Related to this, but also as a result of Brexit and, more recently, the war in Ukraine, projects could not receive deliveries of equipment or materials, resulting in delays within the supply chain:

> *'Mostly supply chain issues, especially because of the microchip crisis, finding out that components will be delivered in 6 months while the project is 12 months. That is what we are dealing with on our side quite often. It was expected and we are managing it, this is the main risk that we have had to mitigate so far'.*

> *'The other one is supply chain issues; it is a super hardware intensive project, lots of electronic components being ordered. Some we were not able to order at all because they just weren't in stock, the supplier wouldn't take the order until they were confident they could fulfil it. It is not a secret about how bad some of the supply chains have been, due to COVID and how bad they are at the minute'.*

> *'We would like to have been operating by September, by now, we're going to be 6 months behind schedule because of supply chain. Things like getting onto site and getting people or if you want for seeing things like its picking up off the ground, you find things you didn't know were going to be there until you dig them up. The longer you take those costs will just keep adding up'.*

Difficulties in recruiting the right skills

Mirroring the supply chain issues discussed above, a few project leads cited issues with recruiting people with the right scientific, technical and practical skills. Visa issues created by new Brexit regulations led to delays in bringing people on to project teams, while lockdown restrictions also prevented people from re-locating and engaging face to face:

> *'We have had a couple, the first was we were going to hire a Controls Engineer for the project for the electronics work involved, mainly in the second quarter, but because of Visa issues, it took a really long time to get him on board, longer than we planned. We had some skills in house to start them off but when it got to the nitty gritty of designing the PCP's and the control panels we had to wait for the expert'.*

'I think the main ones were just staff. Recruitment was very, very difficult to get people to relocate. Obviously, this project was supposed to start in November 2020, and I mean most people were locked down or staying put so to bring people in was very difficult and I think that that caused about a six-month delay'.

Technical barriers

The other most common barriers that projects faced were technical, scientific and technological. Many of the projects are at the cutting edge of research and scientific discovery. There are, therefore, always issues with technology not working properly or difficulties with developing the science behind new polymers or processes.

'I guess there are always technical issues with this. They have been quite novel and very low TRL. A lot of the time things don't work, and you must have back-ups in mind or be able to look at a different material and try to accommodate for one of them not working as expected. There's not been too much so far but we are not too far into the project to be honest'.

'It is a challenging topic. Creating a biopolymer from a biobased feedstock is very hard to do. So, the chemistry is very difficult. The biggest hurdle was the technology, trying to get the reactions to the work in the way that you want them to, but we got that'.

'The main ones were, as they involve technology and software development, risk of delays which didn't necessarily happen, and risk of engagement, so are people going to interact with the product that we are selling or not. We decreased those by doing field research, studies, testing and extracting those learnings as much as possible'.

These barriers are, perhaps, more expected than those associated with COVID-19 and the supply chain, but they still lead to delays in progress and project delivery.

Key Findings:

COVID-19 represented the most cited and detrimental barrier, leading to delays in project set-up and delivery, the suspension of all face-to-face and practical research and engagement, including laboratory-based and consumer-facing (i.e., ethnographic) research.

COVID-19, Brexit and increasing costs also led to difficulties in the effective functioning of the supply chain, with projects unable to access capital equipment, electronics components, and other materials. These supply chain issues also extended to recruiting the technical and scientific skills and expertise need to start projects, and specific aspects of projects on time.

These barriers have led to inevitable delays in the completion of certain project activities, and therefore delays in the achievement of impacts but projects have managed to work through most of the challenges reported.

Considerations for future evaluation:

More research is needed to identify and discuss any barriers that may have resulted directly from the implementation and delivery of SSPP, and what some of the unexpected positives were that resulted from the programme.

2.4 IE3: Were there any unintended adverse impacts from the activities of the Challenge that conflicted with the Aims of the programme?

In the main it is too early to look at this evaluation question at this stage and will need to be assessed in the next phase of the evaluation. Based on evidence collated to date Winning Moves is not aware of any unintended adverse impacts at this stage.

Key Findings:

None at this interim phase.

Considerations for future evaluation:

Winning Moves would recommend that the evaluator ensures the final evaluation includes a technical assessment of any negative environmental impacts that may be associated with projects. For example, quantifying the environmental impacts of the new solutions compared to those they are replacing to ensure that elimination of plastics does not create other issues or considering whether it takes more energy to produce alternatives, whether projects have created new waste streams to deal with.

2.5 IE4: To what extent is the challenge on target to offer good value for money?

2.5.1 IE4.1 How do the benefits of the programme compare to the costs?

In the main it is too early to look at this evaluation question at this stage and a full method on Value-for-money will need to be developed and agreed for the final phase of the evaluation.

The evaluation framework produced in the first phase discusses two Value-for-money methods that would compare benefits to the costs of interventions, including adverse and unintended aspects. The two methods described are:

- Cost Effectiveness Analysis (CEA): compares the costs of alternative ways of producing the same or similar outputs.
- Cost Benefit Analysis (CBA): goes further to assess the impact of different interventions with all relevant costs and benefits valued in monetary terms (where proportionate and possible).

Key Findings:

None at this interim phase.

Considerations for future evaluation:

A full method on value for money will need to be agreed and developed for the final phase of the evaluation. Winning Moves suggests that in the next phase UKRI and the evaluator may wish to consider carrying out a cost effectiveness analysis (CEA) for the fund as a whole, with a focus on cost effectiveness in leveraging additional investment in this area as for some projects it will not be possible to adopt a full CBA. A full CBA should then be considered for demonstrator projects on the basis of the costs and benefits achieved in the context of the project, and beyond (where the evidence allows).

3 Programme Logic and Theory of Change

The original programme logic was produced by Eunomia and is included in the Final Evaluation Framework Report produced in March 2021. Winning Moves went through a review stage with UK Research and Innovation as the outset of second phase of the evaluation to:

- Update language and terminology.
- Include Programme Management as a set of activities in their own right that are necessary for the delivery of the programme.
- Change emphasis in line with focus of the Challenge throughout the logic, for example, broadening activities within the Enabling Research stream to include on a wider range of materials rather than just those that are 'recyclable'.

To facilitate future Theory Based Evaluation, Winning Moves built on the existing programme logic to produce a Theory of Change first outlining the **rationale of the programme**:

Table 21. SSPP Challenge Rationale

Rationale:
The Smart Sustainable Plastic Packaging (SSPP) Challenge is intended to establish the UK as a leading innovator in smart and sustainable plastic packaging in consumer products by funding, supporting and catalysing research and innovation with the potential to transform the design, production, supply, recovery and sustainability of plastic packaging across the entire value chain.

Source: Final Theory of Change agreed with UK Research and Innovation on 17/02/22

External factors outside of the Challenge that could act as barriers or enablers (i.e. factors that can either facilitate or hinder) the changes the Challenge is expected to bring about were then considered:

Table 22. SSPP Challenge External Factors

External Factors:
Public awareness, perceptions, attitudes and behaviour towards plastic and plastic waste (incl. societal acceptability of plastic waste and releases to the environment); private sector/organisational awareness and perceptions of plastic and plastic waste; plastics innovation policy (within and outside the UK); wider government policy (e.g. Resource and Waste Strategy, tax on non-recyclable content, bans on single-use plastics); UK Plastics Pact priorities and wider voluntary agreement commitments; changing access to overseas markets for the export of plastic waste; technological and other innovation outside of SSPP; currency exchange rates; commodity prices; energy prices; investor risk appetite; results of post-Brexit trade negotiations; ongoing implications of the COVID-19 pandemic.

Source: Final Theory of Change agreed with UK Research and Innovation on 17/02/22

A revised programme logic was then produced (included in Appendix 3) alongside development of a series of **assumptions** or necessary conditions for expected changes to be realised. One way of assessing whether the Challenge is on track to achieve its objectives is to assess evidence that support the assumptions set out in the Theory of Change. The table below outlines the assumptions in the Theory of Change and current evidence that supports these assumptions. In the main, evidence has been drawn from Tranche 1 qualitative interviews with beneficiaries, but other evidence is included where applicable. Each assumption is also given a Red Amber Green (RAG) rating in terms of whether evidence suggest the Challenge is on track to achieve its impact.

Table 23. SSPP Challenge Theory of Change Assumptions

Assumptions underpinning the ToC	*Evidence review and summary of progress*	*RAG rating*
Announcement of the SSPP Challenge, and amount of funding on offer, sends a strong signal to the market (supply chains, value chains and investors) that the sustainability of plastics packaging for consumer products is a serious societal issue to be addressed, supporting and reinforcing pre-existing signals (e.g. the UK Plastics Pact). > SSPP Challenge priorities are sufficiently aligned with, and build on, existing priorities and commitments > UKRI announce and promote the SSPP Challenge effectively. Those in a position to respond to the Challenge are made aware of SSPP > The Challenge evolves and is responsive to changes and challenges in the wider landscape > Funding eligibility criteria and timing etc. make SSPP a good fit in practice as well as principle	**Evidence from qualitative interviews with stakeholders and project applicants:** **Alignment with existing priorities and commitments** > The SSPP Challenge team took a conscious and deliberate decision to align the Challenge objectives to Plastics Pact targets – these were developed collaboratively with businesses, UK Government and non-governmental organisations. > Alignment with UK Plastics Pact ensures similar alignment with Pacts in Europe and India. > SSPP and funded projects recognise importance of re-use, recycling, removal of problematic plastics and development of new bio-polymers and plastics replacement. **Effectiveness of challenge promotion** > It is clear from review of project applications and successful projects that the SSPP Challenge has received a variety of applications across the competitions, and areas of interest detailed within the Theory of Change. > However, while many agreed that using existing networks proved to be a highly effective mechanism for attracting applicants, some Challenge Staff and project leads felt that it had led to the *'same old organisations applying'*. > Interview evidence confirms many application submissions were received from organisations with pre-existing relationships with UKRI and SSPP; however, there is evidence of new organisations, including new start-ups and small companies. > The SSPP Challenge used advertisements and articles in selected trade publications; however, none of the projects we interviewed made any reference to hearing about the project via this media. This is corroborated through analysis of FPPS applications conducted by UKRI, where analysis of 150 applicant responses on how they became of aware of funding, showed that none mentioned these advertisements as a mechanism.	Evidence collected to date, supports this assumption.

	Responsiveness to changes and challenges > Original business case responsive to the platform established via Blue Planet 2 – submitted at time of heightened societal and governmental interest. > Core Programme addressing barriers preventing supply chain collaboration – focus on developing new standards for collaborative relationships and for testing suitability of new polymers for food contact. Educating different parts of the supply chain – decision making and processes for development of new polymers. > Focus on large-scale demonstrators in a bid to deliver measurable and significant impacts against Plastics Pact targets by 2025. > The SSPP Challenge were adaptive to the COVID-19 pandemic granting extensions where required and were flexible, whilst still holding projects to account.	
<u>SSPP Challenge is sufficiently attractive to individual subgroups</u> of the relevant supply and value chains to encourage a diverse range of high-quality applications necessary to allow for a balanced portfolio of funded projects: > Awareness of SSPP Challenge is sufficiently high across the entire supply and value chain > SSPP is sufficiently attractive to individual subgroups of the supply and value chain to attract a diverse range of applications > Those in a position to respond to the Challenge: o Have or are able to formulate ideas and projects that are eligible for funding	**Evidence from qualitative interviews with stakeholders and project applicants:** > Innovate UK KTN and UKCPN played an important role in raising awareness of SSPP Challenge throughout the supply chain. Evidenced by involvement of universities (scientific and research communities), investment from private sector, including plastics producers, waste management and collection, recycling facilities, retailers and consumers. > There are some new organisations and start-ups, however there is also evidence that smaller organisations found the application process more difficult and those less engaged with UKRI were less likely to receive funding. **Evidence from Indicators work:** > The 57 applications reviewed as part of the interim evaluation, address the four UK Plastics Pact targets and include projects with focus on all areas targeted by the SSPP Challenge including projects understanding environmental impacts, understanding consumer behaviour and which make use of 'smart' technology. The nature of these projects are discussed in more detail in Section 2.2.	In general, evidence to date suggests that the Challenge is working as intended, with applicants from across the value chain and with diverse focus of applications.

○ Have sufficient time and skills to write applications of sufficiently high quality to be considered for funding	Note: The SSPP Challenge has adopted a number of mechanisms but work conducted to date has not assessed its reach amongst those that did not apply to the Challenge. There is currently a survey live with UKCPN members and members of the UK Plastics Pact that may provide some further insights on this in the future.	
Highlighting specific issues/problems in need of solutions (in calls for applications, promotional webinars etc.), encourages academics and actors in the plastic supply and value chains to pursue and/or prioritise efforts to address these issues/problems. > Activities to promote the SSPP Challenge raise awareness and reach those in a position to address specific issues/problems > Those in a position to respond to specific issues/problems formulate or tailor their ideas/proposed projects to address particular issues > A sufficient number of applications of sufficient quality are put forward to address the issues highlighted	**Evidence from qualitative interviews with stakeholders and project applicants:** Launch events struck an appropriate balance between administrative necessity and subject matter discussion, with the latter including presentations and discussions relating to key issues of concern. There are at least some examples in qualitative interviews of individuals formulating project ideas in response to specific issues and problems highlighted by the Challenge. Wider use of UKCPN and Innovate UK KTN ensured engagement from across the supply chain: > Research and Development at universities focused on development of plastics alternatives. > Retailers and large supermarket brands engaged in re-use and re-fill schemes. > Waste collection companies involved in projects aimed at recycling and 'high value' plastics collection. > Consumers engaged in behavioural change projects aimed at encouraging re-use, re-fill and plastics recycling. The total value of all eligible applications to date is far beyond the £60m pot of available funding. SSPP's portfolio balancing saw several projects, primarily in the FPPS competition, that scored above the fundable threshold of 70, not receiving funding, which illustrates that the Challenge received a sufficient number of high quality applications from which to choose.	Evidence confirms that the SSPP Challenge both highlighted and encouraged applications in these areas.

The funding on offer is sufficient to de-risk investment, reducing the outlay required by applicants to progress innovative ideas and projects to an acceptable level given the risks and uncertainty involved. > Project ideas exist that are promising, but deemed too risky to progress in the absence of grant funding > The availability of funding prompts people to consider or reconsider projects that they would have dismissed otherwise > The SSPP Challenge prompts acceleration or earlier scaling-up of projects that might not be prioritised otherwise > The extent to which the SSPP Challenge de-risks the investment is sufficient to secure internal approval to proceed / for R&D investors to match fund the investment	**Evidence from qualitative interviews with stakeholders and project applicants:** > Just over half-of successful projects interviewed reported that they would not have been able to progress with their projects in the absence of funding, with some commenting directly on risk, and the difficulty funding projects deemed to have a low Technology Readiness level (TRL). > Enabling Research and Feasibility Studies &Industrial Research (FS&IR) competitions are funding 'riskier' projects aimed at identifying new technologies and polymers, and sustainable solutions for increasing recycling and re-use and reducing the production of problematic, single-use plastics. > Funding allowed academic institutions to research and pursue experimental and 'proof of concept' activities that would otherwise be too financially and resource intensive. Smaller organisations, and those working on lower TRL projects, would not have been able to invest the required level of funds due to the perceived risk of doing so. SSPP funding effectively 'de-risked' the activities for these projects. > SSPP funding also served to attract private sector investment needed by effectively 'endorsing' the decision to research, in the eyes of the private sector. > Several projects also received funding from private sector R&D companies that saw commercial benefit from their research activities that otherwise would not have been identified.	Evidence to date supports the assumption that the SSPP Challenge has been sufficient to de-risk investment at the project level. It is recommended that this is explored further with wider stakeholders in the final phase of the evaluation to understand if the funding has been sufficient to support realisation of UK Plastics Pact Targets.
Programme Management and governance by UKRI and activities delivered by the Core Programme bring together and connect relevant actors and experts across the supply and value chains to collaborate where they may not have otherwise:	**Evidence from qualitative interviews with stakeholders and project applicants:** > Qualitative evidence relating to the Core Programme shows: o Six projects securing collaboration between UKRI and organisations across the supply chain, including British Plastics	Evidence to date shows collaboration across the supply chain, but it is too early from an impact perspective to tell how long-standing collaborations initiated will be.

> Actors in the relevant supply and value chains are willing and open to collaboration > New collaborations (between people and/or projects) are formed as a result of SSPP Challenge activities and are maintained following the completion of projects and the end of the Challenge. > Projects selected for funding allow proposed collaborations and the forming of new networks to progress OR these collaborations progress outside of the SSPP Challenge > UKRI recommendations to assist in knowledge exchange across the supply and value chains are practical and aligned with the needs of stakeholders > Actors across the value chain communicate effectively so collaborative networks endure across disparate elements of the chain	Federation, British Standards Institution, WRAP, Ceflex[14], Re-coup and Suez. ○ The Core Programme includes a project aiming to establish recognised standards and expectations for facilitating formation of collaborative relationships. > In funding projects that are further along the commercialisation 'journey', the SSPP Challenge has successfully established collaborative partnerships with high profile companies including recognised retail brands and larger plastics producers and manufacturers. > Evidence of retailers and producers becoming interested in findings and data from behavioural change projects and how can be used to shape product and service developments. > Many collaborative relationships between academic institutions existed before they applied for SSPP funding. However, SSPP has been effective in developing links with private companies that can scale-up project activities once funded activity comes to an end. > Several wider stakeholders referred to 'legacy' and the role that SSPP has played in developing longstanding partnerships between segments of the supply chain that had never previously worked together. > For those competitions that have reached completion, evidence has been captured trough UKRI benefits work on collaborations (discussed further in Section 3). **Evidence from benefits realisation data:** > A total of 26 collaborations initiated or enhanced have been captured though benefits realisation work for Feasibility Studies and Industrial Research and Feasibility Studies for Demonstrators competitions which have reached completion.	

[14] Ceflex **The Circular Economy for Flexible Packaging (CEFLEX)** initiative is a collaboration of over 180 European companies, associations and organisations representing the entire value chain of flexible packaging. https://ceflex.eu/

Support is provided to projects funded under the Dynamic CR&D programme, throughout delivery, to overcome barriers to the success of the project and/or maximise return on investment. This support helps to address skills and knowledge gaps and tackle barriers to market, resulting in better (e.g. quicker, larger scale) outcomes than would have occurred if funded by an alternative source: > Through the SSPP Challenge beneficiaries are able to access the skills and advice to deliver their projects successfully. > Beneficiaries are willing to accept help and support	**Evidence from qualitative interviews with stakeholders and project applicants:** > There are instances of providing support to all types of projects however, stakeholder interviews suggest that the focus on CR&D having a greater degree of support may not be correct, and we recommend this assumption is reviewed and updated in the final phase of the evaluation. > There were projects that requested specific types of support (e.g. with commercialisation and scale-up) but did not receive this. For example, several projects highlighted the difficulties they had in engaging with Innovate Edge, a partner organisation aimed at supporting projects with commercialisation and scale-up activities. The SSPP Challenge team has recognised the issues of collaborative working and signposting with Innovate Edge, and steps have already been taken to improve this working relationship.	There are some projects that would benefit from support, for which there is an outlet within UKRI but have not received this support to date. This presents a potential risk to the achievement of impacts.
Projects funded by the Challenge are successful and progress sufficiently for the intended immediate outcomes and impacts to be realised: > Investable propositions emerge from projects funded by the SSPP Challenge to stimulate further investment in R&I to improve plastic packaging sustainable packaging in the value chain > New standards and methods emerge for simulating and measuring environmental impacts of full life cycle of plastic packaging > New learning is generated and disseminated to inform best practice and advance knowledge in	**Evidence from qualitative interviews with stakeholders and project applicants, the online survey and monitoring outcomes:** > Some projects have already started writing and publishing academic articles, however, evidence from our interviews points to far more activity in this area, once projects have progressed to the right point. Some projects have referenced the possibility of writing up to six academic and scientific articles, and the Challenge will need to wait to see whether these commitments are realised. > The online survey has also shown that some projects are at a stage where they have patents in progress or have signed IP licenses in place.	Too early to tell extent to which projects will progress sufficiently to realise intended impacts.

terms of exploring innovation, design, demonstration, and development		
Outcomes and impacts from the SSPP Challenge enable the UK to build a reputation as a leader in consumer smart sustainable plastic packaging: > Effective leadership, programme and stakeholder management contributes to policy developments as well as the UK's global standing in plastics innovations > Outcomes and impacts from the SSPP Challenge are relevant to tacking global consumer plastics packaging issues > Relevant audiences outside the UK recognise the increasing progress being made in the UK above and beyond that of other nations in terms of knowledge advances, demonstrating innovation, and connecting the value chain for consumer plastic packaging > Consumers and retailers engage with and are accepting of new materials and regulations arising out of plastic innovation research	**Evidence from qualitative interviews with stakeholders and project applicants, the online survey and monitoring outcomes:** It is too early to assess the Challenge level impacts associated with developing the UK's global standing in plastics innovation. However, a couple of projects have referenced the establishment of academic partnerships with European universities and academic institutions in the Americas, who have expertise in areas of polymer development and plastics re-use. These relationships are expected to continue, but the longevity of them is unclear. Reference has also been made to attending and presenting at international conferences and events, but this activity is not yet taking place on a large enough scale. This engagement will likely increase as more projects come to conclusion.	It is too early to assess whether the outcomes and impacts from the Challenge have built the UK's reputation as leader in this space as although some projects are complete most are yet to complete their dissemination strategies.
Knowledge sharing and dissemination (through the SSPP Challenge and the individual projects) supports ongoing innovation and further raises awareness among wider stakeholders and interest	> Evidence of proactive monitoring leading to stronger relationships with projects and earlier identification of delivery issues or concerns over underperformance. > Acceptance from SSPP Challenge team that reporting requirements more extensive than for other Challenges.	Too early, but evidence suggests it is on track with activity reflecting what would be expected at this stage.

in plastic packaging value chain sustainability: > Monitoring activities are sufficient and accurate so that lessons can be learnt to inform future challenges > Findings are disseminated to relevant external parties e.g. wider stakeholders, policy makers, general public and these parties engage with data and reports generated through the SSPP Challenge > Actors in the supply chain and value chain look to draw on existing collaborations and knowledge gained through the SSPP Challenge to further progress research and development for consumer plastic packaging allowing environmental gains from the Challenge to be realise in subsequent years	> Projects stated that not all indicators are directly relevant to their activities and expected deliverables and outcomes. > From our perspective, as an independent evaluator, the number of indicators far exceeds the number typical for evaluations of this nature. When viewed in conjunction with wider monitoring requirements and data collection for benefits mapping, this presents a greater burden to beneficiaries than might normally be expected. Innovate UK KTN and NERC are working with projects to establish a communications approach or 'pathway' for sharing findings: > Projects are being encouraged to support with the development of case studies, press releases, blogs, and social media content to share findings. > Additionally, UKRI are working more closely with Innovate Edge to secure support for business growth and exploitation. With 3 competitions now concluded, UKRI are shifting attention to drafting and implementing a structured communications strategy, which will include running events and conferences, similar to the current annual GRIPS Conference. The online survey of successful projects, where 24 completed the survey indicate five academic papers have been accepted for publication with 16 academic papers published. A total of 128 UK events where projects have had a speaking slot and 37 International events where projects have had a speaking slot.	Winning Moves recommends that there is a synthesis of learning across the SSPP Challenge, both to facilitate the final evaluation of impact. and to ensure that that the Challenge achieves its potential in terms of impact.

Source: Final Theory of Change agreed with UK Research and Innovation on 17/02/22 alongside a review of supporting evidence.

4 Summary

4.1 Overview of Key Findings

At the interim stage evidence suggests the SSPP Challenge is on target to realise impact from the funding delivered. Within the Challenge there are a number of projects that will likely deliver impact within the lifetime of the UK Plastics Pact, in particular demonstrator projects that boost the UK's capacity to process plastic packaging. Projects supported at lower commercial readiness, are also likely to have impact beyond the lifetime of the UK Plastics Pact but will need to be followed up in future to understand their successes and whether they are taken further to full commercialisation. These projects include those focused on reuse and refill, understanding consumer behaviour, and the introduction of new plastic packaging.

Early indications show a strong case for attribution to the fund, with successful projects reporting they would not be able to proceed in the same timeframe and at the same scale in the absence of the fund. Further, a substantial proportion of unsuccessful projects reported they would not have progressed in the absence of funding. A full assessment of additionality will need to be made in the final phase of the evaluation.

A review of the assumptions that underpin the Theory of Change alongside evidence collated shows good progress and supports the conclusion is on track to realise impact. When considering the Impact Evaluation questions specified in the evaluation a framework, a summary of key findings on progress for each is outlined below:

Impact Evaluation Question Description		Key Findings
IE1: To what extent, and how, did the Challenge achieve its Objectives?:	> IE1.1 To what extent, and how, did the Challenge unlock a significant increase in R&I spend on new forms of plastic packaging with improved functionality and sustainability?	At this interim phase, the Challenge has already exceeded the £149m co-investment target (achieving 140% of target), with Demonstrators Round 1 playing a key role in this achievement. The data analysed provides a snapshot in time and should be updated in the next phase of the evaluation. SSPP has played an important role in encouraging R&I activities through investment in early stage, low TRL and proof of concept activities that would have otherwise not been taken forward. Evidence collated at project closure to date shows progression through TRL levels over the course of the project lifetime. This includes projects where focus is on new forms of plastic packaging, enabling existing polymers to be used in different ways. These projects have resulted in materials that, in the main, are renewable or recyclable, and functional, including some that will be used in food packaging in years to come.
	> IE1.2 To what extent, and how, did the Challenge deliver R&I to support more sustainable plastic packaging in line with the UK Plastics Pact targets?	The portfolio of successful projects funded show potential contribution to all four UK Plastics Pact targets based on review of project descriptions and interview evidence relating to project progress. Demonstrator projects alone are set to increase the UK's recycling capacity for plastic packaging by at least 144,000 tonnes per annum and should be realised within the lifetime of the UK Plastics Pact. Further, the Core Programme project to introduce kerbside collection of flexibles is a crucial first-step in establishing collections infrastructure. It will be important to consider which projects are likely to contribute to targets in the lifetime of UK Plastics Pact, set to conclude in 2025 as although some projects are aligned to targets, impact may not be realised for some projects in time to contribute to Plastics Pact targets for 2025. Wider innovations, where successful, will provide potential alternative packaging solutions that also contribute towards targets, though

		it remains to be seen how far these will be commercialised within the lifetime of the UK Plastics Pact Contribution to UK Plastics Pact targets is supported through qualitative interviews with successful projects that are contributing to these targets. It will be important to continue to monitor the successes and learnings from these projects.
	> IE1.3 To what extent, and how, did the Challenge increase UK plastic packaging value chain collaboration on improving sustainability?	There is clear evidence that there is collaboration across the value chain, however future assessment should be made once all projects have conducted a project closure interview, as these collect information about the extent to which relationships existed prior to the Challenge. This will help to understand whether collaborations are above and beyond what may have occurred otherwise.
	> IE1.4 To what extent, and how, did the Challenge increase understanding of environmental impacts of existing and new plastic packaging to inform new and improved design, technologies and processes?	Coding of project applications shows evidence of projects with the specific aim of improving understanding of environmental impacts. Some papers have been published already with further papers expected. A full review of these papers, and other evidence disseminated by SSPP projects will be needed in Phase 3 of the evaluation to ascertain whether and to what extent they advance understanding, or influence new and improved design, technologies and processes.
	> IE1.5 To what extent, and how, did the Challenge increase understanding of behaviour on the sustainability of plastic packaging to inform new and improved design, technologies, processes and business models?	Substantial investment has been committed to projects which include consideration of consumer behaviour, including projects for which this is their core focus. With papers in progress, further papers expected and feedback from qualitative interviews that there is already significant interest in some of the emerging findings, the Challenge is likely on target to improve the knowledge base. The extent to which these projects go on to inform new and improved design, technologies, processes and business models will need to be assessed at a later date.
	> IE1.6 To what extent, and how, did the Challenge increase the UK's international recognition and an	Assessing the impact of the SSPP Challenge on the UK's international recognition is difficult to assess at this early stage. However, there is already evidence of

	increase of international finance (export and investment)?	dissemination of project findings through academic papers and presentations at both UK and international events. For completed competitions, there are plans for overseas products, but for some it is too early to quantify what this may realise in terms of sales. Additionally, the online survey has captured one example of inward investment, providing early signs of progress towards this objective.
	IE2: Did the Challenge result in additional effects in alignment with the Objectives of the programme?	SSPP Challenge funding has been critical in allowing projects, particularly those earlier stage, lower TRL activities to go ahead. Funding has de-risked research for smaller organisations that don't have the resources to fully fund activities. SSPP funding has also served to 'endorse' research concepts and their support has actively encouraged involvement and significant investment from the private sector. Successful projects reported they either could not progress without funding or may have had to progress at reduced scale in the absence of the fund. Evidence collated from unsuccessful projects shows the impacts of SSPP funding with almost three quarters of unsuccessful projects interviewed in the qualitative interviews stating that they have had to suspend or 'mothball' their planned projects due to a lack of financial resources or alternative funding. Similarly, online survey results show that 21 out of 35 unsuccessful projects completing the online survey were unable to progress their project without Challenge Funding. Where projects did proceed in the absence of Challenge funding, financial backing was achieved from a variety of sources, showing market interest in innovation in plastic packaging and that at least some activity would have happened anyway in the absence of the SSPP Challenge. Overall, available evidence provides strong early indication of additionality.
IE2: Did the Challenge result in additional effects in alignment with the Objectives of the programme?	> IE2.1 To what extent, and how, is the Challenge on target to contribute to a step change towards a more sustainable value chain (e.g. through thought leadership, trailblazing, reaching critical mass)?	Qualitative evidence shows progress towards a more sustainable value chain. Feasibility studies and several projects under the Enabling Research competition, are keen to use big data and to share useful data with the research community and private sector, to support the continuation of their research. Phase 3 will need to assess to what extent this continues and gather evidence and perspectives on the extent to which SSPP has contributed to this.

		There are also projects with 'transformative potential', where the aim is to change how different parts of the supply chain view the production, re-use and recycling of plastics. Reuse and refill projects are also having transformative potential through encouraging positive behavioural change among retailers, supermarkets and consumers.
	> IE2.2 To what extent, and how, can the projects supported by the Challenge be expected to bring about a reduction in the environmental impact associated with plastic packaging, and over what time frame? I.e., impacts beyond the UK Plastics Pact targets	With demonstrator projects alone, an increase in UK capacity for recycling will be achieved, reducing the environmental impacts of plastic packaging. Many other projects still in progress will also realise impacts but given their early stage at this time tracking their successes and intention to commercialise will be necessary in Phase 3.
	> IE2.3 To what extent, and how, has the Challenge facilitated the innovation of "smart" sustainable plastic packaging? What are the expected benefits of this?	There are clear examples of both smart technology and smart use of technology being explored through SSPP. The potential benefits of these projects include more effective sorting and recycling, understanding consumer behaviour and understanding environmental impacts.
	> IE2.4 To what extent, and how, has the Challenge benefited the UK plastic packaging and related business sectors and contributed to clean growth? Was the timing or scale of projects improved because of the Challenge intervention?	In the main it is too early to assess this evaluation question, although the demonstrator projects due to increase UK recycling capacity will undoubtedly contribute to clean growth – with plastic packaging sent to recycling instead of landfill or incineration. Although a sub-set of the population of successful projects, the 24 projects completing an online survey have reported 5 new jobs created already, and the training or upskilling of 96 individuals.
	> IE2.5Were there any unexpected barriers or facilitators to desired impact?	COVID-19 represented the most cited and detrimentally impactful barrier, leading to delays in project set-up and delivery, the suspension of all face-to-face and practical research and engagement, including laboratory-based and consumer-facing (i.e., ethnographic) research.

		COVID-19, Brexit and increasing costs also led to difficulties in the effective functioning of the supply chain, with projects unable to access capital equipment, electronics components, and other materials. These supply chain issues also extended to recruiting the technical and scientific skills and expertise needed to start projects, or specific aspects of projects on time. It is clear that these barriers have led to inevitable delays in the completion of certain project activities, and therefore delays in the achievement of impacts, but overall projects have managed to work through most of the challenges reported.
IE3: Were there any unintended adverse impacts from the activities of the Challenge that conflicted with the Aims of the programme?		In the main it is too early to look at this evaluation question at this stage and it will need to be assessed in the next phase of the evaluation. Based on evidence collated to date Winning Moves is not aware of any unintended adverse impacts at this stage. Suggestions for the future evaluation phase are included in the section below.
IE4: To what extent did the challenge offer good value for money?		In the main it is too early to look at this evaluation question at this stage and a full method on Value-for-money will need to be developed and agreed for the final phase of the evaluation. This is discussed further under considerations for future evaluation below.

4.2 Considerations for the Phase 3 evaluation approach

The sections below includes recommendations for the next Phase of the evaluation, taking into consideration key findings from the interim phase.

4.2.1 Initial project scoping

It was important for the programme logic to be updated at the outset of this phase and to also expand upon the existing content to a Theory of Change. Given the eventual impact evaluation is likely to be a Theory Based evaluation, it will be necessary to again review this content and ensure it is fit for purpose.

4.2.2 Project-level and Sector level indicators

The indicators proposed to track the progress of the Challenge total 101. Although most map to the overarching Impact Evaluation Questions, there are likely too many to enable robust conclusions on the success of the Challenge to be made.

In addition to this, the indicators requested directly from projects can be difficult for respondents to answer, particularly in an online survey when beneficiaries cannot be provided with further details regarding the indicator in question

At the outset of the next evaluation Winning Moves recommends UKRI and the preferred contractor:

- Review each project against the list of indicators, coding its relevance against the project aims and objectives. Assess the final outcome of this exercise with a view to critically reduce the number of indicators, retaining those of relevance to more projects.
- Review each indicator with a view to further reduce the number of indicators. This could be done through:
    - Understanding the source of information best accessed to populate the metric reviewing:
        - Whether data is captured in a format that matches Indicators. For example, indicators on export sales were sourced from project closure forms but the detailed breakdown within the indicators definitions was not captured and so could only be reported overall.
        - The appropriate time-point for capture/assessment. For example, gain an understanding of where data may only be available for those where project closure has been reached, and whether these indicators should therefore be assessed at a later date when population data are available.
    - Understand the ease of obtaining the required information, in terms of availability of the proposed data source; for example, review of whether any previously free data sources are no longer available making it necessary to revise the approach and removing those where the effort outweighs the benefit in terms of evaluating the Challenge.
    - Critically review indicators that involve a degree of subjectivity with a view to remove them entirely, tighten definitions or consider use of a nominated expert for the task. For example, where manually determining if patent applications or research papers are of relevance to the SSPP Challenge, we would recommend a tighter framework as the current process is likely to vary by researcher conducting the process and may not be a reliable measure when different individuals complete it year on year. For example, in completing the accompanying indicator spreadsheet Winning Moves and UKRI have discussed removal of indicators 48-57 that capture the number of academic papers with specific categories of focus such as 'understanding environmental impacts'.
    - Review the required granularity for groups of indicators to understand if these can be combined, for example, consider capturing combined totals for export sales rather than breaking these down in Indicators 15-17 by packaging, IP license agreements and consulting services.

4.2.3 Consideration of mechanism to capture data

This should be considered for three reasons:

1. There are multiple requests on projects to supply data, at the interim phase successful projects were asked to complete a qualitative interview and accompanying online survey. It would be good to reduce this to one interaction for future rounds of data collection as much as possible. One

possible way of reducing some burden is to extend the data captured in project closure interviews, to include some of the project-level indicators that are sought from online survey.

2. Quantitative data provided through the online survey was sparse for some indicators. This was due to varying reasons including, the timeframe being too early and lack of relevance for particular indicators. Winning Moves recommends considering integrating data capture into telephone approaches in the next phase to allow for questioning to be tailored to particular projects. The task of reviewing relevance of indicators by project will also help to refine the sub-set of questions relevant to each individual project.
3. The next phase of the evaluation may wish to consider alternative mechanisms to gather feedback from UKCPN and UK Plastics Pact members given the response rate to the online survey issued in this phase was low.

4.2.4 Overarching evaluation method

Theory Based Evaluation

The initial evaluation framework suggests that a realist evaluation may be appropriate to understand the impact of the evaluation. However, it was discussed with UKRI that (even at the interim phase), in the absence of realist theories being developed during the first phase of the evaluation, it was likely to too late to initiate an evaluation of this type.

Winning Moves recommend that either contribution tracing or process tracing is used as the basis for assessing the overall impact and contribution of SSPP in the final phase.

Impact and value-for money assessment

As indicated under key findings, it is likely some impacts will not be realised until the closure of the Challenge. It may therefore be advantageous to assess the projects that will and will not realise environmental benefit within the lifetime of the competition. This information could be used to:

- Consider whether approaches to forecasting of impact should be adopted where possible and may help to frame the types of questions that can be asked to each project.
- Set the scene for any final impact reporting, making clear where estimates are likely to be conservative.

In order, to fully address IE3 on adverse impacts, Winning Moves recommends that the final evaluation includes a technical assessment of any negative environmental impacts that may be associated with projects. For example, quantifying the environmental impacts of the new solutions compared to those they are replacing to ensure that elimination of plastics does not create other issues or considering whether it takes more energy to produce alternatives, whether projects have created new waste streams to deal with.

In addition, as indicated in the framework a method will also need to be developed for assessing value-for money of the SSPP Challenge to respond to IE4. As discussed in Section 3.5.1, the evaluation framework produced in the first Phase discusses two Value-for-money methods that would compare benefits to the costs of interventions, including adverse and unintended aspects. The two methods described are:

- Cost Effectiveness Analysis (CEA): compares the costs of alternative ways of producing the same or similar outputs.
- Cost Benefit Analysis (CBA): goes further to assess the impact of different interventions with all relevant costs and benefits valued in monetary terms (where proportionate and possible).

Winning Moves suggests that in the next Phase, UKRI and the chosen evaluator may wish to consider carrying out a cost effectiveness analysis (CEA) for the fund as a whole, with a focus on cost effectiveness in leveraging additional investment in this area as for some projects it will not be possible to adopt a full CBA. A full CBA should then be considered for demonstrator projects on the basis of the costs and benefits achieved in the context of the project, and beyond (where the evidence allows).

5 Appendix 1: Evidence assessed in assessing progress by Evaluation Question

Table 24. Overview of evidence used in assessing progress against IE1.1

Overview of evidence used in assessing progress against IE1.1	
Monitoring delivery and outcome data	Monitoring delivery and outcome data covering Indicator 1: Value of project-level investment in R&D (total), Indicator 2: Value of project-level investment in R&D - pledged co-investment
Benefits realisation data	Not reviewed for this question
Project-Level Indicators	Indicator 1: Value of project-level investment in R&D (total), Indicator 2: Value of project-level investment in R&D - pledged co-investment Indicator 2. Value of project level investment in R&D - pledged co-investment, Indicator 3: Value of project level investment R&D - accompanying co-investment, Indicator 4: Value of project level investment in R&D - aligned co-investment., Indicator 5: % of pledged co-investment relative to £149m target. Indicator 14: % of project-level investment in R&D relative to 2.4% of GDP target
Tranche 1 semi-structured interviews with SSPP project applicants, internal stakeholders and wider stakeholders	Qualitative data from successful projects
Online survey data	Review of questions feeding into indicators work.
Application data	Not reviewed for this question
Project Closure Forms	Data captured on TRL at the beginning and end of the project.

Table 25. Overview of evidence used in assessing progress against IE1.2

Overview of evidence used in assessing progress against IE1.2	
Monitoring delivery and outcome data	Monitoring delivery and outcome data covering Indicator 1: Value of project-level investment in R&D (total), Indicator 2: Value of project-level investment in R&D - pledged co-investment
Benefits realisation data	UK Research and Innovation mapping of 61 funded projects against Benefits B2, B3, B4 and B5.

Project-Level Project-level Indicators	Indicator 6: Value of projects focussed on increasing the recyclability, reusability, or compostability of plastic packaging and Indicator 39: Number of projects focused on increasing the recyclability, reusability or compostability of plastic packaging Indicator 7: Value of projects focused on achieving a recycling/composting rate of 70% and Indicator 40: Number of projects focused on achieving a recycling/composting rate of 70% Indicator 8: Value of projects focused on the elimination of problematic and unnecessary single-use plastic items and Indicator 41: Number of projects focused on the elimination of problematic and unnecessary single-use plastic items Indicator 9: Value of projects focused increasing the recycled content of plastic packaging and Indicator 42: Number of projects focused increasing the recycled content of plastic packaging Indicator 64: Amount of plastic packaging beneficiaries are responsible for POM Indicator 65: Market share of SSPP-funded packaging that is recyclable Indicator 66: Market share of SSPP-funded packaging that is compostable Indicator 67: Market share of SSPP-funded packaging that is resuable Indicator 68: Tonnes of 'problematic and unnecessary' single-use plastic removed from market (e.g., substituting with less damaging material) due to SSPP funding. Indicator 69: Tonnes of single-use plastic packaging not categorised as 'problematic and unnecessary' POM by SSPP-funded projects Indicator 70: Market share of plastic packaging not categorised as 'problematic and unnecessary' POM by SSPP funded projects Indicator 71: Average % of recycled content for SSPP-funded plastic packaging
Tranche 1 semi-structured interviews with SSPP project applicants, internal stakeholders and wider stakeholders	Qualitative interview with successful projects broken down by Plastics Pact target focus.
Online survey data	Not reviewed for this question
Application data	Not reviewed for this question
Project Closure Forms	Data captured on TRL at the beginning and end of the project.

Table 26. Overview of evidence used in assessing progress against IE1.3

Overview of evidence used in assessing progress against IE1.3	
Monitoring delivery and outcome data	Not reviewed for this question

Benefits realisation data	UK Research and Innovation assessment against Benefits for Feasibility Studies and Industrial Research and Feasibility Studies for Demonstrators: > B6: Increase the collaboration of stakeholders across the plastic packaging supply chain.
Project-level Indicators	The following indicators are relevant to this work but are sourced from the Benefits realisation data described above: > Indicator 20 Number of SSPP-funded collaborative projects between industry and academia. > Indicator 21: Number of SSPP-funded collaborative projects between two or more parts of the value chain Note: Indicator 22: Number of SSPP collaborative projects between organisations that had not previously worked together is also relevant but no quantitative data on this has been collected/shared with Winning Moves to date.
Tranche 1 semi-structured interviews with SSPP project applicants, internal stakeholders and wider stakeholders	Qualitative interviews with successful projects and wider stakeholders.
Online survey data	Not reviewed for this question
Application data	Not reviewed for this question
Project Closure Forms	Not reviewed for this question

Table 27. Overview of evidence used in assessing progress against IE1.4

Overview of evidence used in assessing progress against IE1.4	
Monitoring delivery and outcome data	Not reviewed for this question
Benefits realisation data	Not reviewed for this question
Project-level Indicators	Indicator 10: Value of projects focused on understanding the environmental impacts of plastic packaging and Indicator 43: Number of projects focused on understanding the environmental impacts of plastic packaging Indicator 46: Number of academic papers accepted for publication Indicator 47: Number of academic papers published Indicator 59: Number of patents granted Indicator 60: Number of signed IP licence agreements

	Note: Indicator 49: Number of academic papers published related to understanding of environmental impacts, Indicator 50: Number of citations of academic papers published related to understanding of environmental impacts and Indicator 51; Affiliation of authors who cited academic papers related to understanding of environmental impacts are also of relevance to IE1.4 but have not been captured as part of the interim evaluation as it was agreed with UKRI it was not necessary to include a question to capture this in the online survey at this interim phase.
Tranche 1 semi-structured interviews with SSPP project applicants, internal stakeholders and wider stakeholders	Qualitative interview with successful projects.
Online survey data	Reviewed questions feeding into indicators of relevance.
Application data	Reviewed to code projects with focus on understanding environmental impacts.
Project Closure Forms	Not reviewed for this question

Table 28. Overview of evidence used in assessing progress against IE1.5

Overview of evidence used in assessing progress against IE1.5	
Monitoring delivery and outcome data	Not reviewed for this question
Benefits realisation data	Not reviewed for this question
Project-level Indicators	Indicator 11: Value of projects focused on increasing the understanding of consumer behaviour associated with using more sustainable plastic packaging and Indicator 44: Number of projects focused on increasing the understanding of consumer behaviour associated with using more sustainable plastic packaging Indicator 46: Number of academic papers accepted for publication Indicator 47: Number of academic papers published Indicator 59: Number of patents granted Indicator 60: Number of signed IP licence agreements Note: Indicator 52: Number of academic papers accepted for publication related to understanding of consumer behaviour associated with using more sustainable plastic packaging , Indicator 53: Number of academic papers published related to understanding of consumer behaviour associated with using more sustainable plastic packaging and Indicator 54: Number of citations of academic papers published related to understanding of consumer behaviour associated with using more sustainable plastic packaging are also of relevance to IE1.5 but have not been assessed as part of the interim evaluation.

Tranche 1 semi-structured interviews with SSPP project applicants, internal stakeholders and wider stakeholders	Qualitative interviews with successful projects.
Online survey data	Reviewed questions feeding into indicators of relevance.
Application data	Reviewed to code projects with focus on understanding consumer behaviour.
Project Closure Forms	Not reviewed for this question

Table 29. Overview of evidence used in assessing progress against IE1.6

Overview of evidence used in assessing progress against IE1.6	
Monitoring delivery and outcome data	Not reviewed for this question
Benefits realisation data	UK Research and Innovation assessment against Benefits for Feasibility Studies and Industrial Research and Feasibility Studies for Demonstrators: > B8: Increase the Foreign Direct Investment into UK plastic packaging innovation and research. > B9: Enable the export of SSPP research and innovation.
Project-level Indicators	Indicator 13: Amount of inward investment received at project-level Note: Indicator 15: Project-level export sales - plastic packaging, Indicator 16: Project-level export sales - consulting services and Indicator 17: Project-level export sales - IP licence agreements are relevant to IE1.6 but we do not have data at this resolution. Instead Winning Moves have captured Total Project-level export sales (i.e. a summary of Indicator 15-17) Indicator 46: Number of academic papers accepted for publication Indicator 47: Number of academic papers published Indicator 59: Number of patents granted Indicator 60: Number of signed IP licence agreements Indicator 61: Number of UK events where beneficiaries held a speaking slot Indicator 62: Number of international events where SSPP beneficiaries held a speaking slot
Tranche 1 interviews with projects	Qualitative interviews with successful, unsuccessful, ineligible, and withdrawn projects.
Online survey data	Not reviewed for this question
Application data	Not reviewed for this question
Project Closure Forms	Not reviewed for this question

Table 30. Overview of evidence used in assessing progress against IE2

Overview of evidence used in assessing progress against IE2	
Monitoring delivery and outcome data	Not reviewed for this question
Benefits realisation data	Not reviewed for this question
Project-level Indicators	Not reviewed for this question
Tranche 1 semi-structured interviews with SSPP project applicants, internal stakeholders and wider stakeholders	Qualitative interviews with successful and unsuccessful projects.
Online survey data	Online survey responses from unsuccessful projects
Application data	Not reviewed for this question
Project Closure Forms	Not reviewed for this question

Table 31. Overview of evidence used in assessing progress against IE2.1

Overview of evidence used in assessing progress against IE2.1	
Monitoring delivery and outcome data	Not reviewed for this question
Benefits realisation data	Not reviewed for this question
Project-level Indicators	Not reviewed for this question
Tranche 1 semi-structured interviews with SSPP project applicants, internal stakeholders and wider stakeholders	Qualitative interviews with successful and unsuccessful projects.
Online survey data	Not reviewed for this question
Application data	Not reviewed for this question
Project Closure Forms	Not reviewed for this question

Table 32. Overview of evidence used in assessing progress against IE2.2

Overview of evidence used in assessing progress against IE2.2	
Monitoring delivery and outcome data	Not reviewed for this question
Benefits realisation data	Not reviewed for this question
Project-level Indicators	A number of indicators are relevant to this research question, although in the main it is too early to for these to have been captured. This will therefore need further analysis and consideration it the final phase of the evaluation.
Tranche 1 semi-structured interviews with SSPP project applicants, internal stakeholders and wider stakeholders	Qualitative interviews with successful projects.
Online survey data	Not reviewed for this question- little impact data provided at this stage.
Application data	Analysis of capacity figures for ISCF smart sustainable plastic packaging demonstrators projects round 1 and demonstrators projects round 2.
Project Closure Forms	Not reviewed for this question

Table 33. Overview of evidence used in assessing progress against IE2.3

Overview of evidence used in assessing progress against IE2.3	
Monitoring delivery and outcome data	Not reviewed for this question
Benefits realisation data	Not reviewed for this question
Project-level Indicators	Indicator 12: Value of projects that have made use of 'smart' technology to improve sustainability of plastic packaging and Indicator 45: Number of projects that have made use of 'smart' technology to improve sustainability of plastic packaging Indicator 46: Number of academic papers accepted for publication Indicator 47: Number of academic papers published Indicator 59: Number of patents granted Indicator 60: Number of signed IP licence agreements
Tranche 1 semi-structured interviews with SSPP project	Qualitative interview with successful projects.

applicants, internal stakeholders and wider stakeholders	
Online survey data	Reviewed questions feeding into indicators of relevance.
Application data	Reviewed to code projects with focus on understanding consumer behaviour.
Project Closure Forms	Not reviewed for this question

Table 34. Overview of evidence used in assessing progress against IE2.4

Overview of evidence used in assessing progress against IE2.4	
Monitoring delivery and outcome data	Not reviewed for this question
Benefits realisation data	Not reviewed for this question
Project-level Indicators	Not reviewed for this question
Tranche 1 interviews with projects	Qualitative interviews with successful projects.
Online survey data	Review of reported progression of unsuccessful projects.
Application data	Not reviewed for this question
Project Closure Forms	Not reviewed for this question

Table 35. Overview of evidence used in assessing progress against IE2.5

Overview of evidence used in assessing progress against IE2.5	
Monitoring delivery and outcome data	Not reviewed for this question
Benefits realisation data	Not reviewed for this question
Project-level Indicators	Not reviewed for this question
Tranche 1 semi-structured interviews with SSPP project applicants, internal stakeholders and wider stakeholders	Qualitative interviews with successful projects.
Online survey data	Not reviewed for this question

Application data	Not reviewed for this question
Project Closure Forms	Data on whether the project would

6 Appendix 2: Plastics Pact Contribution breakdown

The table below shows the breakdown of qualitative coding on contribution to Plastics Pact targets, as indicated in the main body of the report:

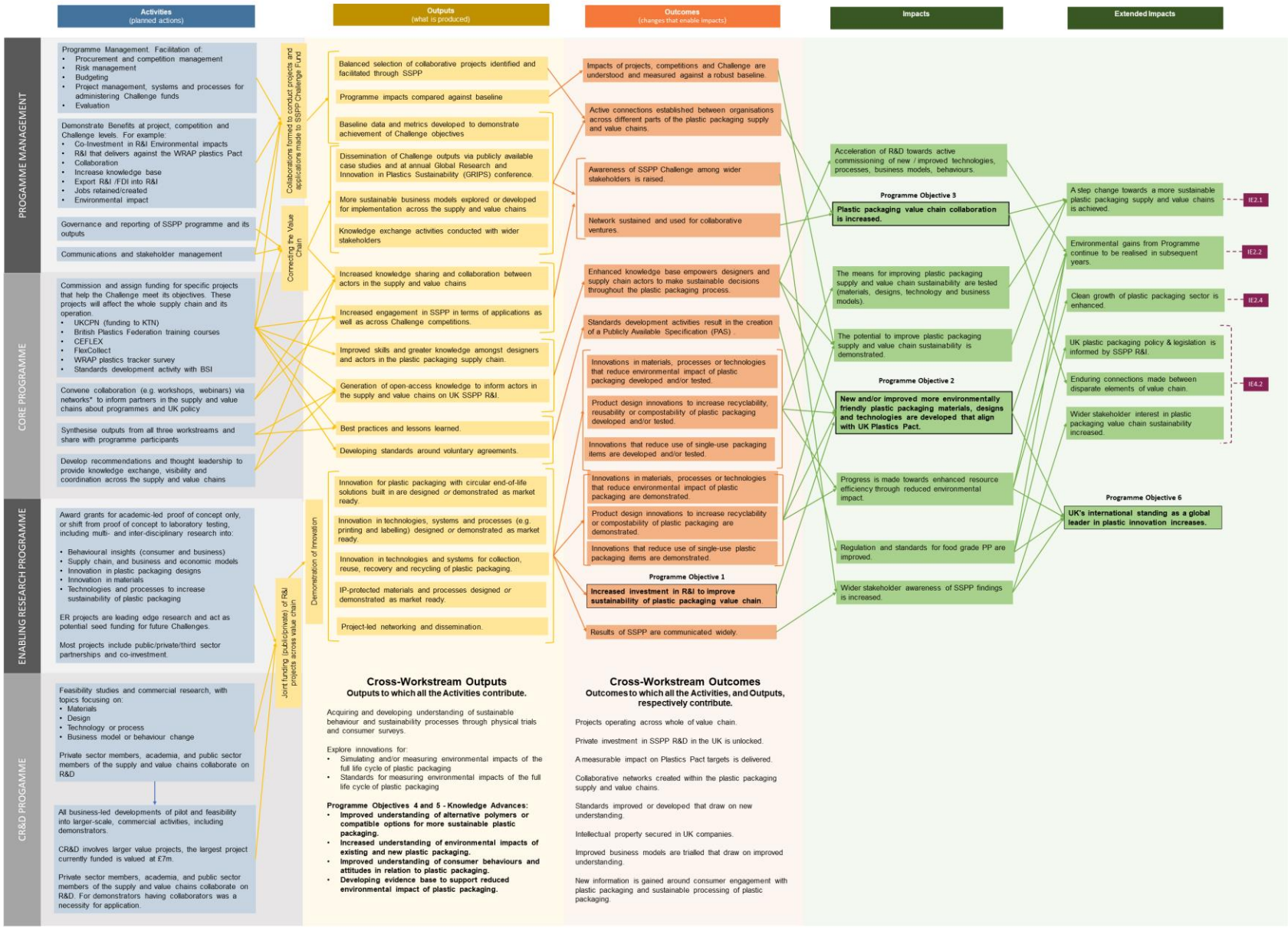
- The assessment made is qualitative without agreed definition of what a low, medium and high contribution should look like. For this reason, if a different individual were to complete the assessment it is possible that the resultant coding may differ.
- The coding has been carried on application forms, and a more robust assessment should be conducted looking at the impacts each project has made following completion or after further progress has been made.
- Each project can contribute to more than one target and as such numbers should not be summed across the four Plastics Pact targets.

Table 36. Qualitative assessment of contribution by competition.

	TARGET 1			TARGET 2			TARGET 3			TARGET 4		
	Eliminate problematic or unnecessary single-use packaging.			100% of plastics packaging to be reusable, recyclable or compostable.			70% of plastics packaging effectively recycled or composted.			30% average recycled content across all plastic packaging.		
Contribution	high	medium	low	high	medium	low	high	medium	low	high	medium	low
Core programme (n=2)	0	0	0	1	0	1	0	0	0	0	0	0
Feasibility Studies for Demonstrators (FS4D) (n=7)	1	1	1	1	1	4	1	4	1	0	1	1
Feasibility Studies & Industrial Research (FS&IR) (n=5)	1	1	0	1	1	0	0	1	1	0	0	2
Future Plastic Packaging Solutions (FPPS) (n=15)	0	6	1	0	1	6	0	1	5	0	0	1
Demonstrators Round 1 (n=2)	0	0	0	0	0	0	1	1	0	0	1	0
Demonstrators Round 2 (n=5)	1	1	0	2	3	0	2	1	1	0	3	1
Enabling Research (ER) (n=10)	0	1	1	2	6	1	2	2	3	0	2	1
Business Led Research and Development (BLR&D) (n=13)	0	0	4	0	6	6	0	4	5	0	5	1
Total	3	10	7	7	18	18	6	14	16	0	12	7

7 Appendix 3 Programme Logic

Then below shows the revised programme logic produced in this Phase of the evaluation.



* e.g. UK Plastic Pact, UK Circular Plastics Network, Alliance to End Plastic Waste, Ellen MacArthur Foundation, Commonwealth Marine Plastics R&I Framework
+ Includes B-2 to B-5

Source: Final Theory of Change agreed with UK Research and Innovation on 17/02/22

8 Appendix 4 Glossary

Terminology	Definition/understanding
Additionality	The extent to which an activity takes place at all, on a large scale, earlier, or within a specific area or target group as a result of an intervention.
Activities	Activities are what is delivered on behalf of the public sector to the recipient
Assessment	Assessment / assess / assessors – the activity undertaken by selected individual (assessors) on all applications to determine the merits of each application against set criteria (assessment guide), typically resulting in an assessment score, which may be used to help rank the applications in an order of merit.
Assumptions	Realist evaluations assume that projects and programmes work under certain conditions and are influenced by the way that different stakeholders respond to them
Benefit	A benefit is the quantifiable and measurable improvement resulting from completion of deliverables that is perceived as positive by a stakeholder. It will normally have a tangible value, expressed in monetary terms that will justify the investment
Benefits realisation	Benefits realisation is the practice of ensuring that benefits are derived from outputs and outcomes
Competition	This includes the following: > Feasibility for Demonstrators (FS4D) - Demonstrators Feasibility Studies and Industrial Research (FS&IR) - Collaborative R&D > Future Plastic Packaging Solutions (FPPS) - Collaborative R&D > Demonstrators Round 1 (D1) – Demonstrators > Demonstrators Round 2 (D2) – Demonstrators > Enabling research (ER) > Business led research and Development (BLR&D)
Core Programme	The core programme does have projects but no competitions. These projects have been/will be funded by SSPP through direct funding. This is done where there is only one organisation in a position to deliver a piece of work which is essential to the overall delivery of the programme, or used to commission projects that we need to deliver in order to meet our objectives but we have not received bids in these areas from our competition applicants and/or we are part funding industry changing work (usually that everyone wants done but nobody wants to fund!) which is being done in collaboration with others.
Impact	An impact is the longer-term benefit or effect from an outcome or intermediate benefit. It may well be the aggregated result of collective benefits. The HEFCE define research impact as “an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia
Inputs	Inputs are public sector resources required to achieve policy objectives

Outcomes	An outcome is the result of the change derived from using the project's outputs and/or capabilities
Monitoring delivery	Monitoring Delivery focuses on project milestones and deliverables
Monitoring Outcomes	Monitoring Outcomes (the product of change) requires looking beyond the lifetime of a project and this supports evaluation and benefit realisation.
Project Outputs	A project's output is any of the project's specialist products (whether tangible or intangible) research or technical.
Project-level indicators	Indicators specified in the SSPP Evaluation framework to be measured at the project level. Where indicators are defined as a selection of measurements used to reflect conditions before, during and after the introduction of an intervention
SSPP Challenge	(1) To prompt innovations in the search for novel polymers suitable for packaging that minimise the environmental impact and are sustainable and viable economically; (2) To facilitate the innovation of novel sustainable polymers and packaging solutions that add value by being smart, for example indicating the freshness of food, or enabling their identification and selective sorting by sensors in a recycling operation; (3) To innovate new ways to reduce the environmental impact of current polymers that are sustainable and viable economically; (4) To support innovative business models that aim to prevent plastic waste or facilitate their collection after discard – for example, refillable bottles, deposit return systems.

Winning Moves | 102 Colmore Row | Birmingham | B3 3AG

www.winningmoves.com

info@winningmoves.com

+44(0)121 285 3800

Registered in England | 03069806