



## INNOVATIVE DIGITAL WATERMARKS AND GREEN SOLVENTS FOR THE RECOVERY AND RECYCLING OF MULTI-LAYER MATERIALS

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### DELIVERABLE N°8.1 Report on KPIs

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## 1 Introduction

This document describes the selected indicators through which technical and non-technical performance can be monitored and performance may be evaluated, ensuring goal completion. The consortium has selected to identify and monitor Key Performance Indicators (KPIs) specific for each WP and where applicable per task.

KPIs are quantifiable metrics that translate measures into simple indicators of performance. Properly framed KPIs will help the consortium track progress, identify risk and navigate between the project development processes. For this project we have identified three different sets of KPIs; technical, marketing and management. The technical KPIs are focused on the technological WPs whereas the marketing KPIs are dissemination and exploitation activities focused and the management ones will be used to measure the running and delivery of the project.

## 2 Methodology

In research and development projects, where innovation is pursued, it is difficult to monitor progress, identify potential risks and track delivery over set timelines. Achieving this requires constant and close monitoring, as well as a continuous evaluation of technical results and experimental outcomes. As opposed to defined analysis or product development, in R&D, it is difficult and in some cases impossible to quantify progress based on a periodic turnover. Analysis is often non-standard and short term targets are commonly unknown in innovation actions. To properly evaluate performance, we have identified performance indicators for each task/WP and defined for each indicator analytical and progress evaluation methods. This way the metrics produced can be used to evaluate the performance and eventually access potential risks and barriers in achieving our goals.



Based on the subject matter, we were able to identify three defined types of KPIs; technical, marketing and management. Technical KPIs refer to indicators relating to the technical and technological developments, evaluation of selections and methods based on research and overall research performance not only in quality but in quantity as well. Marketing KPIs are associated with indicators relating to dissemination and exploitation activities including actions and items released and the quality of the items and quantified reactions and responses on reported project progress, expected impact and overall goals.

Management KPIs are associated with project delivery and include action, task and work delivery and progress monitoring.

### Technical KPIs

Technical KPIs reflect the majority of the indicators to be monitored for this project. For the reasons previously explained, performance indicators have been identified for each task/ WP. This is necessary since each task/ WP is associated with different timelines, actions and deliverables. In this approach, the performance indicators, reference values/metrics and analysis method(s) for monitoring and target(s) have been identified for each WP and further expanded for each task.



### **Marketing KPIs**

Marketing KPIs measure the performances tied with the project's dissemination and exploitation activities and specifically all tasks within WP8. These will monitor the effective dissemination of the project overall, communication of the project objectives and technological developments and check reactions and responses that will eventually lead to the successful exploitation of the technology.

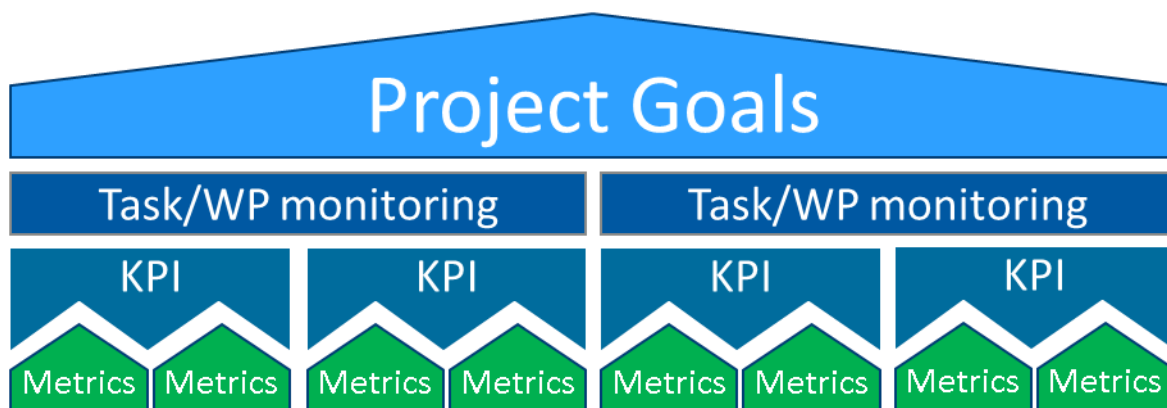
Marketing KPIs are different to marketing metrics in the sense that the KPIs measure the effectiveness and progress over time, whereas the metrics only provide quantitative results without necessarily analysing the effectiveness of the campaign.

Marketing KPIs are defined on the marketing campaign or, in other words, the agreed dissemination strategy. Common examples of Marketing KPIs are the conversion rate, total number of clicks, likes or views, website traffic and release topic popularity. In KPI monitoring of this nature, it is very important to measure visibility, popularity and key words over specific dissemination pieces to evaluate audience appeal and launch a successful campaign.

### **Management KPIs**

Management KPIs are used to monitor the success of management of activities, task(s), WP(s) or projects. Essentially, they monitor the performance in delivery of the aforementioned items against the project timelines and budget. In Sol-Rec<sup>2</sup> successful (on-time and appropriate technical quality) submission of deliverables and tasks, meeting timelines, ensuring proper effort distribution to reflect the budget allocation and successfully meeting milestones are subjects that will be monitored through selected indicators to evaluate performance and on time delivery.

In Sol-Rec<sup>2</sup>, to establish the appropriate KPIs that will effectively monitor the consortium's performance and ensure all project objectives are met, the following methodology was applied. Initially, indicators were identified per task or per task key activities. To quantify and evaluate the performance, reference values were appointed for each identified indicator. To ensure that the most appropriate indicators are appointed, the applied method was also described. In addition, to confirm compliance with the agreed project objectives the indicator target, as described in the DOA, was also described. Finally, to better manage all indicators and associated values, the information was tabulated per task and WP, indicating associated milestones, targets methods and reference. As depicted in the figure below, specific task metrics collected over set references and/ or periods will populate KPIs, which in turn will be evaluated allowing for task monitoring and ensuring that project goals have been achieved.



*Figure 1: Project delivery plan through KPI monitoring*



### 3 KPI Summary tables

As per the described methodology, the tables below describe the monitored indicators and all relevant information for performance evaluation.

Technical KPIs cover WP1-6, marketing KPIs are covered within WP8 and management KPIs by WP9.

#### Technical KPIs

##### WP1- Consumer surveys and consultation with key industrial players

Task	Performance indicator	Reference	Method	Target	MS
1.1	Survey size	Recommended size	Survey (digital and paper)	300 participants per state	MS1
	Achieved diversity of participants (age, country and background)	Overall survey	Diversity enclosure	Desired demographic as per the DoA	
	Responses	Sent invitations	Email, webpage, social media and personal invitation	>2000 (~300 x 8 states)	
1.2	Number of industries contacted	Industry response	All means of communication	>7	
1.3	List of attendees Feedback received (e.g. questions)	Workshop registrations	Webinar	Attendance of >50 % of registrations	

##### WP2- Determine composition of laminate pouches and pharma blister packs

Task	Performance indicator	Reference	Method	Target	MS
2.1	Obtained samples of laminate packaging	Collection point	Procurement from specific collection points	20 kg per collection point	
2.2	Number of tests/analysis on laminate packaging	Time (bi-weekly), special reference on polymer type, number and thickness of layers	User guide of selected practices to determine the nature of layers" (Anja Mieth, Eddo Hoekstra, Catherine Simoneau; EUR 27816 EN; doi: 10.2788 / 10593), applied to each of the multilayer residues. FTIR, DSC, TGA, SEM-TEM	Separation of layers	MS4 (M6)
2.3	Number of tests/analysis on blister packaging	Time (bi-weekly), special reference on composition of multilayers	FTIR, DSC, TGA, ICP-OES	Separation of layers	



WP3 - Waste sorting, washing and shredding options

Task	Performance indicator	Reference	Method	Target	MS
3.1	Successful applications of developed watermark	Number of trials	FIL technology	500 laminate pouches	
3.2	Method/trial success	Number of trials	NIR	95 % separation 30 % faster than existing technologies	MS2 (M5)
3.3	Decontamination efficiency	Number of decontamination trials per method	TBD	Complete decontamination	
3.4	Delamination and selective dissolution efficiency per shredding method	Shredding method (particle size and contamination)	Electrostatic and triboelectric separator	Efficient delamination and selective dissolution 95 % separation 30 % faster than existing technologies	MS5 (M10)

WP4 - Development of toolbox of solvents for selective polymer dissolution

Tasks	Performance indicator	Reference	Method	Target	MS
4.1	Ionic liquids selected Number of ILs synthesised	Time (bi-weekly performance results)	Hildebrand solubility parameters Test tube synthesis using ultrasonication and/or stirring	Prepare a toolbox of low-cost IL solvents suitable for selective polymer dissolution. >50 recipes	MS3 (M5)
4.2	Dissolution trials over time (for each polymer) Successful dissolution over time (for each polymer)	Time (bi-weekly)	1-5 mm pieces, subjected to dissolution trials in 50 ml reactor Viscometer, FTIR	Selective dissolution of PVC, PE and PP Dissolution kinetics - normalised dissolution	
4.3	Methods improvements achieved	Monthly	TBD	Desirable temperature, stirring time, ultrasonication time and solid loading	MS6 (M13)
4.4	Number of experiments achieved	Per polymer Time (bi-weekly)	FTIR	Convenient dissolution rates	
4.5	Successful dissolution	Dissolution trials over time (for each blister and or laminate package)	FTIR and SEM/EDX	Optimised dissolution rates	



WP5 - Design novel polymer recovery/ purification processes

Task	Performance indicator	Reference	Method	Target	MS
5.1	Dissolution trials	Number of trials	Quantitative estimation of the dissolution process aided by FTIR (5 ml aliquot). Temperature, stirring time, ultrasonication time and solid loading will also be studied.	Effective dissolution (in 1 litre scale), within desirable conditions as per WP4	MS7 M(21)
5.2	Amount of polymer recovered in each trial	Initial amount obtained Monitored per trial	Filtration / precipitation. Aqueous two-phase or organic extraction	Efficient recovery system	MS8 M(27)
	Amount of IL, organic solvent, or additive remaining after filtration				
5.3	Separation efficiency per trial	Initial results Monitored per trial	TBD	Effective separation/ isolation of AI from the mixture	MS9 M(27)
5.4	N/A				
5.5	Number of analysis	Time	FTIR. SEM/EDX, GPC*, rotary viscometer, DSC	Development of analysis method	MS9 M(27)

WP6 - Process scale up and pilot plant validation studies

Task	Performance indicator	Reference	Method	Target	MS
6.1	IL synthesis efficiency, QA/QC data (more of a milestone will be monitored to manage risks)	Monitored in ml/hour (per method if applicable )	Volumetric funnel, ion chromatography, NMR, IR, UV, DSC, density and viscosity	100 litres of the selected IL	
6.2	N/A - Milestone activity			50-100 litres HAZCHEM reactor to be built Factory Acceptance Test (FAT) and Performance Acceptance Test (PAT)	
6.3	Validation results obtained per study subject and trial	Number of studies Time	Validation trials applied on three selected classifications of multi-layer waste. Pharmaceutical blister waste (PVC/aluminium); laminate multi-layer packaging waste with PE, PP	A minimum of two validation batches per material (specimen size of >5 kg) will be carried out	MS10 M(31)

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6.4	Quality analysis performed, number of performance comparison	Time (bi-weekly)	FTIR. SEM/EDX. GPC,,DSC. Analytical methodology obtained from 5.5	Quality report, indicating the comparative results of the obtained and commercially available products	
6.5	Number of products fabricated	Product type, Time (weekly)	TBD	Lighting insulation, sewer covers etc.	MS11 M(36)

#### WP7 - Sustainability analysis from a life cycle perspective

Task	Performance indicator	Reference	Method	Target	MS
7.1	N/A, WP covered through managerial KPIs, Individual task covered by technical and marketing KPIs	N/A	N/A	Completion of LCA	MS12 M(36)
7.2					
7.3					
7.4					
7.5					

#### **Marketing KPIs**

#### WP8 - Dissemination and exploitation

Task	Performance indicator	Reference	Method	Target	MS
8.1	Webpage traffic	Quarterly	Site/item monitoring	Increased rate per reference period	
	Social media releases	Monthly			
	Results and items published	Quarterly			
	Page likes and follows	Monthly			
	Number of conferences, dissemination events (webinar) participated	Quarterly			
	Responses or interest received	Per event/per quarter			
8.2	N/A				
8.3	Number of exploitation activities	Quarterly	Market analysis, SWOT, cost benefit analysis, LCA	High market interest, engagement with ten potential clients	MS13 M(36)
	Responses or interest received	Quarterly			





## Management KPIs

### WP9 - Project management

Task	Performance indicator	Reference	Method	Target	MS
9.1	Technical performance, submission	Trend of overall KPIs Timelines	Technical KPI evaluation, project monitoring	Technically credible on-time delivery	
9.2	Effort and Budget monitoring	Financial claims over time	Microsoft project management, Excel	On-time delivery within budget	
9.3	Project delivery	Project timelines	Submission EC Portal	On-time project delivery	

## 4 Summary

A raft of KPIs have been identified and specified, these will allow the Sol-Rec<sup>2</sup> project partners to monitor performance, project/task progress over time and potential unforeseen risks in the process. By collecting metrics from the appointed performance indicators and evaluating over the reference and project targets, the consortium will be able to reach the project goals and achieve best performance. In Sol-Rec<sup>2</sup> we will be tracking the indicators for each WP for the duration of each task, and metrics will be captured at the defined frequency of each indicator. The collected metrics and KPI analysis will be reported in the upcoming deliverables D8.3 and D8.5.