

SUSTAINABLE PROCESS INDUSTRIES CPPP

EXECUTIVE SUMMARY OF PMR FOR 2016

EXECUTIVE SUMMARY OF THE PMR'17 MAIN CONCLUSIONS:

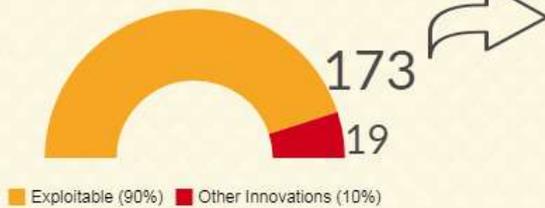
a) Infographic

SPRE - 2016 key facts



**ENVIRONMENTAL
IMPACTS**
Expected by 2030

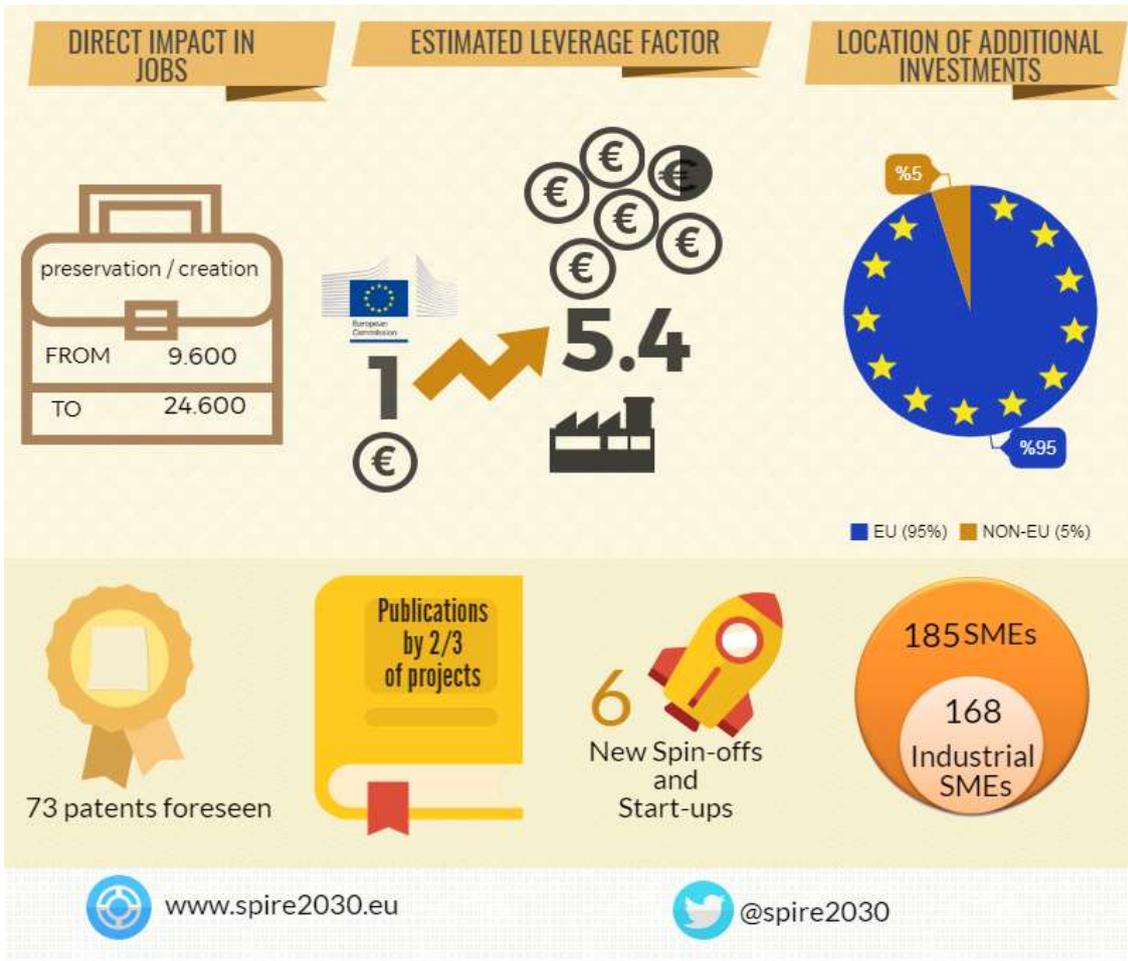
192 RESULTS



OBJECTIVES

INNOVATIVE SYSTEMS AND TECHNOLOGIES

	OBJECTIVE 2020	ON-GOING (by 2016)
	40	173
ALTERNATIVE FEEDSTOCK	7	6
REDUCTION AND RE-USE OF WASTE	6	9
CO ₂ REDUCTION	9	8
NOVEL MATERIALS	8	10
REDUCING WATER USE	6	8
INDUSTRIAL SYMBIOSIS	4	4
OTHER EXPLOITABLE TECHNOLOGIES	NOT FORESEEN	128



b) Summary

INTRODUCTION

SPIRE cPPP was officially launched in December 2013 in the framework of Horizon 2020, with the objective of tackling the challenge of rejuvenating the European process industry, making it more competitive and sustainable, with positive strategic ramifications over the entire European economy and society.

SPIRE cPPP has the mission of developing enabling technologies and best practices along value chains in the 8 world-leading European process industry sectors (cement, ceramics, chemicals, engineering, non-ferrous metals, minerals, steel and water) to contribute to a resource-efficient process industry.

SPIRE implements its Research and Innovation Roadmap ([link](#)) through six Key Components that have been covered by the different topics between 2014 and 2016 as shown in the following table*:

Component	Key Action	2014	2015	2016	Total		
FEED	KA 1.1		SPIRE-07-2015 (3)	SPIRE-05-2016 (1)	2 Topics (4)	7 Topics (19)	20 Topics (54)
	KA 1.2	SPIRE-02-2014 (3) WASTE-01-2014 (5)	SPIRE-07-2015 (3)	LCE-25-2016 (1)	4 Topics (12)		
	KA 1.3			SPIRE-01-2016 (3)	1 Topic (3)		
	KA 1.4	SPIRE-02-2014 (3)		SPIRE-03-2016 (3)	2 Topics (6)		
PROCESS	KA 2.1		LCE-02-2015 (2)	SPIRE-04-2016 (3) LCE-25-2016 (1)	3 Topics (6)	14 Topics (38)	
	KA 2.2	EE-18-2014 (1)	EE-18-2015 (3)	EE-17-2016 (2)	3 Topics (6)		
	KA 2.3	SPIRE-01-2014 (5)	EE-18-2015 (3)	SPIRE-02-2016 (4) EE-17-2016 (2)	4 Topics (14)		
	KA 2.4	SPIRE-03-2014 (1)	SPIRE-05-2015 (5) SPIRE-08-2015 (1)	SPIRE-04-2016 (3) SPIRE-06-2016 (1)	5 Topics (11)		
	KA 2.5	WASTE-01-2014 (5)	SPIRE-06-2015 (4)	SPIRE-06-2016 (1)	3 Topics (10)		
APPLICATIONS	KA 3.1			SPIRE-04-2016 (3)	1 Topic (3)	2 Topics (8)	
	KA 3.2	WASTE-01-2014 (5)			1 Topic (5)		
WASTE2RESOURCE	KA 4.1	SPIRE-04-2014 (3) WASTE-01-2014 (5)		SPIRE-05-2016 (1)	3 Topics (9)	7 Topics (23)	
	KA 4.2	WASTE-01-2014 (5)	SPIRE-05-2015 (5) SPIRE-07-2015 (3)		3 Topics (13)		
	KA 4.3	WASTE-01-2014 (5)		SPIRE-03-2016 (3)	2 Topics (8)		
	KA 4.4	WASTE-01-2014 (5)		SPIRE-01-2016 (3)	2 Topics (8)		
HORIZONTAL	KA 5.1					1 Topic (3)	
	KA 5.2	SPIRE-04-2014 (3)			1 Topic (3)		
	KA 5.3						
	KA 5.4						
OUTREACH	KA 6.1						
	KA 6.2						
		6 Topics (18)	6 Topics (18)	8 Topics (18)	20 Topics (54)		

(X): Number of funded projects

* It is important to keep in mind that a single Topic can address several Key Actions (KA) from the Roadmap (e.g. SPIRE-02-2014 addresses both KA 1.2 and KA 1.4). Projects also can address more than one KA. This cross-relation is shown in the table, while total figures shown in the last row and the last 2 columns need to consider the Topics (Projects) only one time in order to provide an accurate information. For example:

- Total for year 2014: there were 6 different topics that funded 18 different projects
- Total for KA 4.1: addressed by 3 different topics with 9 projects involved
- Total for “Waste2Resource”: addressed by 7 different topics with 23 projects involved
- Total for SPIRE “Roadmap”: addressed by 20 different topics with 54 projects involved

OPERATIONAL SUMMARY

In 2016, the SPIRE PPP has witnessed:

- The end of 3 projects (CSA’s from SPIRE-04-2014)
- The mid-term milestone (average of 69% of their activity by the end of 2016) of the unfinished projects related to 2014 calls (15)
- The consolidation (average of 45% of their activity by the end of 2016) of projects related to 2015 calls (18).
- The actual start of projects related to 2016 calls (18)

The 2016 calls were in line with the priorities defined in the Multi-Annual Roadmap both in terms of themes as well as of time horizon. The targets anticipated in the publishable project synopsis are well in line with the main KPIs in the Multiannual Roadmap in terms of economic (including intellectual property generated and growth potential), environmental & social benefits.

The projects funded within the 2016 call include research and innovation covering several fields such as valorisation of waste heat, systematic approaches for resource-efficient water management systems, plant-wide monitoring and control of data-intensive processes, valorisation of bio-resources into high added value process streams, industrial furnace design, potential use of carbon dioxide / carbon monoxide and non-conventional fossil natural resources as feedstock for the process industry, and business models for flexible and delocalised approaches. In this framework, the SPIRE PPP projects have a clear KET / Multi-KET element and address areas of high policy interest such as COP21, Energy Union, Circular economy and Industrial Symbiosis.

FULFILMENT OF SPECIFIC OBJECTIVES – CONTRACTUAL ARRANGEMENT

SPIRE projects are achieving and even overpassing the goals on creation of innovative systems and technologies established by the PPP and the roadmap. At the third year of H2020, SPIRE projects have already created (or are creating) more than the 40 targeted innovative systems and technologies required at contractual level. Some relevant examples are:

- Reuse of back flush and process waters and alternative water sources in steel industry (project SPOTVIEW);
- Direct heat exchange ORC technology for Energy Intensive Industries (project TASIO);

However, as most of these innovations are under development, the success and real deployment of such technologies is however to be assessed by the end of the projects.

TARGETS OF SPIRE PPP – COMPARISON TO THE CURRENT STATUS

OBJECTIVES: innovative systems and technologies	OBJECTIVE 2020	ON-GOING (by 2016)
TOTAL	40	45 + 128
Adaptable processes able to use different feedstock	7	6
Reduction and re-use of waste with ambition to close the loop	6	9
Innovative processes leading to CO2 reduction	9	8
Green technologies to develop novel materials for new and existing markets	8	10
Industrial processes reducing water use	6	8

OBJECTIVES: innovative systems and technologies	OBJECTIVE 2020	ON-GOING (by 2016)
Technology uptake within/between sectors to enable industrial symbiosis	4	4
Other exploitable technologies, processes and methods (systems, tools, modules, algorithms, etc.) that are complementary to one or several of the above mentioned	Not foreseen	128

BUSINESS IMPACT

SPIRE projects are strongly oriented to the delivery of impacts in the market, as current projects devote 30.55% of their budget (€71.380.489,45) to **demonstration activities and prototyping**.

Nowadays, there are 192 results produced by the SPIRE projects, and more than **90% of these results will be exploitable (173)** while the rest (19) will be other innovations. According to the data provided in the 42 Project Questionnaires collected, the status of progress of these 173 new systems and technologies is the following one: 7 (4%) already developed, 134 (77%) on-going, 32 (19%) planned. The real exploitation and deployment of the results needs to be assessed once the projects have finished.

One key aspect found in the analysis is that 58% of the projects declared that **time to market** (when the first commercial product/process/service reaches the market) will be reduced thanks to SPIRE support, being the reduction time around 24 months on average.

SPIRE projects show a **good balance between exploitation**, that will generate market and societal impact, **and Open Innovation**, that will generate knowledge impact by making results more accessible to all societal actors in public and private sectors:

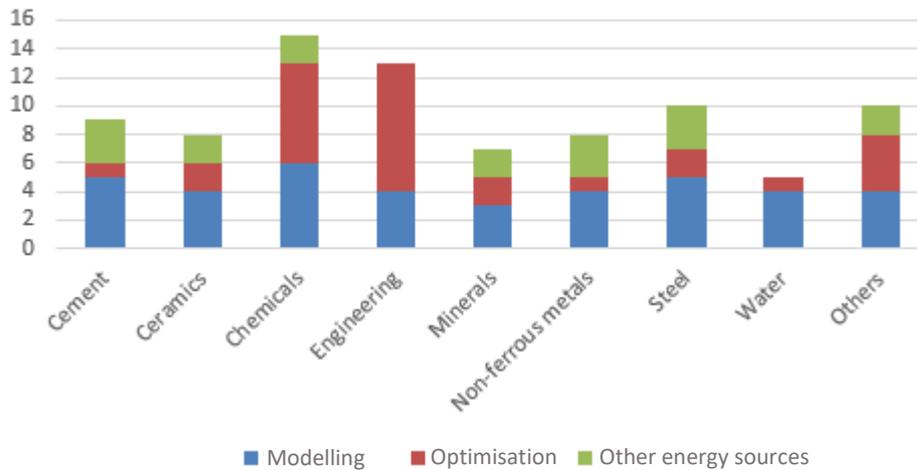
- **Patents:** 73 results will be patented, with 63 cases of direct exploitation of the patents by project partners. 9 projects have already applied for 14 patents (none of them have been awarded yet).
- **Publications:** 58.5% of SPIRE projects foresee publishing of results in scientific articles.

Almost all the SPIRE projects plan to make a broad use of projects' results (exploitable and other innovations) in their own sectors, but they also plan to **transfer results to other sectors**.

On the one hand, as shown in FIGURE A.1, the potential sectors for transferability of results for the 22 projects in area I (PROCESS), are Chemicals (15 projects - 68%) and Engineering (13 projects - 59%). Nevertheless, there are slight differences at sub-area level:

- Modelling – 7 projects: Chemicals (6 projects - 83%); Cement (5 projects - 67%); Steel (5 projects - 67%).
- Optimisation – 9 projects: Engineering (9 projects - 100%); Chemicals (7 projects - 78%).
- Other energy sources – 6 projects: Cement (3 projects - 50%); Steel (3 projects - 50%); Non-ferrous metals (3 projects - 50%)

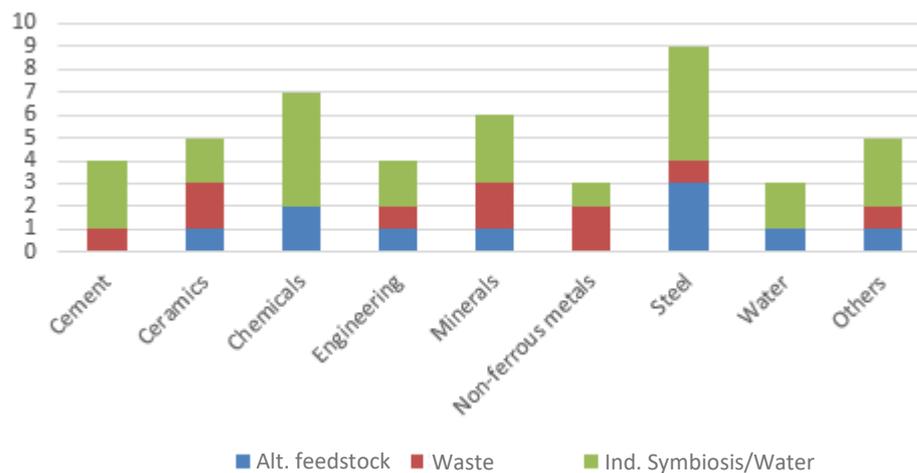
FIGURE A.1: TRANSFERABILITY OF AREA I (PROCESS) RESULTS TO OTHER SECTORS



On the other hand, as shown in FIGURE B.1, the potential sectors for transferability of results of 17 projects in area II (SUSTAINABILITY) are Steel (9 projects - 53%) and Chemicals (41%). At sub-area level (see FIGURE B.2), the 5 projects in sub-area Industrial symbiosis/Water are significantly active in transferring results if compared with the other sub-areas (Alternative feedstock and Waste). The options are as follows:

- Alternative feedstock – 7 projects: Chemicals (3 projects - 43%); Steel (2 projects - 29%).
- Waste – 5 projects: Ceramics (2 projects - 40%); Minerals (2 projects - 40%); Non-ferrous metals (2 projects - 40%)
- Industrial symbiosis/Water – 5 projects: 5 projects: Chemicals (5 projects - 100%); Steel (5 projects - 100%); Cement (3 projects - 60%); Minerals (3 projects - 60%).

FIGURE B.1: TRANSFERABILITY OF AREA II (SUSTAINABILITY) RESULTS TO OTHER SECTORS



Finally, it should be highlighted that 60% of the projects plan to **contribute to standards**. In fact, up to now, over 1/3 of the projects have already contributed to 25 documents (on average 2 contributions per project).

ENVIRONMENTAL IMPACT

Given the scope of the SPIRE cPPP, all its projects are delivering contributions to reductions in energy use and CO₂ emissions except for the CSAs as it is out of their scope. However, their levels vary depending on the areas and projects, on their exact scope and on the type / level of technology developed.

The main contributions from the projects will help to:

- Reduce GHG emissions due to energy use reductions (improvements in efficiency of processes), but also due to the use of alternative feedstock (renewables, bio-based fuels, gas, etc.).
- Better management of waste due to improvements in reuse of waste, material recycling, waste minimization and prevention.
- Reduce the use of raw materials due to recovery of water, the improvement of the operation of existing equipment, etc.

While all SPIRE projects are still ongoing (except 3 CSA’s that are not relevant for this impact), we can estimate that we are on track towards the achievement of the SPIRE overall targets as shown in TABLE B (estimations at full deployment):

TABLE B – ENVIRONMENTAL IMPACT OBJECTIVES COMPARED TO PPP TARGETS

Contribution to...	OBJECTIVE (at contract level)	ESTIMATED (2030)
Reduction in fossil energy intensity	up to 30%	20%
Efficiency improvement of CO₂ equivalent footprints	up to 40%	25%
Reduction in non-renewable, primary raw material intensity	up to 20%	20%
Reduction of waste	Not defined	27.8%

The full deployment time for each project is different and varies from 2020 till 2030 (in some limited cases 2040). The estimation by 2030, when most of these technologies should be deployed, is expected to be close to the targets in most cases. It is important to highlight that these are average values and that these expectations need to be confirmed both at the end of projects execution and in the deployment phase.

SOCIOECONOMIC IMPACT

In terms of **SMEs participation**, the project statistics continue to be encouraging: 208 participants (from 185 different organisations)¹. Other related data are:

- Share of participation of SMEs in SPIRE projects: 28.03%
- Average participation rate of 3,85 SME’s/SPIRE project.
- Estimation of the increase in turnover in SMEs participating in the PPP projects (in the deployment stage): 11.2%

¹ Full number of SME participations is 208 (from 185 different organisations), but if we consider Private for-profit Organizations (PRC) the figure is reduced to 181 SME participations (from 168 different organisations)

- Estimation of the increase in number of employees for SMEs participating in the PPP projects (in the deployment stage): 16.6 (on average)

Clearly, the SPIRE projects have already identified areas where SMEs could benefit from the new value chains which are being created.

In terms of new high-skilled profiles, current SPIRE projects have stated to be defining **58 new types of high-skilled jobs** (Contractual Arrangement target: 10). These profiles will need to be validated along the life of the projects. We could foresee that some profiles could be deleted, reworked or merged depending on the evolution of the technologies and the markets. Further actions would be needed in this sense (e.g. define the competences of each profile defined; establish the competences as part of educational curricula). This is out of the scope of current SPIRE calls and it will not be covered either by the WP2018-20. Thus, the risk is that these profiles do not match the relevant skilled work force. Options to address the need to ensure the validation of these profiles and potential educational actions need to be defined. Projects through other EU programmes (e.g. Erasmus+) or other types of actions with the support of A.SPIRE’s Horizontal WG could be considered.

This is complemented by different impacts in terms of **educational** aspects:

- 141 PhD students (3-4 per project on average)
- 62 bachelor and master theses being written
- 23 courses + trainings

SPIRE projects have already resulted into **6 new Spin-offs and Start-ups**. In addition, 14 organisations (9 IND – 5 SME) identify potentiality to generate Spin-offs and Start-ups in the future.

Moreover, it is also highlighted that SPIRE support also contributes to **jobs preservation/creation**. According to the Projects’ Questionnaire, at least 30 projects have currently confirmed a direct impact on a range from 9,600 to 24,600 jobs, considering both preserved and created jobs. Total indirect impact once the technologies deployed can be over 5 M jobs.

LEVERAGE FACTOR

For the first SPIRE batch of projects funded within the 2014-2015-2016 calls, the overall co-financing contribution by the industrial partners and corresponding EC contribution is shown in the table below.

INDUSTRIAL / EC CONTRIBUTION IN SPIRE PROJECTS

(Data in EUR Million)	2014	2015	2016	TOTAL
Industrial contribution to eligible costs	18	10	12	40
EC contribution	113	94	99	306
Total SPIRE Projects budget	<i>131</i>	<i>104</i>	<i>111</i>	346

58% of project results is foreseen to be taken-up for further investments (into higher TRLs), and based on the data provided by 37 companies these investments are foreseen to reach ~ 754 million euros. Considering the amounts from previous table B (40 million euros of private contribution / 306 million euros of EC contribution), we obtain a leverage factor of 2.6 (Total amount of funds

leveraged through the cPPP (including additional activities), divided by the EU contribution to the PPP projects).

However, if we consider that this data is taken only from 37 companies due to current uncertainties associated to mid-term execution of projects and to confidentiality issues, it looks reasonable to extrapolate the data from all the companies replying to the questionnaire (79). Thus, we could estimate a figure of around **1,611 million euros** of additional investments mobilised in other R&I activities related to the SPIRE PPP. This yields an estimated leverage factor of **5.4** at deployment level.

Another fact that supports the estimated leverage factor of 5.4 is that currently 54 SPIRE projects actually involve **389 different industrial organisations, 168 of them being industrial SME's**. This relevant involvement in the projects from the private sector shows a strong commitment and interest in the SPIRE activities.

Finally, another important data highlighted from the questionnaires received from the companies is that more than 95% of the ~ 754 million euros is going to be invested in the European Union territory, supporting the localisation of knowledge-based activities and infrastructures in the EU and ensuring high-quality jobs for the European citizens.

MAIN A.SPIRE-DRIVEN ACTIVITIES

As A.SPIRE-driven activities (addressed to members and non-members), we can mention:

- A.SPIRE Community day (18 February 2016): 120 attendees.
- A.SPIRE brokerage event (June 2016) where extensive exchange of views, consultations and networking have brought more than 150 attendees
- An event dedicated to the new projects composed by Projects' conference (20 April 2016) with 90 attendees and SPIRE projects' communications meeting (21 April 2016) with over 30 attendees. This event allowed SPIRE projects to introduce themselves and present their aspirations and objectives to the whole SPIRE community.
- SPIRE WGs day (September 2016): 90 attendees.

COMMUNICATION

Certain communication tools and techniques have been identified, put in place and made available for the projects. They include the annual SPIRE projects' dissemination conference, the SPIRE web-based platform, the SPIRE label which provides visibility and recognition among targeted stakeholders, co-organised events, thematic discussions, online and print publications, social media campaigns.

MAIN COMMUNICATION ACTIONS

ACTION	Main facts and figures
SPIRE Newsletter	4 editions in 2016 More than 1300 active subscribers
SPIRE website	Sessions: 28,434

	<p>Users: 16,232 Page views: 98,410 Unique page views: 72,045 Average session duration: 00:03:27 Bounce rate: 47%</p>
Twitter @SPIRE2030	More than 750 followers
Videos	16 introductory videos to SPIRE projects from 2014 - 2015
Brochures and other printed material	<p>SPIRE Brochure (available in printed version and <u>online</u>) SPIRE Roadmap (available in printed version and <u>online</u>) SPIRE-2014 projects' brochure (available in printed version and <u>online</u>) SPIRE-2015 projects' brochure (available in printed version and <u>online</u>) SPIRE-2016 projects' brochure (available in printed version and online)</p>
Events	<p>Community day (18 February 2016) – 120 participants SPIRE projects' communications meeting (21 April 2016) - >30 participants Projects' conference (20 April 2016) - 90 participants Brokerage (June 2016) – 150 participants SPIRE WGs day (September 2016) – 90 participants</p>