Project SOPHIA

PhotoVoltaic European Research Infrastructure

GA N° 262533

Data Beneficiary

Name Beneficiary	ECN
Contact person	Jan Kroon
Postal address	PO Box 1, Petten, Netherlands
E-mail	j.kroon@ecn.nl
Project Website	www.sophia-ri.eu

NA2: Expert groups for a PV Infrastructure Strategic Vision

D2.4 (M24) – Working draft of strategic vision document on PV Research Infrastructure

Proprietary rights statement
This document contains information, which is proprietary to the SOPHIA consortium. Neither this document, nor the information contained herein, shall be used, duplicated or communicated by any means to any third party, in whole or in parts, except prior written consent of the SOPHIA consortium.

Document Information

Document Name	**SOPHIA_D2.4(M24).doc**
Revision	~~Final~~ | Draft
Due date Annex I	M24
Author	Maarten de Bruijne, Greg Arrowsmith, Jan Kroon
Dissemination Level	~~Public~~ | ~~Restricted~~ | Confidential

Document approval

Name	Position in the project	Beneficiary	Date	Visa
Philippe Malbranche	Coordinator	CEA	30.12.2013	PM

Document history

Revision	Date	Modification	Author
V0	20/06/2013	Creation and first version submitted to Coordinator	Greg Arrowsmith/ Maarten de Bruijne
V1	7/11/2013	Included input Stephanie Ruguet. Output Chambéry discussion added.	Greg Arrowsmith/ Maarten de Bruijne
V2	23/12/2013	Included input from Excom and topic leaders	Greg Arrowsmith/ Maarten de Bruine/Jan Kroon

Table of contents

1. Executive summary

1.1 Description of the deliverable content and purpose

This document is the working draft of D2.4 "Strategic vision document on PV Research Infrastructure". It is a snapshot of its status at M33; the final version is due on M48. The deliverable, named Strategic Research Infrastructure Agenda (SRIA), includes inputs from all topic leaders and their expert groups within the SOPHIA consortium: silicon materials, organic PV, thin films, concentrator PV, module lifetime, module and system performance and building-integrated PV.

The activity to generate a joint strategic vision on PV research infrastructure with the NA2.1-NA2.8 expert groups has been kicked off at the NA02 meeting in Frankfurt in September 2012. The goal of that meeting was to decide on the context, scope and structure of the Strategic Research Infrastructure Agenda (SRIA). At the M18 meeting in Brussels in October 2012, Chapter 1 and 2 were discussed in more details. It was agreed to start with a trend analysis (Chapter 2); Chapter 1 on European PV research infrastructure in figures will be included in the final version of the SRIA. A questionnaire on trends in PV research infrastructure was sent out to the expert groups to generate content. The draft version of Chapter 2, which is included in this deliverable, has been discussed during the SOPHIA General Assembly meetings of April 2013 in Chambery and November 2013 in Berlin and during a telcon with ExCom and topic leaders end of November 2013. To generate content of Chapter 4 of the SRIA document, new questionnaires were sent out to topic leaders in September and input collected in November/December. At this stage of the process all the input is processed and consolidated and will be used to generate text for Chapter 4 .

The SRIA should serve as an input for policy makers at national and EU level (e.g. next ESFRI revision, 2020 Roadmap). In addition, it can be used as a marketing tool for the SOPHIA consortium. The focus is on the short to medium term (2015-2020).

1.2 Deviation from objectives, corrective action

A first version of D2.4(M24) was uploaded to the Coordinator in June 2013. The current version (v2), includes the outcome of the NA2 discussion during the General Assembly in Chambéry and Berlin. The minutes of the discussion are added as annex to this report. The final version of D2.4 will be delivered M48.

1.3 Technical progress

N/A

1.4 Impact of the results

Shortly after the General Assembly meeting in Chambery (April 2013), contact has been made with the ESFRI (European Strategy Forum on Research Infrastructures) to discuss what input the SOPHIA consortium could provide. In 2014, this contact will be intensified to create the maximum impact for ths document.

1.5 Dissemination activities carried out, planned

A two-day 'Final Forum' will be organized by the end of the project (month 48), most probably in M44 during the 29th European PVSEC taking place in Amsterdam (22-26 Sept 2014). We will aim to attract 30 external participants to the forum to listen to presentations of the results of the project from SOPHIA partners. It is expected that among the results to be discussed will be the NA2.9 report offering a vision of PV research infrastructure in Europe.

2. Overall structure of the SRIA

The chapters of the SRIA are represented in the subsections of this chapter. Notes about the content have been placed between square brackets.

2.1 Introduction

[Overall objectives, relation to other vision documents]

2.2 Chapter 1 : European PV RI in figures

[Content will be based on overviews of RI at the SOPHIA partner institutes. These overviews have been made and are updated within several work packages/expert groups of the SOPHIA consortium. The data will be included in the final version of the SRIA.]

2.3 Chapter 2 : Trends in PV RIs

[Draft version included in Chapter 3 of this deliverable. The content is largely based on input collected from questionnaire inside the consortium. It has been discussed quite intensively with ExCom and topic leaders (see Annex 1 and 2). It was generally agreed that there is a need to get the view of the "clients", including (or especially) industry, to bring in other opinions. The text will be put on consultation to other stakeholders, for instance the EU PVTP General Assembly]

2.4 Chapter 3 : Recommendations: how to correct undesirable trends and strengthen desirable trends

[Some input can be derived from the first questionnaire. Chapter 3 to be filled after Chapter 4.]

2.5 Chapter 4 : Upgrading the capability of EU PV RIs

[The questionnaire on Trends in PV RIs provides some content. A second questionnaire will provide input about research infrastructure needed and priorities. It has been sent out to the expert groups by ECN and EUREC in September 2013. The aggregate results have been discussed by the Topic Leaders in a meeting in Berlin in November 2013 and during a telco on 27 November 2013 (see Annex II). It was recognized that, besides the input that was generated within the topic expert groups, a broader view beyond SOPHIA is needed. It was decided to use long term technology roadmaps like the Strategic Research Agenda (SRA) to frame the discussion and translate from the recommendations given in the SRA.

2.6 Chapter 5 : Topics to be addressed in world-wide RIs and Outlook

[Chapter 5 to be filled in after finishing all the first sections].

3. Chapter 2 - Trends in PV research infrastructure (draft)

What is research infrastructure

Research infrastructure as understood in this document is the scientific apparatus needed to carry out an experiment. The complex in which it is housed is the "research centre". In the context of the SOPHIA project, research infrastructure might be a climate chamber for accelerated ageing tests, test rigs to simulate faults on the grid and analyse the response of inverters or a synchrotron for probing the structure of materials. A pilot line and the equipment manufacturing devices on it may also be described as research infrastructure (These are crucial for developing and testing novel manufacturing processes ahead of their transfer to industry. CEA-INES and RSE have respectively invested in an heterojunction and a multijunction cell manufacturing facility, while in the OPV community roll-to-roll printing equipment is being installed at an increasing number of sites). The line might be being used to test the manufacturability at high throughput of a new process. Also, a 1-2 MW array of mountings that tests different solutions for dealing with feed-in to the grid could be considered research infrastructure. More research infrastructures like ISFOC, which provides a grid connection to developers wanting to field-test variants of CPV technology could be built. Broader definitions of Research Infrastructure exist. They might include the resources and services needed to support a research centre[1]. Here, however, we focus on the hardware because the SOPHIA project, in which frame this document is being produced, also places the physical piece of apparatus at its centre.

Effects of manufacturing decline

Considering complete, installed systems, the European PV Technology Platform notes[2] that more than 50% of the value of that system (from the raw materials to the functioning, grid-connected system) is still realised in Europe. But it acknowledges that "cell and module manufacturing in Europe have been hit hard in the last few years by fierce competition and painfully low or negative profit margins." The diminishing total value (volume multiplied by price) of PV components sold from factories located in Europe has presented European PV research centres with some considerable challenges. Many research centres have relied on contracts with industry for a large and (until recently) increasing share of their income. The research centres have allowed industry to access their apparatus, most often with their staff on-hand to guide them or to perform the experiments on their behalf. Their collaborations have been paid for entirely by industry or subsidised in the framework of national or European projects. In any case, regardless of the form or detail of a particular collaboration, a weaker PV industry could result in job losses in research centres or a downscaling of its capacity to perform the highest quality research.

Demand to use research infrastructure

Demand to access apparatus for system-level research and grid integration has held steady, and multinational component or material suppliers are showing an interest in using them.

[1] The European Commission considers Research Infrastructure to be "facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields" (http://ec.europa.eu/research/participants/portal/desktop/en/support/reference_terms.html)
[2] Position Paper *Photovoltaics: creating new opportunities for Europe* (December 2013)

Apparatus related to basic research and that has an international reputation has also held up well. There has been a slight drop in demand, but it is still fully booked.

European research centres in OPV have seen a steady increase in their activity. This is a sector where the R&D centres drive the industry, as they are the major customer base for OPV materials and machinery. However the sector is exposed to public finance, meaning that a cut of N% in the budget that funds OPV might have a greater impact on OPV than a cut of N% on other cell technologies.

Some R&D centres are expanding. Many are reorienting their activities to cater for the needs of the downstream end of PV business. There is a general feeling (module/system performance and BIPV) that soon, the PV community will not be so interested in cost per W_p which tends to limit focus to the module. Instead end-consumers and therefore also the clients of research centres will look to the number of kWh that may be fed into the grid for a given investment cost (i.e. the levelised cost of electricity from the device). Thus research apparatus that tests lifetime, module performance and grid integration are well placed to withstand the downturn.

> No time
>
> Visiting users of research apparatus, it seems to CREST, are more “pushed for time”. CPV agrees. The CPV industry is on the cusp of becoming a mass-market technology. As it makes that transition, rating and characterisation procedures will need to get much quicker.

In the field of module and system performance, supply of services related to durability, ageing and performance assessment is increasing to keep pace with demand. Researchers want to understand degradation mechanisms better. Indoor accelerated ageing tests are evolving to simulate more closely external conditions. The tests increasingly combine ageing agents. They are getting more aggressive, testing products beyond the requirements of the now rather outdated IEC standards (e.g. IEC 61215 testing exposure to damp heat for at least 1000 hours). The need for updated standards arises partly from the fact that the research community is busy developing new ideas. This implies a need for infrastructure for reliability testing to check they work in the real world (IMEC). On the other hand, RI related to the fabrication of modules are in less demand.

There is another trend, which is to extend the range of expertise of research centres. Thus, centres that used to focus on module and system performance are adding BIPV-related tests to their portfolio of competences.

Inverter manufacturers are concentrating more on equipping their products with functionalities to manage the energy, facilitate grid integration and provide ancillary services and less on efficiency.

Activity in these areas can broadly be categorised as downstream work. But there remains also a need for upstream work, noted for example by the silicon materials

> Statement by JRC
>
> In module and system performance testing, sites for field testing are increasing. This category potentially includes both "smart-home" type-scenarios to optimise own-consumption, as well as energy efficient buildings. In these cases PV needs to be considered as an integral part of an energy management system covering production, storage and consumption aspects.

topic (i.e. ‘upstream’ meaning the work is closer to basic research) on:

- implantation and related analysis;
- new architectures including finely structured cell technology including rear contacted cells and related simulation and analysis tools as micro-characterisation
- Si baseline processes, advanced high throughput manufacturing processes,
- quicker inline characterisation processes

Financing of research infrastructure

The choice of apparatus to buy, build or procure is with each research centre’s management. Bigger apparatus tends to be donated or lent for a specified period by industry, or purchased by the research centre using funding lines intended for that specific purpose (but these lines are running dry). Industry typically contributes to the equipping of research centres in the ways indicated in Table T.

The trend is for public funds to make up a larger proportion of the income stream of PV research centres than during the boom years. Public funding for research centres is declining more slowly than industry contracts, which has allowed research centres, often after some cuts and restructuring, to survive.

Research centre takes all risk	Research centre shares risk with industry users	Apparatus is donated
Industry makes no contribution upfront. The research centre makes the investment. Industrial or other external users pay to access it once the apparatus has been installed. This has been and appears to remain the tendency for smaller apparatus.	Equipment manufacturers would supply a device and cover its depreciation from their balance sheet, while the research institute would cover the cost of lab space and maintenance. The latter cost is substantial (but often assumed not to be): about half the total overall lifecycle cost. An agreement is reached before the equipment is supplied that after N years it becomes the property of the research centre, with an agreement for one party to buy out the other if the company and research centre terminate their relationship.	industry makes donations. These were relatively common in the boom years and as the European industry began its consolidation phase. Now, however, they are drying up.

Table T – the roles industry can have in the equipping of research centres

Deferred investments

One of the easiest (least painful) ways for a research centre to cope with reduced income is to cut investment in new equipment.

It is always risky for a research centre to invest in new research apparatus. When a new investment must be made, it is often the research centre, backed with a government grant, that carries the risk of (or rather responsibility for) the investment, even if later on companies will pay per hour to use it. When lean times accompany a period of rapid transition, it is especially difficult for research centres to know where they should be directing their resources (Tecnalia: "Tendencies in PV technology change very fast, so it seems risky to make a long-term bet on specific equipment." BIPV: "Before funding a BIPV RI, investors and companies would verify that the market is not too risky" ZSW (speaking at a non-SOPHIA event)[3]: "short-term industrial orientation not helpful – long term strategic programs needed").

At least one PV research centre, and quite possibly many more, has not expanded its facilities for three years. It is relatively painless also to defer upgrades of existing research infrastructure or to increase maintenance intervals.

Survival strategies

Go niche

ECN says you should market RIs for unique market applications.

Go extensive (covering the whole value chain of one technology)

CEA-INES has observed the attractiveness of complete lines: In the field of silicon technologies, from the crystallisation processes to the wafering, from the cell processes to cell interconnection and module encapsulation, it is important to assess the benefits of one new material, process or equipment within the relevant step it has been designed for, but also to assess the overall value, considering all potential impacts (efficiency, yields, etc.) along the entire processing steps.

Go international

One way for a research centre to make up for a shortfall in income from traditional sources (local industry and the government) is to increase its visibility and its attractiveness to companies or research teams based overseas. Research centres are becoming more aware of the importance of raising their profile internationally (Tecnalia, AIT) and more adept at creating contacts in third countries (RSE). But while DERLAB points out that examples exist of European research centres advertising their certification services in Asian languages, at least one research centre finds it easier to collaborate with centres in countries with a similar cultural tradition (Tecnalia). Providing testing and certification services to Chinese manufacturers is seen as an easy way to collaborate with them. It is 'easy' because such collaboration carries minimal risk of leakage from Europe of intellectual property related to manufacturing.

[3] Hans-Werner Schock, EUREC Agency College of Members June 27 2013

Flexibility: providing services to other fields and keeping doing business with what you have is a way to avoid risking making bad decisions in the short term.

A research centre is more insulated from downturns in the PV industry if its apparatus can be used to perform research relevant to other industries. Carefully selecting the assets of a research centre to be relevant for industries other than the industry it primarily intends to serve will reduce the centre's need to take short-term corrective action to respond to a change in fortunes of its main clients. In OPV, for example, apparatus is typically used for a wide range of materials science research. In BIPV, flexible use of RI is also apparent.

In BIPV, conventional (existing) solar simulators are used in experiments to measure the response of façade elements to different angles of incident light, whereas a solar simulator with very low divergence (parallel rays of light) should be used. But if you can't afford it, you may do with what you have.

Taking decisions under time pressure is difficult for research centres (Tecnalia, ECN) and can lead to poor decisions. AIT goes as far as to say that long-term plans are the only plans worth following.

Market yourself as the cost-saving solution

IMEC and CEA offer "affiliates programmes". These programmes involve the research centre making discoveries in certain areas of interest to industry, then sharing the results only with a group of companies that previously agreed to cover the costs of the research. IMEC uses its model to work with companies wanting to develop baseline processes in silicon. The companies might, if they could afford it, prefer not to share knowledge, but cooperation is an acceptable alternative if money is tight. CEA offers affiliate programmes in topics with a lower innovation potential (because it is in such areas, it finds, that companies are most willing to share costs): battery performance and module performance.

Research centres need to be imaginative in the offer they make to potential clients, for example clients wanting to test outdoor performance, by flexibly moving equipment between themselves instead of buying it themselves (suggests DERLAB), but the costs relating to contracts and transport need to be taken into consideration.

Research centres could also offer commercial services, but this can backfire. One centre said: "We prefer not to be seen as a provider of research infrastructure for standard tests. Private testing or research companies or consultancies can supply these services. When we provide them, the private companies object. Their objections have led to us being excluded from collaborative research projects."

Go application-driven

Application driven research projects are a way to interest customers to use or expand research infrastructures. For example, in BIPV demo buildings and test roofs have been established in consortia to characterise BIPV products. Another example are projects where grid connection strategies are demonstrated and tested.

Look around you and be complementary

This is not the climate for trying to outgun other research centres that are leading in a field, but rather the time for a research centre to consolidate whatever position it already holds. The BIPV community, in particular, notices that it is not worthwhile to emulate research that is being done better in the US or Asia. Hard times promote the cooperative instinct over the competitive one. Research centres are using fora like EERA and Research Infrastructure FP7 contracts to work out how they can make complementary investments.

> Research centres would together create a database listing the static and mobile equipment available at a research centre and other partners' labs. The members of this group would loan mobile equipment to each other. Standard contracts would be used for the loan and to cover transport insurance. The result would be that relatively complex research can be done at one location by moving equipment in and out, rather than by moving the experiment.

[Box]This idea (DERLAB's) is an extreme version of how research centres might collaborate in future. It is in line with the aims of the SOPHIA projects and other related projects on research infrastructure, like DERRI. CEA agrees that mobile RI is being developed, citing the example of electroluminescence equipment: flash simulators that can fit into vans and be taken to do field tests. CEA and IMEC agree that on the one hand, the unaffordability of apparatus will "lead to more collaboration between centres", and on the other hand, that joining forces will enable research centres to make "a more comprehensive offer to industry."

Trends in clustering

Clustering refers to the aggregation of companies that offer a similar service or product. They might be direct competitors or they might work in related industries, sharing suppliers or having customers in common. The bigger the cluster, so the theory goes, the more possible interactions can take place between workers in the cluster, and therefore the greater the ability of its constituents to innovate[4]. Also, interactions can take place more quickly because of the close physical proximity of the constituents to one another. A hinterland of industries or organisations interacting more loosely with the core of the cluster grows up around it at the same time.

The question is to what extend RIs can be an engine for cluster formation in PV. Are there any trends observable? This question goes to the heart of research centres' relationships with industry and could hold the key to reversing the decline in Europe of certain segments of PV manufacturing.

[4] The NREL-MIT study of 5 Sept 2013 '[Assessing the drivers of regional trends in solar photovoltaic manufacturing]' attributes 5-15% of the price advantage of Chinese manufacturers over US manufacturers to the clustering of PV companies.

At CEA in France and some other publicly owned laboratories, clustering is promoted indirectly by a scheme that allows a worker to leave CEA to set up or join a start-up company. They receive some seed funding and are given free access to the CEA's apparatus, which is an incentive for them to stay in the area and build their business close by. They can also return to the lab after 3-4 years if the venture fails. An example of a company that began in this way is SOITEC.

Established companies may be encouraged to interact with research centres with various subsidies. In CEA, companies may receive grants or tax credits from the state for research work if they use a research centre. They tend to come to CEA to access apparatus they do not possess. CEA's involvement helps the company developing its product. Smaller companies wait longer before turning to CEA (they have fewer resources to cover the administrative overhead of setting up the collaboration). They come when they hit a limit in what they can do in-house, or if they want to optimise a process.

Box: CEA example

Research centres performing basic research (i.e. delivering results that have less certain commercial prospects) have less of a need to interact with industry and are less able to become the nucleus of an industrial cluster. Apparatus like BESSY is known across the world: it meets the needs of an international community, and is less focused on meeting the needs of a local user base.

No trend towards clustering has been observed in CPV characterisation, nor modelling, nor Si materials, neither. But in thin films, Solliance is emerging as a leading cluster and seems to have developed a certain resilience to the ravages in the PV industry. Its companies and research centres face fewer barriers to interacting than actors separated from each other by large distances.

Wide divergence in willingness to host third parties

Some research centres are much more comfortable than others with hosting single visiting researchers or visiting teams of researchers. JRC has accommodated a team of two researchers once in the last four years. Its experience is with visits of short duration (a week), which seems to be a model that many others are familiar with. The alternative is for much longer stays, of the order of 6 months (Table H).

		Length of stay	
		One week	Half year
Number of members in the visiting team	One or two	Most common	Fairly common
	Six	Fairly common	Least common

Table H: Typical lengths of stay and number of members in the visiting team. Other combinations of numbers of people and length of stay are not common. Shorter stays might concern general characterisation and longer stays setting new standards.

There are often substantial administrative barriers to hosting researchers. The hosting research centre needs to believe that hosting the visitor has a strategic long-term value, as the real costs of hosting the visitor can often not be fully covered. The visitors need to get the most out of their trip by being well prepared before they arrive and by focusing on one specific task. Single visitors tend to need more time to find their feet than teams.

BIPV notes growing interest for visits to research centres that have innovative or unique configurations of BIPV systems, reflecting the expansion of this segment of the PV market. Experiments can require half a day to a month to set up, and much longer to run. In the case of CEA (mentioned also by specialists in device modelling), the staff of the research centre (CEA) analyse the data from the experiments for their clients. They see that a greater need to access the test benches available at different sites across Europe will drive greater mobility. Others in the consortium agree the need to perform research work efficiently is the driver of mobility, but maintain that the existence of a trend towards more mobility (especially in the absence of a project like SOPHIA) is not proven.

The realisation of some studies needs the access to specific test benches existing in one or more research centers. SOPHIA project through the calls for proposal in the Networking activities contribute to change this situation.

Trends in confidentiality and industry access to lines

Safeguards are put in place to protect industry's interests. The NDA (non-disclosure agreement) is the primary contractual instrument to ensure the data gathered by or on behalf of a company at a research centre remains with that company only. NDAs are widely used. This is particularly important when the research centre makes not only its apparatus but also its staff available to a third party, or when an industry client wants characterisation data for its modules (comment from the CPV characterisation topic). They are enforced by various practical measures, such as the ones outlined in Box F.

As research apparatus is increasingly used by many parties, sometimes simultaneously, some research centres decided they need to give greater assurances to each user that their data remains confidential. ECN seems to be the research centre in SOPHIA that is pursuing most diligently a policy of guaranteeing confidentiality to attract external users, particularly from industry, though RSE has recognised a need to upgrade its confidentiality provisions, too. These are of a contractual and practical nature (Box F). Other research centres have a variety of approaches. CEA, for example, completely forbids access to some specific zones and joint labs (labs that host staff from both CEA and an industrial partner), but , allows visitors around other facilities (although photographs may be forbidden and CEA may choose not to reveal the company whose product(s) are being tested), and is more relaxed about the use of outdoor test benches (BIPV test benches, zero-energy building test facility). AIT and JRC, at the other end of the scale, have not noticed a trend in small and medium research infrastructure towards more or more strongly enforced measures to preserve confidentiality. Tecnalia notes that there are relatively few areas where industry demands tough safeguards: optics for CPV and new materials for encapsulation are examples. The results of this research are of high immediate commercial value.

Practical issues

At planning stage

- Guest use requires more separate rooms in the lab, which introduces extra costs compared to a single-use/private lab.
- Careful consideration must be given to the equipment that can be placed in the each room, to match the interests of equipment suppliers/industrial partners.
- Allow sufficient lockers and private racks for storing samples and materials

During operation of the RI

- IT safety; data storage to be arranged per user or per project, no shared network drives etc.
- joint use requires extra discipline to clean up and store away samples after use of RI.
- a reservation system for RI should be in place (eg electronic agenda), which excludes combinations of parties who cannot/should not be in the same lab at the same time.
- sometimes users of the RI (especially industry users) work longer hours than the usual staff of the RI. The RI staff cannot monitor the external users outside of normal hours. To ensure there is no foul play, badges registering all times of entry and exit to a particular person, are used. This is considered more effective than access codes, which might not be particular to an individual.

Contractual

- ECN provides industrial partners with full details of all the parties involved in its RI. Sometimes this “gives them a fright”, but ultimately it fosters a culture of transparent dealing between both parties, building trust.
- An NDA is always in place between the research centre and the RI user.

Box F: Steps taken by ECN to attract external users to its RI.

Strong relationships between research centres and particular companies can make it harder for the research centre to work with other research centres, but the costs and benefits are well known and the situation is not seen as problematic. If a company supplies a piece of equipment, it is consulted by the research centre before access to it is given to another experiment. On the other hand, it is unreasonable for a company to monopolise a piece of apparatus owned independently by the research centre, by seeking to prevent other companies from using it when it itself is not using it. There are cases when this has happened, and it is happening slightly more often now than in the past. The research centre and its industry client need to anticipate potential causes for misunderstanding when they agree terms.

Some technologies are at too early a stage for industry to be interested in the question of possible access to apparatus by their competitors. This is the case of tools for characterisation of CPV. The CPV industry is at the stage of defining the standards for assessing CPV performance. It makes no sense for companies, which all support the standard-definition process, to hold it up. The OPV community similarly feels that industry blocking of research apparatus is not an issue – companies willing to commercialise OPV are simply not yet there.

Annex 1: Conclusions of NA2.9 discussion in Chambéry 16 April 2013

Provocative question 1 / slide 7: "Imagine there was no SOPHIA… "Hosting visiting researchers is something we would like to do more of? / less of?"

Brigitte: in BIPV, yes. Research centres have different test benches and the community needs to be able to access them. This need to access different test benches will increase in future.

Eric Gerritsen: The same could be true for different characterisation tools. The tools themselves could be exchanged, so could the people who know how to use them. Those people could also explain how to exploit and evaluate data, interpret images. Projects like SOPHIA help people to see what is where and how the tools are used. There's a general awareness that this is useful, because people have a common desire to understand failure mechanisms, but I'm not sure there is hard evidence of a trend towards increased mobility.

Nigel noticed there was an absence of data on mobility. He would like to see more detail on how many hosting opportunities are offered and how long the hosting periods last.

AIT (Stephan) said the barriers to more frequent exchanges were administrative and that exchange *per se* had no value: there needs to be "thematic work" (i.e. research work). "I have seen the EC tend to give more money to these cooperation issues and less money to real research work. […] Always the main reason for mobility, e.g. in the TNA mobility that HZB has hosted, is because there are established contacts between research centres" – that have been resulted from contact through research work (as opposed to open calls for proposals, like on SOPHIA website).

Provocative question 2 / slide 8: "It is an emerging trend that RI moves to an experiment. Or does the traditional model (experiment moves to RI) continue?"

Vincent Helmbrecht (Derlab): Expensive measurenment equipment that is not sensitive to the mechanical effects of transportation can be shared. We coordinated exchanges of measurement equipment between two institutes for an outdoor test setup: a pyranometer, data logger and UV curve measurements. The idea behind this question is to enable the entity hiring the apparatus to avoid high investment costs. The main barrier is administrative: the establishing of hiring contracts. Ideally, such contracts should contain standard provisions and clauses."

Eric Gerritsen: "Yes, there is a trend towards greater moving of apparatus to experiments. I see it for electroluminescence equipment: flash simulators can fit into vans and be taken to do field tests.

Provocative statement 3-4 / slide 9-10: passed over (lack of time)

Provocative statement 5 / slide 11: "True or false: de-industrialisation in EU leads to…

- … less demand for module RI"
- … less demand for system-level RI"
- … less demand for grid integration RI"

Audience member: "I think the statement is false: As the market grows, there is more demand at every level"

AIT: On the module level, you must distinguish between fabrication-related RI (where the statement appears true), and characterisation-related RI, where it is false. For system-level RI and grid-integration RI, it is false.

<u>Provocative statement on slide 11: "Research apparatus that tests lifetime, module performance and grid integration are well placed to withstand the downturn"?</u>

Audience view: Yes, it is fair enough to say "Research apparatus that tests lifetime, module performance and grid integration is well placed to withstand the downturn", but not "Research apparatus that tests lifetime, module performance and grid integration is *better* placed than other apparatus to withstand the downturn." Nigel: a shake-out of module technologies is happening. There might be fewer module technologies in future [Ed note: the implication of what he's saying (but he didn't say this) is surely: so to that extent, module RI are a risky thing to invest in).

Vincent: what affects your ability to withstand the downturn as a research centre is your exposure to government contracts vs industry contracts. Government funding protects you.

<u>Provocative question on Slide 12: "These days, if a research centre doesn't have a strategy to encourage the Chinese and Koreans to access it, it will be dead in 5 years"?</u>

DERLAB: a way to collaborate with Asia and get business from them without giving up intellectual property is to focus on providing testing and certification services but not to provide know-how related to the manufacture of the device.

IMEC: there are other ways to die, for example by having an empty pipeline. And one of the ways to have an empty pipeline is to spend too much effort on short-term close-to-market research.

PMalbranche: you must distinguish between KR and CN. KR is an easier partner to do business with. They respect contracts. INES has "not seen good examples so far" of CN research centres honouring IPR and sticking by signed contracts. "On the long term, it is not sustainable to have strong research without industrial researchers around." He debates with Jens, saying EU funds microelectronics because there are still some actors. Jens: "Yes, but manufacturing strength will return to Europe." Jens supported by another guy in the room says that China's ability to produce cheaply will not last and its dominance is temporary (that "75% of companies will go bust in China in the next 5 years, too"). In five years' time, he expects Europe to have reconquered large shares of the value chain.

Jens's evidence for the fact that PV research pays a dividend to European society is apparently that the EU continues to fund

PMalbranche: INES's strategy is towards expensive to transport technologies, like BIPV. Also we are trying to make high-efficiency cells. The record efficiencies are still in Europe.

Annex 2: Minutes of NA2.9 discussion, telcon on 27 November 2013

27 -11 - 2013

14.00-16.00

Telcon

4. MEETING MINUTES

5. SOPHIA – CONTRACT N°

Meeting organised by :	Alma	**Meeting category :**	Telcon
Participants :	Excom and topic leaders		
Excused :	Stephanie Ruguet		

Comments :

The main topic of this telcon was a discussion NA2.9, which was originally scheduled at the GA meeting in Berlin

6. SUMMARY OF MAIN ACTIONS

Actions decided	Responsible	Due Date
✓ Chapter 2 to be finalized based on comments made in telcon	Greg Arrowmsith	23-12-2013
✓ Revised intermediate version D2.4 to be submitted to EC	Alma	31-12-2013
✓ Additional input for Chapter 4 is required with a broader view taking the SRA as guiding document	All topic leaders	24-12-2013
✓		
✓		
✓		
✓		
✓		

7. DECISION MINUTES

Discussed item :	Status Chapter 2, SRIA document D2.4	**Leader :**	Greg Arrowsmith (Eurec)

Issues which were raised after first evaluation working draft version

1. Definition of Research infrastructures. The EC uses a different and broader definition of RI (focus on facilities, resources and services), than we do in Sophia (only focus on facilities).
   See also link: http://cache.media.education.gouv.fr/file/Infrastructures_de_recherche/98/2/IR_Infoday_20131107_P-Froissard_EC-DGRetI-RI_280982.pdf

The following comments were made in this respect:

- Greg Arrowsmith (GA, Eurec): Prefer to follow present approach with a focus on things
- Nigel Taylor (NT, JRC): focus on physical infrastructure is OK, but write it at the front.
- Philippe Malbranche (PM, CEA) : Present both definitions at the front, and explain the choice of the narrower one. Put it in a Foreword.

2. Some statements in the present version of the SRIA document were considered to be a bit negative (comment NT):
   - **GA** asked the Exco for a mandate to rewrite parts of the text to be less negative. Everyone agreed.

3. What is the end-user perspective?

   - It was generally agreed that there is a need to get the view of the "clients", including (or especially) industry, to bring in other opinions. The text should be put on consultation. It was suggested to bring in authorities, for example or to show it to other stakeholders
   - **GA** suggested to use the EUPVTP GA platform (June 2014) for feedback. EPIA in principle agreed but a high quality document is needed at that time
   - **PM** suggested Intersolar as platform
   - **NT** suggested EPIA to use its network ahead of EPIA. EPIA agreed and will check if SEII Team is interested in commenting.
   - **GA**: Intersolar and then GA EUPVTP, followed by MS in SEII Team before Amsterdam PVSEC for public launch.

4. Pilot lines are crucial to develop and test novel manufacturing processes which then can be easily transferred to industry
   - Iver Lauermann (**IL**, HZB): HZB offer one manufacturing line on sputtering, 30x30 cm

- **PM**: But is a growth area and needs coverage.

General remarks on SRIA document:

- Jan Kroon (JK, ECN): Do we need a more global scope of the document.
- **GA**: by all means we comment on competitive position, and the capabilities of EU RI compared to RoW, but difficult to catalogue non-EU.
- **PM**: RI for module reliability needs to be organised at a global level. International products => international standards. Identify any other topics, e.g. advanced characterisation
- Juergen Hupkes (**JH**, Julich): appropriate to focus on European RI. Module reliability – really? Could be done at one location. Modelling and system reliability need a global effort
- **NT**: Technology roadmaps have set targets. They are our guide for RI recommendations. Jan agrees.

An intermediate version of the document (D2.4) needs to be finished and submitted to EC before end of December according to the new DoW.

- **JK**: What is sufficient as 'intermediate'?
- Definitely clarify our understanding of 'RI'. PO has not yet seen a draft version of the SRIA – so in no position to judge rate of progress. In addition, Greg will integrate the other requested changes as described above

Conclusions :

Actions decided	Responsible	Due Date
✓ Chapter 2 to be finalized based on comments made in telcon	Greg Arrowmsith	23-12-2013
✓ Revised intermediate version D2.4 to be submitted to EC	Alma	31-12-2013
✓		
✓		

Discussed Item :	Status Chapter 4 questionnaires, SRIA document D2.4	**Leader :**	Jan Kroon (ECN)

Outcome first round of questionnaires:

- **JK**: Most people focused on tools and development standards, failure modes. Focus was much less on processing for the various topics, except for OPV (and maybe Si-materials although input was not received at the time of the telco, Wilhelm Warta is working on it). This balance is a reflection of the discussion in the topic groups. Now we need a broader view, beyond SOPHIA, that uses the technology roadmaps as input. Additional input can be sent to JK and G

- **NT**: what is the framework that is our basis. Should we just translate from the recommendations of the SRA? Use this as a boundary condition. That would frame the discussion.
- **PM**: the topic Si solar cells will certainly require more RI related to processing but are not which include more processing in SOPHIA but are to be in Cheetah. Either we make a warning, saying it is not addressed. Or we try to address it. **JK, PM GA**: we should to try to address it in the doc. We will identify people to plug the gaps.
- **NT**: my feeling is the SRIA is longer-term looking and it is good to take one doc. But we can mention it as a source of inspiration.

Conclusions :

Actions decided	Responsible	Due Date
✓ Additional input for Chapter 4 is required with a broader view taking the SRA as guiding document	All topic leaders	24-12-2013
✓		
✓		
✓		