INTERNAL DELIVERABLE - MILESTONE 22

Report on new mechanisms for increasing future collaboration between research centres and industry

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Executive Summary

This milestone deals with mechanisms for increasing future collaboration between research centres and industry. To achieve this task, direct interviews were done by ESTELA to the research centres of the EU-SOLARIS consortium. The respondents could explain how they collaborate with the private sector.

We can say at first that the terms of collaboration are very different among the institutions reviewed: some are very flexible, while others follow a stricter policy, some enter national collaborations exclusively and others are more acting international.

The structure of the research centres studied is similar in most of the cases: they pertain to the government and are partly funded by it. The rest of the budget comes from bilateral contracts or joint projects. Also, most of the structures do have a department dedicated to administration that deals with the contract validation regarding the economic and legal aspects, although the technical definition of the work is previously agreed by the technical team.

IP rights are usually an important issue and some institutions allow exclusivity although the bigger part does not. Overall, royalties are shared depending on the participation rate on the activity.

As a general comment, the Concentrating Solar Thermal (CST) and Solar Chemistry industry at national level is not very much developed – except in Spain and Germany – and a strong push through innovation is needed to leverage the technology transfer of the research sector to the market.

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1. Introduction

The milestone 22 intends on one hand to analyse the existing collaboration mechanisms between the research centres and the industry and on the other hand to identify ideas to foster those mechanisms in order to break up administrative bottlenecks that prevent industry and research to cooperate. This achievement is part of task 4.4 of WP4 named: "*Establishment of the EU-SOLARIS participation procedures for the private sector and industry*".

Following the work plan set up by ESTELA at the beginning of the project, face-to-face interviews were performed with each of the research centres from the EU-SOLARIS consortium all along the year 2014. The partners were asked about their experience in collaboration with the industry sector via a discussion with the interviewer. This method was preferred to a classical written questionnaire, since a lively conversation was thought to be more spontaneous and would allow providing more details on the matter.

Fruitful testimonies came out of those discussions and their content is therefore transcribed, when relevant, in this report. The first part of the document will, on the basis of the interviews achieved, establish the state-of-the-art of the past and present collaboration modalities with the industry – from the perspective of the research centres – and the second part will propose possible new mechanisms to improve this collaboration, based on suggestions by the respondents.

The next step in the task 4.4 will be the MS 24 "*Definition for the participation formulas for industry in the operational phase of EU-SOLARIS*" expected in month 35 i.e. in September 2015. This new report will take into account the positive aspects identified in this report and translate them into an operative model, taking into account the structure and schemes defined for the EU-SOLARIS legal entity in other work packages and related to user access (WP2).

2. State of the art of the current collaboration

In order to be able to draw out efficient mechanisms between the two sectors, it is essential to understand the general operating schemes of the partner institutions. Therefore, the following sections (1.1 to 1.9) report the related information gathered during the interviews.

The amount of details given is not equivalent for all research centres. Some institutions have a lot to say on specific topics, then, their experience is explicitly quoted. When some information is common to several institutions, it is reported as a global trend and in this case, institutions are not quoted.

2.1. Research centres' structure

We can distinguish, among the EU-SOLARIS consortium three types of structures: public research centres (pertaining to a national Ministry such as LNEG, ENEA, DLR, PSA, GUNAM, CRES, CyL), private research centres (such as CTAER and APTL/CERTH, who is a non-profit private body governed by public law) and Universities (such as the University of Evora, University of Selcuk). Each of them is managed by specific national/categorical rules, putting different priorities at the forefront of their strategic policies.

To begin with, the complexity degree of the internal structures of the institutions can be underlined: most of them do have several laboratories, clustered in research topics and geographically spread out, implying a corresponding administrative management structure (chapter 1.7).

We can also mention the following particularities:

- The University of Evora, initially dedicated to fundamental research, has been supported by a grant from a Bank and by R&D projects, manly funded at EU Level. Only now (2015) it managed to get its candidacy to integrate with LNEG a new Research Infrastructure (ESFRI type) thus getting partial support from the government in the transition for commercial applications. The hurdles of publication vs. IPR encountered for such implementation are described further in the report (chapter 1.9).

- DLR is a research centre whose principle is to transfer knowledge to the industry. Indeed, by its own status, the institution cannot take any engineering civil responsibility for the work performed which is considered as pre-engineering. By consequence, there is no possibility for real engineering contract. The companies exploiting the knowledge transferred (that could be DLR spin-offs for instance) have, on their part, all the flexibility and liability possible.

- PSA has two different categories of workers in the staff: permanent staff members (i.e., civil servants) and non-permanent staff members. PSA through its statute of Spanish public research centre encounters some barriers related to recruitment of permanent staff members because the

Spanish State[1] does not allow adapting the number of permanent staff members to the work load. If PSA has a new contract offered by a company and all its staff is engaged in other projects, PSA cannot (by law) contract an additional permanent staff member to respond to this demand. Concerning non-permanent staff members, the long administrative process (it takes from four to even more than six months) currently imposed by the Spanish State to hire non-permanent-staff members makes this option actually unfeasible to undertake new activities that must be started soon, which is usually the case of activities demanded by industrial partners. So, PSA has serious problems to adapt its staff to the work load, which sometimes is a significant barrier to undertake new activities, even when PSA has sufficient financial resources. to hire personnel.

- LNEG has similar limitations regarding staff recruitment.

- The CERTH (Centre for Research and Technology) is the largest research centre in Northern Greece and one of the largest in Greece. It is composed of four institutes: chemical processes and energy resources, informatics, transport, agro-biotechnology. The APTL is the aerosol particle technology laboratory and is hosted by the chemical processes and energy resources institute. Hiring subcontractors as free lancers in case the work load requires it is easy. This statute represents a significant percentage of APTL personnel. Like in PSA, full time permanent staff is way too complicated to arrange. Following the crisis, the law imposed a drastic reduction of permanent staff hiring in the entire public research sector: 1 out of 5 positions can be replaced.

Considering those research structures in the national and international landscape, a viable model for industry to participate in the innovation development will be submitted in the next milestone MS 24.

2.2. Financing and funding schemes

Some information could be gathered for five of the members of the consortium regarding their structural financing. As a general rule, research centres (LNEG[2], DLR, CTAER, CyI, CRES and APTL quoted as examples) see their research programmes partly supported by their national and regional government. Such public involvement can vary depending on the country specificities and the nature of the institution.

As an example, DLR has a high share of basic, long-term funding, coming from governmental bodies allowing to achieving DLR's mission to do long term, independent and free research. Before the crisis, real industry contracts used to reach 30 % of the income. Now this budget, complemented by EU and governmental projects limited to a specific scope, is reaching the unusual high share of nearly 70 %. The freedom of choosing activities is hence reduced and sadly not compatible any more with DLR general rules of "free research".

[1] This common guideline has been taken consequently to the financial crisis, as the number of civil servants could not be increased – the allowed ratio of staff renewals is one per ten. Consequences of those decisions are very bad, leading to a total absence of flexibility for R&D public centres, a very high unemployment rate, and avoided business contracts.

[2] In the case of LNEG government support corresponds to wages. Overheads costs, consumables, equipments, etc. usually come from projects (which might be funded by the government although only after a competitive call procedure)

Another example is the APTL, who is non-profit, driven by public law and supervised by the administration of the Ministry of Education and Religious Affairs. The public funding reaches only a 10 % of the total budget – covering only a part of permanent personnel cost – The rest is made of national and mainly EU projects and industrial contracts.

Finally, CRES is a public institution with a share of 80 % of private funding and 20 % of public funding (from EU, national projects, contracts), with freedom to choose research topics. The institution needs to apply to project calls in order to get funded.

2.3. Industrial use of research infrastructures

Research infrastructures from the EU-SOLARIS partners are detailed in the report related to milestone MS15 from WP3: "*Status Report on Existing Capacities, Technological and Human Resources*". Without listing the inventory again we approach the practical aspect related to the industry collaboration modalities. Since all the approaches are peculiar, we use a specific bullet point for each institution of relevance.

- DLR: All operations are lead by DLR staff: companies pay to have a test performed, as a service provided.
- CNRS: Industrial clients are not performing the work. They rent the facility and the operators, following the same rule as in DLR.
- ENEA: The bulk of the agreements with the industry are done through the SFERA project.
- PSA: Many companies of all sizes, in possession or not of R&D facilities, request PSA services since PSA has the major and most cutting-edge technology R&D infrastructure in Europe. The most cost-effective arrangement for the industry is to sign an agreement, which duration may vary a lot from one agreement to another (from several weeks to several years). Contractual terms of such arrangements can be tailored depending on the testing needs. The contracting process is very much simplified for activities with a short duration, because they can be directly requested as external services, which have a very simple administrative process: a) order issued by the industry, b) budget preparation by PSA, c) budget acceptance by the industry, d) delivery of results and issue of the invoice by PSA, and e) payment by the industry.
- Turkey (information given by GUNAM): Greenway, one of the main Turkish private companies, collaborates with the Energy Research Institute of Istanbul Technical University (ITU), created a year ago. The ITU has a geothermal solar hybrid pilot plant facility and the Energy Research Institute has an incubator for small energy technology companies. Those companies have to support a graduate student from the ITU to be able to be hosted in the incubator.
- WEIZMAN has a demonstration plant in Israel. Nevertheless, the Weizmann management decided to terminate the activities of its solar facilities.
- LNEG: An Accredited laboratory for solar collector testing belonging to the LNEG is set up in Lisbon. The collectors implemented by private companies that need a certification are tested and validated by LNEG staff, who perform the operations. This certification is called the Solar KeyMark (see Annex for explanation). Besides the solar collector testing LNEG also performs other services to companies.
- Selcuk University has small test benches but no advanced infrastructure. Users can choose to operate the testing themselves or to be seconded by the researchers. The industry can also ask for the University to test some of their components.

- The Concentrating Solar Thermal (CST) facility in CRES is quite small and comprises testing services connected to solar radiation measurements. The scope of CRES is to set up demonstration plants for CST that do not exist yet in Greece.

- APTL researchers only are allowed to use the facilities. Industrial clients can attend or participate to the operations but the safety, security and liability issues have to be taken into account. Most of the contracts are implemented with international companies (United States, Japan, EU, multinationals). Collaboration with national companies doesn't allow continuing working together as contract price ranges are too high and there is no financial incentive to support them.

- CyI is nearing completion of the Pentakomo research facility and will draft the access rules to users and industry in line with the EU-SOLARIS activity under the same name. Industry in Cyprus that can make use of the facility is scant, but the aim is to attract interest in the wider geographical scientific neighbourhood. A Fresnel based system that will be added to the list of infrastructures will also be completed in the main campus of CyI by the end of 2015.

- University of Evora: The first Portuguese Roadmap of Research Infrastructures of Strategic Interest for the period 2014-2020[3] sets the country on the map of Europe. It also provides international political leverage to position Portuguese teams in leading roles, influencing future research agendas and facilitating a closer link with industry. The Roadmap will achieve these goals by underpinning world-class science and encouraging the involvement of a variety of user communities, from the public and private sectors. One of its goals is to generate momentum for innovation and creation of value through top-level research and by facilitating the creation of spin-offs as well as providing services to industry.

Thus, many research infrastructures are available for the industry, and the technical specificities are spread out all over the countries studied. It is important then to publish an accurate mapping of all the existing services. This has actually been done within WP3 in the report related to milestones MS16&17 "*Portfolio of Available Technical Services as EU- SOLARIS*".

[3] http://ec.europa.eu/research/infrastructures/pdf/pt_roteiro-fct2014.pdf

2.4. State of collaboration with the industry

In section 1.3, the types of interaction with the industry were described, for the different institutions. We are analysing the actual state of play of the collaboration between research centres and industry. Again, each case is different thus the different situations will be explicitly described, depending on the statement made by the respondents:

- LNEG is a lab of reference for testing Portuguese or international industry prototypes, international companies can also use the test facility. As an example, Bosch has its own factory in Portugal and performs products developments and collaboration projects with LNEG. LNEG can offer testing services in their Laboratories, either for collector testing in an accredited laboratory or other testing services with relevance for material studies. Projects can also be designed in collaboration with industry for product development or development of testing methodologies. Duration of the project depends on the specific needs of industry.

- DLR has a high share of collaboration. 5 to 10 companies are collaborating with DLR solar department. A big burden arises though when making a contract based on another legal regime than the German one, and particularly if the company is located outside the EU. Thus, DLR finds it easier to deal with German companies, as standard procedures are established. PSA has the same problem in Spain. Also, it is important to note that German funds do not allow any non-German industry party, in order to simplify procedures.

- In the last years, the CST-related department in ENEA saw an intense collaboration period with the industry, when the first prototypes of solar collectors came out. A dozen of different industrial contacts can be counted up. Currently, the Italian plant Archimede passed the implementation phase and ENEL, the main Italian national electricity company, took over the industrial contacts and manages the plant.

- PSA is a public entity and must fulfil tight requirements to be in accordance with the Spanish law. In any collaboration agreement, there is an article related on how unexpected discrepancies and problems will be solved in case of dispute. Usually foreign industrial partners request to comply with the law of their country (i.e. The Netherland, France, Germany…) but the Spanish law for public entities does not allow neither arbitration nor to act under foreign laws. This is a major source of concerns that can be partially overcome by relying on the mutual willingness to solve the problems that could arise during the activities and therefore using a light wording (such as "*problems will be solved amicably"*). This is indeed the same problem faced by DLR (see above). Since a couple of years though, the Spanish law sometimes accepts the Belgian law due to the European core in Belgium. This solution can be applied then when dealing with European entities and many industrial partners are fine with this option. Nevertheless, if a non-Spanish company, paying 100 % of the costs to perform specific activities at PSA, wants to apply its own national law in case of disputes, then no agreement and therefore no business is possible. This is another restriction imposed by the current Spanish law regulating the functioning of public entities.

- At CNRS, industrial contracts are mainly agreed with French companies. CNRS has one collaboration with Japan.

- At CTAER, main industry contacts are big corporations. There is no collaboration with SMEs regarding the CST sector so far. CTAER has relations with Moroccan companies on other topics than CST (biomass, phosphates) but also with Chilean companies. For now, this Chilean contact is just a window of opportunities and no contract is yet signed. Currently, CTAER is initiating its first contracts for services with the industrial sector in Spain, providing technical assistance, and is collaborating with companies and institutions in Chile and South Africa.

- The Selcuk University has relations with solar H&C and CPV companies but no CST companies. Their test facilities are not accredited which allows national companies to come and use them flexibly.

- Half of CRES collaborations is long term and the other half is short term and all of them are national – except one with Cyprus. Those collaboration practices are estimated to reach an annual number of ten. CRES uses standard national contracts based on the services provided. Interactions occur with SMEs exclusively, being the only type of industry in the country. CRES can offer pre-design or design studies for CST applications as well as information on solar radiation. Big construction companies working in other fields (wind/construction etc.) interested in the CST sector request also CRES services. The facilities are operated by CRES, as a specific knowledge is required.

- APTL has industry clients – 3 to 5 companies – in the automotive sector since the creation of the lab. Most of them are international and there are no obstacles with the national laws. Research facilities are mainly used by EU or national projects (80 %) but also by industrial partners with bilateral contracts (20 %). For this last configuration, research and services belong mainly to the automotive field as well as materials testing, analysis and characterisation. Also, APTL focuses mainly on Solar Fuels and Solar Chemistry and Materials Research and is not involved in industrial STE applications, although EU-SOLARIS helps in widening the lab activities to the field.

- GUNAM is a centre of Excellence of Turkey on Solar Energy that has collaboration with industry through about ten national and international projects of 4 months to 3 years. The current collaboration mainly focuses on PV. The centre utilises a clean room, a c-Si solar cell laboratory, a thin film PV laboratory, several characterisation laboratories, a central laboratory and a test platform for current and potential collaborations with the industry.

- Since 2002 in Portugal, a constant collaboration with national and international industry is in place, although difficulties exist to find industrials interested in research projects. In 2012, the RE Chair created IPES- Instituto Português de Energia Solar, a non-profit association, integrating an important number of R&D Institutions, companies, energy agencies, financing and insurance institutions and a patent office. IPES is dedicated to contribute to the definition of adequate sectorial policies in Portugal and to add value to the interests and initiatives in R,D&D for the technologies and solutions of its associates, with a particular view towards export markets. In 2014 the RE Chair proposed and got approval for the creation of the Research Infrastructure INIESC, part of the Road Map for new the RIs financed by FCT, which will also integrate LNEG.

It seems that the preferred collaboration format is the national one, for simplification and compliancy reasons and this problem touches especially DLR and PSA. Portugal and APTL seem to succeed in their internationalisation efforts.

2.5. State of CST companies at national level

In this section, we are looking at the national situation and prospects of the CST industry. The information gathered is very unbalanced across the different partner countries. A lot of information has been gathered for Portugal:

In **Italy**, CST is in a start-up phase. There is no secure market prospective or national development plan for the industry, despite the economic incentives set up for CST plants – although ultimately, some efforts were done in this direction. This lack of market prospective prevents companies from investing. In all sectors, there is little interest from the industry to invest in research.

In **Turkey**, there is no mature CST industry. Two Turkish STE-scale companies exist: Hittite solar and Greenway. Since the market is much more mature in the United States, those Turkish companies developed their activities there, where they both have a test facility within NREL. There has not been any collaboration between GUNAM and these two companies in the past.

In Spain, most of the SME that were created to participate in the commercial deployment of STE plants during the period 2007-2013 disappeared when the implementation of new plants was stopped. The lack of resources to participate in the commercial projects promoted abroad has made continuation of their business activities impossible. Only the bigger companies have survived thanks to their involvement in many of the commercial STE plants promoted in other countries, especially in Morocco, United States and South Africa. So, the number of Spanish SME in the CST technology sector is small at present. On the other hand, there is a bunch of bigger companies (e.g., Abengoa, SENER, ACS-COBRA, ARIES,..) that are leading the commercial deployment of STE plants in other countries and are still interested in R&D activities to improve the technology and reduce cost while increasing the efficiencies. These bigger companies are the main entities demanding access to RI and collaboration for R&D activities.

In **Israel**, cooperation with industry is challenging: there is no way to test a system that takes some time to implement or to test a new system. The industry sticks to what already works and is reluctant to any test from the research sector on their existing system.

In **Greece**, there is no CST industry although the country is leader for solar thermal installations. Greece is in a very initial phase regarding CST development and lags behind the other countries. There is only one research centre able to make tests for solar collectors in general, complying with specific standards. The CRES has a strong collaboration with international industrial partners in other sectors but not CST, since CST is not yet a big market in Greece. Nevertheless, CRES can provide a valuable knowledge on design study or measurements for demonstration activities in CST.

In **Cyprus**, the CSP industry is practically non-existent. Despite that, the island-country is the leader globally in per capita installations of solar thermal systems, and it thus hosts a number of small to medium sized companies that deal with flat plate and evacuated tube collectors, usually also active in the booming home-based PV systems. This puts them in prime positions for any shift in focus towards CST. There are also companies involved in EPC contracts of larger STE systems; collaboration with which is actively pursued by the Cyprus Institute.

In **Portugal**:

After its expansion in the first decade of 2000, the Portuguese market has undergone substantial difficulties: market incentives stopped, and many companies lost their market, bringing the Portuguese industrial sector to struggle. Currently, there is no CST plant in Portugal because there is no legal framework associated.

It is currently possible to manufacture collectors and other components in Portugal, as the industry and the engineering for electrical components are good and well implemented. It would make sense to create a cluster of industry in the country to create a capacity for exports. Indeed, Portugal is looking for new opportunities for its economy and solar energy appears to be a strategic choice.

- Previous policy initiatives in Portugal:

During the previous government – i.e. before the crisis – the idea of creating relatively small (+/- 4 MW) demonstration plants of different technologies was popular: there would be some continuity since the companies involved would have been able to move to larger projects in case of success, based on international competition, and few companies would be selected. Then, the new government did not show any kind of interest to this, breaking the possibility of continuation and expansion for successful companies, and investments stopped. Unfortunately, licences were sold and transferred to the photovoltaic sector. A strong push from the STE sector is currently given to the government to raise the interest and to come back to the concept proposed by the previous one, in order to set up commitments, lower tariffs and more academic opportunities. Weather conditions are indeed excellent in Portugal and a proper political will is missing to exploit the resources potential of the country.

- Private sector and research in Portugal:

LNEG reports that there are very few CST companies (not more than half a dozen). The spirit of research is not spread out and the market went down because of the crisis. The University of Evora reports also about the lack of research activities of the industry in Portugal, as they rely on and assemble well proven systems. There is no collaboration between research and industry in a wide scope. Private companies do not want to pay for research, unless good incentives are implemented. Albeit, even with incentives there is not necessarily a response since it has been experienced in the past: Portuguese companies are not even responsive to industrial calls with financial incentives due to the administrative contribution requested, which was seen as a waste of time, even though the core of the proposal was drafted by a third party.

- SMEs and research in Portugal:

SMEs do not have the human resources to deal with administration and to look for the existing instruments. Thus, they focus on short term production and do not get involved in activities which are not contributing to increase the company's turnover. They are not comfortable with administrative interactions with research, and they don't understand the advantages of such collaborations. There is a lack of trust. Industrial issues in Portugal are raised by small companies that are not getting any public fund to develop research activities: they rely on benchmarking and they check what competitors are doing. This statement could actually be extended to other countries.

- Big companies and research in Portugal:

The business with big companies is running (as there is a dedicated administrative department) but they are not specifically looking for research collaboration since they often have their own R&D facilities. They are aware of the research funding available and they get most of it.

- Universities and research in Portugal:

For industry, the collaboration with the University is a good option since a portion of the University budget is covered by the government. Also, the University hosts researchers with a good range of knowledge, which makes this knowledge easily accessible.

Overall, the European CSP policy picture is not brilliant if we consider the countries quoted but we can also extend this remark to the other countries of the consortium.

2.6. Project and collaboration format

We are going now more into details of collaboration between research and industry. Let's see in practice which kinds of agreements are in place among the EU-SOLARIS partners:

- **Competition for national calls** for products development, direct contracts to develop specific research activities, implemented by national funding (Example: Portuguese National Strategic Reference Frame)

- Joint/EU projects

- **Collaboration:** The research centre contributes, with cash and/or in-kind contribution, to the project and requests a portion of the property rights on the product. The part of IPR coming to the research centre is proportional to its contribution. If the company is not interested in taking the patent, the research centre can take it. Tests are made on the demo-plant or RI of the research centre.

Example: The molten salt receiver installed at Gemasolar STE plant is the fruit of collaboration between PSA and SENER where PSA contributed with money and manpower for the prototype testing at PSA. As result, PSA got a fraction of the IP rights, so that SENER must pay a royalty to PSA when developing commercial projects using this receiver.

In most of the cases, the collaboration is limited in time (for SMEs especially) but a steady collaboration can also be put in place.

Example: At CNRS, big corporations (such as EDF, Total etc.) collaborate on large periods (more than 3 years) under a contract of collaboration and share of rights.

- **Contracts of services / Specific bilateral agreements / Subcontracting**: the company takes on the full costs, from manpower to the use of the facilities. Also, big companies look for steady collaboration through broader agreements with a general scope in order to save time and

administrative work redundancies (with a person/month package): it allows them to come last minute and to achieve a specific work rapidly.

- There is a **patent development section** within the WEIZMAN institute: a new company has been created thanks to the involvement of investors. This company takes the patents and sells them worldwide. WEIZMAN works with them on a regular basis.

Also, it is worth mentioning some specific situations that do not fit in any of the above categories and related to the specificities of the country:

Publication vs. patenting (University of Evora):

Applied research is different from fundamental research, although this difference is now fading out. Earlier, publications were the most meaningful parameter for a researcher. Nowadays, the University is financed by the contracts signed with the industry. Therefore, the evaluation of the contribution of researchers in connection with the industry became essential. This issue is closely linked to the debate publication vs. patenting: since it is not possible to publish and patent at the same time – patents prevent from publications – the researcher's reputation must not be based relatively on the number of his/her publications but on the number of patents emerging from collaboration with the industry. In Portugal, this vision is not yet spread and the old scheme is still topical but things are moving little by little in this direction.

Bottlenecks encountered at ENEA, against CST development in Italy:

In the case of system engineering and/or plant construction, ENEA has the know-how for the system of the plant, and transfers it to the collaborating companies. But in those cases, the structural collaboration is usually not maintained and the company leaves with ENEA's know-how.

Regarding the Archimede plant in Sicily, ENEA provided the technology development and the assistance while the executive planning (construction, ordering) was done by ENEL with ENEA's support. The receiver tubes and collectors were patented by ENEA and managed by ENEL. This concept could not be exported because of 3 reasons: very innovative concept (thus not well proven), more maintenance needed compared to regular plants with synthetic oil, and the fact that banks will not take the risk to finance such projects. Those issues did not allow the business perspective needed for companies to go forward.

The specific case of CTAER:

Since CTAER is a private research centre, the power of adjudication is different from the one under public law, but CTAER needs to fulfil a part of the law from the public sector. According to the Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 CTAER is considered as "other bodies governed by public law entities". CTAER has had direct contacts with Spanish companies so far, but is starting to operate in South Africa and Chile.[4]. Normal contracts of services are made between the private entities: CTAER has a 'Foundation Law' and "instructions for contracting" fulfilling the European and Spanish law. This leads to a competitive subvention and contract.

[4] except CST services from Germany, a spin-off of DLR

2.7. Internal administrative management

In this section, we are looking at the administrative aspect of the collaboration between research centres and private companies, especially during the preliminary phase, at the time of the negotiation of the contract: budget, deadlines, intellectual property issues and manpower involved.

Actually the process in each research centre interviewed is pretty similar and is quite a standard approach of contract establishment. Following the description of those standard steps, we present in detail the particularities encountered for some specific research centres:

The common approach is:

- the researchers and technicians involved in the collaboration prepare the technical part of the contract, together with the company;
- they set up the budget and technical details (deadlines, manpower);
- they send this second part to the administrative department – most of the time located at a different place, and the contract is revised by the lawyer and economic officer for compliancy with the rules of the research centre. The standard template is adapted depending on the conditions agreed; case by case contracts are generally set up and big groups can submit their own template;
- they submit this final version to the company for bilateral signature;
- the work can begin.

Overall, no particular difficulty has been identified during such process, which is quite flexible. Negotiations come quickly to an agreement between both parts: the procedure is usually smooth and quick with fair conditions – albeit the law-article for dispute in PSA (see chapter 1.4). Such agreement implementations require the active involvement of both the researchers and the administrative staff, since the administrative part is too much time consuming for the researchers.

When the requests of partnership with the industry are very low, as it is the case in ENEA, it can happen that no dedicated administrative service exists. In this case, the researchers take on them the whole procedure. Hiring an extra person is also foreseeable, if needed.

Some other configurations can also arise depending on the status of the centre: contracts can be signed through the University (Example: GUNAM), or the research centre can subcontract the administrative part (Example: WEIZMAN). In the case of CTAER, funding is requested to the government when initiating a project.

2.8. Misunderstanding and disputes

Besides the normal procedure of contract implementation with the industry, the following section deals with the issues of misunderstanding and disputes: it is indeed an aspect that needs particular attention in the establishment of the EU-SOLARIS participation procedures for the private sector. Lessons learned need to be taken on the basis of previous experiences. The research centres that are not cited in this chapter did not refer to any case of misunderstanding or dispute with the industrial sector.

- Timing differences: (reported by EVORA, DLR, PSA, SELCUK, CRES, APTL)

A trend reported by three respondents regards the incompatibility of timing between the research and the industry sectors. The research centres have to undergo some delays directly linked to the number of sunny days and to the unpredictability of the results. They suffer from pressure from the industry to maintain the deadlines. This can be overcome by clarifying the situation with the company, setting priorities and informing in advance about the delays. It is also a regular practice to re-negotiate deadlines.

- Concerns differences: (EVORA, PSA)

The industry is very much concerned by knowledge protection and fast results. Although researchers take into consideration knowledge protection issues, they are likely to give more importance to the accuracy and reliability of the results than to the duration of the R&D activities. The industry likes especially to have the work under control and has limited flexibility, regardless of the risks induced and the potential slackening of research on prototypes. Those misunderstandings bring difficulties in industry-research relationships.

- Company size issue: (DLR, ENEA)

Start-ups and SMEs have little financial background, and the collaboration with the research centres has to stop during the process as soon as financial constraints arise. With big companies, a problem relates to the fact that they take the knowledge gathered during the time spent in the research centre and then do not use their services anymore.

- Geographical issues: (ENEA)

Difficulties to coordinate the work can arise if an activity requests the implication of different labs geographically spread out.

- Reasons for stopping or not renewing collaborations:

Non-fulfilment of the work agreed, disagreement on budget, bad experience with IPRs (if confidential data is published), suppression of publication or database against the initial agreement, understanding incompatibility, competition between industrial clients can be reasons for not renewing collaboration. If a private partner cannot fulfil its duty, the research centre can request the full value of the contract.

Within CNRS, conflicts with contracts occurred, in the past, on the specific domain of interest. This happened when a company asked exclusivity in one field. If this field is wide, CNRS is not allowed to give

the exclusivity to one company, so this limitation can hinder the set up of the collaboration. This issue is solved when signing the contract, but it can be problematic if tests begin before the finalisation of the contract. This happened only one time but CNRS intends by all means not to repeat it.

Within DLR globally, 30 % of initial contacts with industry do not lead to a final agreement.

- Company withdrawal:

The withdrawal of a company during the ongoing phase of a project can occur for the following reasons: lost of interest (for EU-projects), economic difficulties (industrial projects) or new ownership resulting in priority changes.

On the other hand, more positive results can be reported, where the research centres do not suffer from any time pressure and collaboration goes smoothly, as every detail is always very well defined before starting the work. (WEIZMAN, CNRS, CTAER, LNEG, PSA)

2.9. Intellectual property issues (IPR)

IPR issues are of the most sensitive and important concerns for the private sector, when dealing with public entities. Those issues are broadly approached in the EU-SOLARIS project from several perspectives (WP2, WP4), and they need particular attention. Indeed, this will determine the founding principles of participation of the private sector, and a wrong IPR participation model could be very much penalizing during the operational phase of the project.

Below, an overview of the current IPR practices in place in the different research centres is presented. We can distinguish different degrees of policy severity with respect to IPR:

- LNEG has an internal IPR policy and regulation. No severe policy, regular confidentiality agreements, industrial exclusivity might be considered if requested. .

- The contract between the institute and the company favours the company wishes. The institute does not have a say. (WEIZMAN)

- The two possibilities described below can be seen at ENEA, PSA, CNRS, CRES and LNEG depending on the agreements established with the external entity:

- IPR sharing: when the total cost of the development of a new product or patent is shared by the research centre and the external entity both parties are co-owners of the IPR in a rate proportional to their contributions to the total cost. Commercialisation of the result or patent is subject to the payment of a royalty, which is distributed between the co-owners in a rate proportional to their contribution to the development. Exclusivity for the commercialisation of the IPR is decided on a case-by-case basis.

- IPR commercial exploitation contract: Commercialisation of a patent 100 % developed by the research centre with its own resources is granted with no exclusivity to any external entity willing to commercialise the patent with the payment of a royalty to the research centre.

- At CNRS, the IP-related policy has changed with time in favour of a stronger sharing of IPR. The rights are shared in case of project collaboration. They are not shared if it is a contract of services. Patents belong to who is taking them.

- At CTAER, PSA and APTL, the entity paying has the rights. If companies are paying 100 % of the total costs, they keep an exclusive access and commercialisation rights to the results.

- IPR issues at Selcuk are overseen by the TTO: if Selcuk gets a project, the TTO is in charge of assessing patent application possibilities and seeks for appropriate industrial partners for a potential spin-off creation. The interested researcher(s) would have their time divided between the Techno Park (incubator) and the University. There are also possibilities to obtain financial support for the initial investment through Tübitak[5]: once a project with potential application has been submitted a governmental grant of up to 100 000 € can be awarded. Project holders can also be tax exempted if they install their lab in the Techno Park.

- At CyI, IPR issues do not have a defined policy yet; this is actively worked on and will be ready sometime in 2015.

- The Middle East Technical University (METU) provides technical and financial support for patent applications originating within the University campus including those of GUNAM researchers. For the industrial collaboration projects, it is the most common practice that the company owns the intellectual property and the contributors from the METU/GUNAM only have their names on it, though there are some exceptions based on prior agreements.

- Moreover, a lack of knowledge from the industry has been reported by the University of Evora: companies involved in the setup of a contract were arguing about the potential commercialisation of the product. But if a patent were to be registered, full rights or royalties would be applied depending on the agreement, as a regular procedure. But, in general: no severe policy, regular confidentiality agreements, industrial exclusivity if requested.

However some industry can make a lot of pressure not to use any single element for scientific purposes. It can be a reason to stop collaboration, if the conditions are not clear from the beginning. If the contract conditions of the other partner are demanding, then they have all the rights on the shared work. It makes it difficult to reconcile the purposes of the research and of the industry.

The IPR issues within the University are inherent to the perception of recognition by the research community – described in chapter 1.6 – putting in contradiction the act of publishing and patenting. The University still needs to transmit the message to researchers that it is equally important to have good collaboration with the industry, and that they are open to adapt those measures in the individual evaluation criteria. Actually, it is possible to publish, some time after the patenting – one year at the fastest. But usually, patents are pending for many years.

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The Scientific and Technological Research Council of Turkey (TÜBİTAK) is the leading agency for management, funding and conduct of research in Turkey.

3. Possible new mechanisms to increase collaboration

In chapter 1, the information gathered during the interviews of the EU-SOLARIS partners related to the participation procedures of the private sector in the research infrastructure use was presented. It allowed to better understanding the obstacles encountered by both sides to reach a smooth and active collaboration.

In chapter 2, ideas to foster industry interactions and improve the procedures are presented, on the basis of the information gathered during the interviews. Consequently, the participation formula for industry in the operational phase of EU-SOLARIS will be defined through the MS24.

The following bullet points list the suggestions made by the partners:

- Increase the industry awareness on:
  - national or international calls (Horizon 2020 calls, etc.)
  - research infrastructures and their potential: place, capacities, operational rules, and typical contracts etc. – and especially for SMEs
  - success stories of ongoing projects with industry: companies want publicity
- Set up a network of direct contacts, on the example of the textile industry[6]
- Specifically support SMEs
- Consider horizontal incentives: CST depends much on public policies. Solar collectors should not deal only with STE which relies too much on FiT and policy but they should address other markets such as process heat. Industrial consumption of heat represents 30 % of energy consumption in the EU (as much as electricity as a whole). The most effective way to address solar concentrators' manufacturers is to enlarge the applications (not only STE) in order to avoid relying only on areas where public incentive is available.
- Provide a standardised template for industry contracts and a common interface procedure for all research centres at EU level to deal with confidentiality and dispute aspects with industrials.
- Harmonise international standard: ENEA reports that they have their own internal standard qualifications that are different from the several international ones (EASME, etc.). Collaborating companies are looking for an international recognition; it is a strong bottleneck for ENEA as an

[6] In Portugal, a critical mass to develop innovation was achieved, combining resources, dedicating personal to seek for research funding, developing a network of technological centres and associations, in order to counteract the Chinese concurrence. The experience was a success. One company alone cannot bring critical mass to research.

Italian project cannot be brought out of the country. Issues arise also for molten salt collectors and mirrors where 4 different measuring methodologies exist in the EU.

- Improve the bankability of a project through a better combination of bank, industry and research perspectives that are for now extremely divergent.
- Implement more flexible laws at international level for public institutes, related to staff flexibility and international contracts. EU-SOLARIS, as an international entity, could help in lobbying towards national Ministries.

4. Conclusion

The main administrative and structural aspects of the research centres of EU-SOLARIS were presented in this report. These constitute the essential basis prior to a proper establishment of EU-SOLARIS participation procedures for the private sector and industry, as stated in the DoW.

The collaboration with the industry can be summarised as follows: the current cooperation with the private sector offers a lot of room for improvement and an adjustment for both sides needs to be done. Innovation is at the core of the CST commercial development and market implementation, thus raising awareness to a broader range of companies and spread a more harmonised participation model at international level is required. Indeed, national legislation is still hindering many cooperation opportunities.

Finally, the participation formulas for industry in the operational phase of EU-SOLARIS will be presented in the MS 24.

List of abbreviations and definitions

CSP	Concentrated Solar Power
CST	Concentrating Solar Thermal
CPV	Concentrated Photovoltaics
DoW	Description of Work
EC	European Commission
EPC	Engineering Procurement and Construction
ESFRI	European Strategic Forum for Research Infrastructure
EU	European Union
FCT	Fondation for Science and Technology (*in Portugal*)
FiT	Feed-in-Tariff
FP7	Seven Framework Programme
H&C	Heating and Cooling
INIESC	National Research Infrastructure for Solar Energy Concentration (*in Portugal*)
IP	Intellectual Property
IPES	Portuguese Institute of Solar Energy
IPR	Intellectual Property Rights
MS	Milestone
NREL	National Research Energy Laboratory
PV	Photovoltaics
RE	Renewable Energy
RI	Research Infrastructure
R&D	Research and Development
RTD	Research and Technological Development
SFERA	Solar Facilities for the European Research Area
SME	Small and Medium Enterprise
STE	Solar Thermal Electricity

TTO	Technology Transfer Office
WP	Work Package

ANNEX

Solar KeyMark:

The Solar Keymark was created to certify solar thermal products of high quality at European level. The aim is to reduce trade barriers and promote the use of high quality solar thermal products in the European market and beyond. It is a voluntary third-party certification mark for solar thermal products, demonstrating to end-users that a product conforms to the relevant European standards and fulfils additional requirements. The Solar Keymark is used in Europe and increasingly recognised worldwide.

The Solar Keymark is a CEN/CENELEC European mark scheme, dedicated to:

- Solar thermal collectors (based on European standard series EN 12975)
- Factory made solar thermal systems (based on European standard series EN12976

The Solar Keymark was developed by the European Solar Thermal Industry Federation (ESTIF) and CEN (European Committee for Standardisation) in close co-operation with leading European test labs and with the support of the European Commission.

More information can be found at http://www.cen.eu/pages/default.aspx