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Bridging Gaps: Relevance, Success Factors and Challenges of Implementing Personnel Exchange in Intersectoral Energy R&D Collaboration

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IMPRESSUM

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Bridging Gaps: 
Relevance, Success Factors and Challenges of Implementing Personnel Exchange in Intersectoral Energy R&D Collaboration

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**Abstract**

R&D collaborations, including intersectoral partnerships involving both academia and industry, have a proven track record of fostering innovation, especially in highly specialized technological fields. However, challenges can arise in terms of knowledge transfer and trust building between the partners due to differences regarding strategic objectives, motivations and interests, organizational culture as well as the often ‘virtual’ nature of such initiatives. Appropriate HRM measures to counteract this risk are therefore required. Personnel exchange (PE) between R&D partners of different sectors and institutions is one such potential measure. However, PE is currently not a routine 'tool' in intersectoral R&D collaboration. To gain insights into key factors influencing the successful implementation of PE in an intersectoral context, a qualitative survey with 24 key executives in both academia and industry has been carried out. Results indicate that there is an underlying interest in such measures. However, implementation suffers from important barriers such as (1) missing personnel resources, (2) employee motivation, (3) career considerations, (4) IP/disclosure issues and (5) financial resources. Furthermore, a need to increasingly raise awareness in academia and industry regarding the value and benefits of intersectoral PE as well as to enhance information flow in terms of existing concepts has been identified.

**Keywords:** Intersectoral collaboration, knowledge transfer, personnel exchange, R&D collaboration, trust
I. Introduction

Sustainable energy supply is a major driver for industrial and social development. In the light of current issues including the growing scarcity of fossil resources (e.g. Shafiee & Topal, 2009), safety concerns regarding nuclear power (e.g. Davies, 2011) and the inability of renewables to cover global energy requirements (e.g. Dorian, Franssen, & Simbeck, 2006), there is thus a need to intensify goal-oriented research and development (R&D) in the field of energy technology in order to effectively address these challenges.

R&D partnerships in the form of collaborative projects between organizations with complementary expertise have a proven track record of driving innovation in highly specialized technological fields (e.g. Deeds & Rothaermel, 2003; Dodgson, 1993; Faems, van Looy, & Debackere, 2005; Hagedoorn, 2002). Energy R&D partnerships can therefore help to address the current challenges. However, collaborations and especially those with multiple partners from both the academic and the industrial sector, are highly challenging because of various administrative, organizational and management issues they face, not to mention the potential clash of 'cultures' and interests (Davenport, Davies, & Grimes, 1998; Porath, 2010). Different authors have investigated this topic in order to better understand and address these issues. Related findings suggest that although R&D collaboration is an innovation driver (e.g. Deeds & Rothaermel, 2003; Dodgson, 1993; Faems et al., 2005; Hagedoorn, 2002), failures of such initiatives are not uncommon (e.g. Harrigan, 1986; Lawton Smith, Dickson, & Smith, 199; Lhuillery & Pfister, 2009).

Therefore, a crucial question for managers or policy makers who have to plan or manage R&D collaborations is how to effectively organize and successfully run them. Human resource management (HRM) is key to address a number of challenges associated with collaborations (e.g. Devlin & Bleackley, 1988; Dodgson, 1992; Pucik, 1988). Thus R&D collaboration requires skillful managers (e.g. Devlin & Bleackley, 1988) who can counteract these potential problems through applying appropriate HRM measures. One challenge they have to address is the involvement of partners...
from different sectors and backgrounds with potentially diverging motivations and objectives. Another barrier is the often virtual nature of such partnerships (e.g. DeRosa, Hantula, Kock, & D'Arcy, 2004; Harvey, Speier, & Novecevic, 2001; Kerber & Buono, 2004). In the energy context, this is especially the case when the respective partners work on highly specialized and often large-scale equipment (e.g. demonstration power plants) which binds them to the locations of their original institution. This ‘distance’ not only in terms of mindset but also in terms of geography can impact the relationship between the partners through impaired knowledge transfer (e.g. de Long & Fahey, 2000; Inkpen & Dinur, 1998) and limited opportunities for trust building (e.g. Dodgson, 1993; Kelly, Schaan, & Joncas, 2002; Parkhe, 1998) – two crucial aspects necessary for fruitful partnerships and a positive collaboration outcome (e.g. Dodgson, 1993; Inkpen & Dinur, 1998; Kelly et al., 2002; de Long & Fahey, 2000; Parkhe, 1998).

One particular HRM measure to manage the aforementioned challenges is personnel exchange (PE) between collaborating organizations. For this paper, PE is defined as

- a temporary secondment of R&D personnel from an industrial company into an academic research institution

or vice versa as

- a temporary secondment of R&D personnel from an academic research institution into an industrial company

Through PE, employees have the opportunity to be integrated into the environment of the collaboration partner. This can thus enhance personal relationships, mutual understanding and encourage team building between employees from different partner organizations (e.g. Mitchell, 1996; Neweling & Sonnek, 2006; Sabisch, 2003). Theoretical benefits of PE have been acknowledged in the literature (e.g. Mitchell, 1996; Neweling & Sonnek, 2006; Sabisch, 2003; Schmiemann & Durvy, 2003). These include the successful transfer of knowledge, improved
communication as well as a strengthening of relationships between collaboration partners (e.g. Mitchell, 1996; Neweling & Sonnek, 2006; Sabisch, 2003; Schmiemann & Durvy, 2003). However, PE does not seem to be widely used in intersectoral R&D collaboration in practice (e.g. Sabisch, 2003; Beckert, Bührer, & Lindner, 2008; Lambert, 2003; Lo, Kulicke, & Kirner, 2005). To the best of our knowledge, existing literature cannot provide adequate insights into how different stakeholders in intersectoral R&D collaborations perceive PE and the challenges they face in implementing such measures.

To address this gap and to gain insights into PE in energy R&D collaboration, this study investigates who and what really matters in successfully implementing PE in such a context. The specific objectives of this paper are (1) to investigate challenges associated with the implementation of PE, (2) to understand the extent and form of current PE measures, and (3) to unveil how the interviewed stakeholders perceive PE.

This paper is structured as follows: the study context will be presented by reviewing some selected literature on intersectoral R&D collaboration and will subsequently present a rationale for PE. This is followed by an outline of the specific research objectives and the methodology of our survey. Furthermore, results will be presented and discussed. Eventually, conclusions and implications for further research will be provided.

II. Study context

1. Intersectoral R&D collaboration

There is broad consensus among scholars that innovation is a crucial element for the long-term survival and growth of firms (e.g. Baumol, 2002; Schumpeter, 1939). This insight provides the basis for extensive research on the matter and various factors influencing technological as well as commercial innovation have been
identified. According to van der Panne and colleagues (2003), corporate culture and structure, the composition of R&D teams or the firm’s management style can play a decisive role in terms of technological innovation potential. One major element of these factors influencing innovation is R&D collaboration. Interorganizational collaboration has been shown to positively influence the innovation activities of the involved parties (e.g. Deeds & Rothaermel, 2003; Dodgson, 1993; Faems et al., 2005; Hagedoorn, 2002) and enables companies to increase their strategic flexibility, which is required in many industries where inter-firm competition is affected by increased technological development, innovation races and the constant need to generate new products (e.g. Hagedoorn, 2002).

Besides inter-firm collaboration in the form of for instance contractual partnerships or joint ventures, intersectoral collaboration between academia and industry - often as ‘triple helix’ partnerships with assistance provided by governmental funding partners - is considered as especially promotive for driving technology transfer and allows firms to integrate innovative approaches and to transfer them into marketable products (e.g. Becker & Dietz, 2004; Betz, 1997; Etzkowitz, 2002; Oetker, 2008). Especially during the past three decades, this form of R&D collaboration has increasingly become a measure to drive innovation in highly specialized technologies (e.g. Corley, Boardman, & Bozeman, 2006; Boardman & Bozeman, 2006).

Increased realization of ‘triple helix’ projects also applies to the energy sector, where practitioners, scholars and policy makers recognize the benefits of and the need for bundled R&D activities (e.g. Foxon, Gross, Chase, Howes, Arnall, & Anderson, 2005; Gallagher, Holdren, & Sagar, 2006; Hanebuth & Lee R. P.; Philibert, 2004; Worrell, van Berkel, Fengqi, Menke, Schaeffer, & O. Williams, 2001). National programs supporting intersectoral R&D activities in the energy context have been deployed in many countries based on the initiative of policy makers. An example for such a program is the German ‘Energy Research Program of the Federal Government’. In the context of this initiative the German Federal Government has allocated approximately € 3.5 billion for funding the research and development of energy technologies between 2011 and 2014 (representing an increase of about
75% percent on the corresponding program period from 2006 to 2009) (BMWi, 2011). As illustrated by the following quote the program focuses on intersectoral approaches for fostering innovation in this field: “Collaboration between industry, science and state funding policy is vital for the successful development and market introduction of new energy technologies” (BMWi, 2011). Further examples from other countries for such national programs driving intersectoral energy R&D collaboration include the ‘Advanced Energy Initiative (AEI)’ in the USA, which was launched in 2006 (e.g. Milliken, Joseck, Wang, & Yuzugullu, 2007) and the establishment of the ‘Carbon Trust’ in the UK in 2001 (Kern, 2008).

However, although being commonly viewed as ‘innovation incubators’, such multiple-partner R&D partnerships are highly challenging. They face various problems on administrative, organizational, social and management levels (e.g. Davenport et al., 1998; Porath, 2010), which can potentially lead to complications, delays or even failures of collaborative exercises (e.g. Dodgson, 1992). Literature shows that problems not necessarily occur only in intersectoral settings, even collaborations within one sector experience difficulties. Lawton-Smith and colleagues (1991) for instance identify in a series of case studies issues arising in innovation-based collaborations between small and large firms. Their findings show that problems mainly evolve around acceptance of innovations provided by the partner organization (‘not invented here’ syndrome), loss of control over the direction of a project and differing priorities between the partners (Lawton Smith et al., 1991). On a more quantitative level, Harrigan (1986) finds that in a sample of 895 inter-firm joint ventures, only 45% were rated as being successful. A third example highlighting R&D collaboration outcome difficulties is provided by the analysis of data from the ‘French Community Survey (CIS)’ by Lhuillery and Pfister (2009). The authors add to the aforementioned observations by pointing out that “14% of R&D collaborating firms had to abandon or delay their innovation projects due to difficulties in their partnerships”. This was especially the case for firms collaborating with competitors and those running projects together with public research organizations – bringing us back to the challenges of especially intersectoral collaboration.
In the light of the aforementioned facts, the importance of identifying and implementing factors, which can counteract negative developments of R&D partnerships, becomes evident. A number of scholars have attended to this matter and investigated success factors for specifically intersectoral R&D collaboration (e.g. Barnes, Pashby, & Gibbons, 2002; Elmuti, Abebe, & Nicolosi, 2005; Mora-Valentin, Montoro-Sanchez, & Guerras-Martin, 2004). Adding considerations from interorganizational collaboration in general to broaden the picture, two critical factors for successful partnerships, among others, emerge: (1) **knowledge transfer** (e.g. Cummings & Teng, 2003; Criscuolo & Narula, 2007; Inkpen & Dinur, 1998, Lam, 2004) and (2) **trust** (e.g. Barnes et al., 2002; Das & Teng, 1998; Davenport et al., 1998; Dodgson, 1993; Mora-Valentin et al., 2004; Parkhe, 1998). The following sections highlight important implications of these two factors and will subsequently investigate the role human resource management can play in fostering them - with a special focus on PE.

### 1.1. Knowledge transfer

In the context of interorganizational collaboration exchange of information between the partners is key and it is decisive in which form existing or newly acquired knowledge will be transferred between collaborating organizations and individuals (e.g. Cummings & Teng, 2003; Criscuolo & Narula, 2007; Inkpen & Dinur, 1998, Lam, 2004). Especially the transfer of so-called ‘tacit’ knowledge, i.e. knowledge, which cannot be easily codified but requires close personal contact between the collaborating individuals to share personal dimensions including experiences, interpretation and emotions, plays a substantial role for efficient and goal-orientated knowledge transfer (e.g. Cavusgil, Calantone, & Zhao, 2003; Nonaka, 1994; Roberts, 2000; Rynes, Bartunek, & Daft, 2001). In 1994 Ikujiro Nonaka set the scene for such considerations by publishing his model of the “spiral of organizational knowledge creation” (Nonaka, 1994 p. 20). In this much cited seminal paper he proposed that “tacit knowledge held by individuals may lie at the heart of the knowledge creating process” (Nonaka, 1994 p. 20). According to Nonaka, especially individuals with broad experience of ‘high quality’, i.e. whose hands-on experience is not limited to routine operations (e.g. research scientists, senior staff in the industrial sector)
accumulate significant levels of tacit knowledge. Tacit knowledge is important to transfer within an organization to support its knowledge creation process (Nonaka, 1994 p. 21). It is therefore crucial for R&D collaborations to be established in a way to allow and support tacit knowledge transfer.

1.2. Trust

Trust building between collaborating individuals and groups has been identified as another crucial success factor for collaborative projects (e.g. Barnes et al., 2002; Bardach, 1998; Büchel, 1998; Das & Teng, 1998; Davenport et al., 1998; Dodgson, 1993; Mora-Valentin et al., 2004; Parkhe, 1998). Only in the case of an organizational climate, which is characterized by trust, a partnership can persist throughout difficult periods (e.g. Dodgson, 1993). Especially in the starting phase of collaboration the risk for misunderstandings, cultural clashes or relational problems is high and trust building therefore particularly important (e.g. Büchel, 1998; Kelly et al., 2002). In a survey assessing the management of alliance relationships in early stages, Kelly et al. (2002) have found that the most critical issues impeding trust building in early collaboration stages relate to people and relationships in the alliance. Problems specifically arise around communication, such as misunderstandings between the partners due to physical distance and an associated lack of face-to-face communication, personality conflicts and organizational

2. Human resource management (HRM) in intersectoral collaboration

The need for transfer of implicit knowledge as a basis for successful knowledge creation and for creating opportunities to build trust through improved communication mechanisms in collaborative settings requires specific management approaches. Specifically, human resource management (HRM) can be a central element impacting knowledge management (e.g. Soliman & Spooner, 2000; Yahya & Goh, 2002) and should create opportunities that enhance the "building of emotional intelligence of groups", which will lead to trust, identification and efficacy within a
team (e.g. Druskat & Wolff, 2001). One major element of such a process is intensified face-to-face interaction and communication between the members of a team, i.e. the collaboration partners (e.g. Collins & Smith, 2006; Yahya & Goh, 2002). In intersectoral R&D collaborations, which at the most represent virtual organizations, face-to-face contact needs to be specifically initiated and planned based on the physical distance between the partner organizations and their employees involved in the joint activities. Besides for instance informal one-off interactions, regularly scheduled team meetings or jointly visited events, one particular enabler of face-to-face interaction in intersectoral R&D collaboration can be personnel exchange (PE).

2.1. Personnel exchange (PE) in intersectoral R&D collaboration: benefits, examples and challenges

2.1.1. Benefits of PE

PE allows collaborating partners to entirely immerse in the environment of the partnering institution for a given period of time (e.g. Höfer, 2005; Lam, 2004; Neweling & Sonnek, 2006). This close working relationship supports the partners in gaining an understanding of the framework, motivations, practices and challenges their collaborators are confronted with. In the literature PE is discussed as a potential measure to support the success of collaborations in different ways (e.g. Lam, 2004; Lambert, 2003; Neweling & Sonnek, 2006; Pleschak, 2003; Ritter, 1999). The benefits, which are attributed to PE in collaborative R&D settings, fall into the following categories: (1) qualification/competence benefits, (2) human resource benefits, (3) transfer benefits and (4) network benefits. As the following paragraphs will demonstrate, these benefits have on the one hand a valuable positive impact on various aspects relating to the individual partners of a collaborative exercise. And, even more important for collaboration outcomes, they support the two key factors described above, i.e. knowledge transfer and trust in collaborations.
Qualification/competence benefits:

When R&D staff members participate in PE they benefit from an immersion into a new and different work environment. They collaborate with partners at their respective locations and have the opportunity to acquire new skills and work methods. They will learn to handle new equipment and potentially improve social skills due to the need to adapt and adjust to new colleagues and personalities. PE can thus be viewed as a form of ‘training period’ for the exchanged staff. In a study evaluating a national program of the German Federal Government for the promotion of the innovation competence of SMUs (‘PRO INNO II - Programm zur Förderung der Erhöhung der Innovationskompetenz mittelständischer Unternehmen’) Lo et al. (2005) find that participating SMUs view these training effects and the associated improved qualification of their staff as major advantages of PE. Complementary to the immediate benefits of this ‘training effect’, the newly acquired skills will in addition subsequently strengthen the organization’s internal innovation competence (e.g. Kulicke, Bührer, & Ruhland, 2006; Neweling & Sonnek, 2006).

Human resource benefits:

Further benefits associated with PE in the literature relate to human resource issues. According to Lam (2004 p.25) exchanges between industry and academia can lead to “the creation of a pool of human resources”, i.e. “the ‘linked scientists’, who engage in the practices of both science and business and work on common projects in collaborative teams”. Scientists from the academic sector can be viewed as ‘network nodes’ and companies working with them on collaborative projects, especially on a long term basis, can regularly draw upon them when needed (e.g. Lam, 2004). Furthermore, PE has been described as a potential measure to retain qualified personnel by offering incentives in terms of acquisition of new competences by spending time in the partnering organizations (e.g. Lo et al., 2005).

Transfer benefits:

One of the main advantages and drivers for PE is effective knowledge and technology transfer (e.g. European Commission, 2012; Lam, 2004; Lambert, 2003; Lo et al., 2005). From an industry point of view, PE is considered as especially
effective for entering a new technological field as know-how can be transferred without necessarily committing to another organization or corresponding specialized staff on a long-term basis (e.g. Hicks, 1993; Lo et al., 2005). Especially the transfer of tacit knowledge is key (Hicks, 1993) as it requires personal contact between the exchanging parties to transfer ‘uncoded’ skills and experiences by physically working together. This knowledge dimension can hardly be transferred in any other way (e.g. Nonaka, 1994).

**Network benefits:**

Collaboration is an excellent way to build and fortify networks between organizations, which are active in similar professional environments and can benefit from each other (e.g Lam, 2004; Neweling & Sonnek, 2006; Ritter, 1999). To build effective networks, relations between the partners should go beyond formal organizational structures, so that personal relationships between collaborating individuals can emerge and strengthen the ties between the collaborating parties (e.g. Neweling & Sonnek, 2006; Ritter, 1999). This, in return, will help to create a network environment of trust (e.g. Kelly et al., 2002; Lam, 2004). PE is a very appropriate measure to support network building and to strengthen the “network competence” of organizations (e.g. Ritter, 1999) and can positively influence the management of emerging network interfaces between collaborating institutions (e.g. Lam, 2004). Furthermore, the joint activities of staff involved in PE will result in a knowledge base, which is specific for the collaboration network (e.g. Neweling & Sonnek, 2006).

The aforementioned benefits demonstrate that PE is a measure having the potential to positively influence the collaboration process and by this the associated outcome. Figure 1 visually summarizes this observation.
The previous sections have touched on the benefits of PE and provided a rationale for it in research collaboration. Following this description, some examples of programs supporting intersectoral PE with a special focus on related uptake issues, which can be identified in all three program examples, will now be provided. This observation will lead to the conclusion that challenges impeding the implementation of such programs must exist.

2.1.2. Examples of intersectoral PE in R&D collaboration and related uptake issues

PE in the context of research activities takes places under various circumstances and in different settings. Before concentrating on three concrete examples of programs supporting intersectoral PE between industry and academia, it should briefly be emphasized that the most common and best described form of PE in a research context is purely academic staff mobility. Academic exchange schemes have, as opposed to intersectoral PE, a long history based on the well-established idea of
spreading knowledge and globalizing education and research (e.g. Altbach & Teichler, 2001; Welch, 1997). Hence, various schemes and programs of academic PE have been developed over the last decades, especially to promote the internationalization of research staff and the institutions themselves through international exchanges. Examples for such initiatives are the European ERASMUS program, the European Marie Curie Fellowships, exchange activities sponsored via the German Academic Exchange Service (DAAD), the American Fulbright exchange program or the UMAP exchange program for the Asian-Pacific region. These programs aim at supporting the globalization of academic teaching and research activities as well as the improvement of knowledge transfer between academic institutions in different countries through supporting student and staff mobility (e.g. Altbach & Teichler, 2001; Welch, 1997).

Intersectoral PE however appears to have less formal support mechanisms at its disposition than academic PE. Also it seems to be applied in a rather infrequent manner (e.g. Sabisch, 2003; Beckert et al., 2008; Lambert, 2003; Kulicke et al., 2006). However, we want to cite and touch on three examples of intersectoral PE programs: (1) The European Marie Curie Industry-Academia Partnerships and Pathways (IAPP) (ongoing), (2) the ‘innovation assistant program’ offered by a majority of German Federal States (ongoing), and (3) the program module ‘personnel exchange’ of the ‘program for the promotion of the innovation competence of SMUs’ of the German Government (closed since 2008 and replaced by the ‘central innovation program for medium-sized enterprises (ZIB)’ since).

Example 1: The Marie Curie Industry-Academia Partnerships and Pathways (IAPP)

- **Background:**

The Marie Curie Industry-Academia Partnerships and Pathways (IAPP) program supports the collaboration and knowledge transfer between public institutions (universities, research organizations) and firms. Based on a research program, which must previously be agreed between the participants, personnel involved in the
collaborative project will be exchanged. It is required that at least two participants from two different EU member or associated states and of two different sectors (public, private) join the project. PE can last up to 24 months and always has to be of intersectoral nature. In this context, the EU financially supports the personnel costs for the PE as well as some additional costs related with the research activities (European Commission, 2012).

The following quote from the IAPP information page of the European Commission, addressed at university representatives, illustrates what IAPP is all about:

“Research and business have to work hand in hand. For their own good and for society as a whole. To compete on world markets, Europe’s industry needs the fruits of your research. And you need the extra resources that industry can put in. That’s why we at Marie Curie Actions have been building up Industry-Academia Partnerships and Pathways (IAPP). They help public and private research to work together. Partners include universities and companies of all shapes and sizes. Focusing on joint research projects, IAPPs aim to boost skills exchange between the commercial and non-commercial sectors.” (European Commission, 2012).

- **Identified uptake issues:**

IAPP application statistics are available for the years 2008, 2009 and 2011 (Nationale Kontaktstelle Mobilität, 2012). Although data of the various Marie Curie funding schemes and fellowships are difficult to compare as they differ in design, required number and type of partners, overall budget, etc. statistics indicate that the number of IAPP applications and allocations are by far lower than purely academic collaboration and mobility schemes (Nationale Kontaktstelle Mobilität, 2012). Furthermore the numbers of IAPP applications have significantly decreased between 2009 and 2011 (2010 data are not available) from 356 to only 165. Conversations with the ‘EU co-operation office of the scientific organizations’ (‘Kooperationsstelle EU der Wissenschaftsorganisationen, KOWI’) in Bonn (Germany) and several international university offices confirm the trend observed in the Marie
Curie data. The respective staff members underline that intersectoral mobility represents a minority as measured by the sum of all exchanges and secondments they come across.

**Example 2: The ‘innovation assistant’ program of the German Federal States**

- **Background:**

  The ‘innovation assistant’ program of the German Federal States also aims at knowledge transfer between public research organizations and firms (especially SMUs). Nearly all Federal States offer this program, which is financed via regional public banks associated with the respective state governments. In the case of Saxony (one of the 17 German Federal States) for instance, it is the ‘Sächsische Aufbaubank (SAB)’, which provides the funds for the Saxon ‘innovation assistant’ program. The program comprises two main aspects: (a) funding of graduates and (b) funding of senior scientists and engineers with at least five years of work experience (they must be employed by a research organization). In the case of successful applications, the candidates will be placed for a defined period of time in SMUs to support innovative research projects (Sächsische Aufbaubank, 2012).

- **Identified uptake issues:**

  Data from the ‘innovation assistant’ program in Saxony underline the observation that programs fostering intersectoral PE in R&D suffer from limited uptake. The data reveal that only two exchanges of senior scientists have taken place through this program between January 2007 and December 2011 (data drawn from preliminary allocation statistics kindly provided by the SAB).
Example 3: The ‘program for the promotion of the innovation competence of SMUs’ of the German Government (PRO INNO II)

- **Background:**

The third example of intersectoral PE programs we want to briefly touch on is a project variant called 'personnel exchange' of the ‘program for the promotion of the innovation competence of SMUs’ of the German Government ('PRO INNO II - Programm zur Förderung der Erhöhung der Innovationskompetenz mittelständischer Unternehmen'). This program ran from 2004 to 2008 and was initiated by the German Federal Ministry of Economics and Technology (BMWi). The aim of this initiative was the sustainable support of the innovation power and the competitiveness of SMUs, craftsmanship and freelancers. Through co-operative agreements between firms and non-profit research organizations the development of promising innovative technologies should be fostered. Four project variants were available in this program: co-operation projects between SMUs, co-operation projects between research organizations, co-operation projects between SMUs and research organizations and PE between research organizations and SMUs (e.g. Kulicke et al., 2006).

- **Identified uptake issues:**

A subsequent evaluation of the PRO INNO II by the Fraunhofer Institute for Systems and Innovation Research (ISI) in Karlsruhe (Germany) demonstrates that PE was not a preferred form of collaboration in the PRO INNO II sample. As measured by the other three program variants the option 'personnel exchange' was chosen least of all by the collaborating organizations. Similar to what is observed based on the Marie Curie IAPP applications, there also is a decreasing trend for this program variant (-13% of grant allocations for the PE in the context of PRO INNO II compared to the previous round which was called 'PRO INNO' and ran before PRO INNO II) (e.g. Kulicke et al., 2006).
The above three raised examples of intersectoral PE programs summarize an apparent issue: policy makers recognize the need and benefit of interchange between academia and industry in the form of PE and translate this into the design of corresponding programs. However it seems that such programs are rarely made use of. This suggests that significant challenges impeding the implementation of intersectoral PE exist.

2.1.3. Challenges of PE

The previous paragraphs illustrate that intersectoral PE suffers from low uptake, which indicates the existence of barriers discouraging academia and industry stakeholders from using related programs. In order to potentially address these barriers, insights on them need to be gained.

However, to the best of our knowledge, there is no in-depth investigation of intersectoral PE in the R&D context and of factors influencing its implementation in the literature. At the most, challenges associated with PE may be derived from publications on (especially short term) international assignments or professional secondments on a rather general level. These challenges include administrative questions regarding assignments in terms of for instance taxation, work permits, appraisal or compensation (especially in organizations having limited assignment experience) (e.g. Barkworth, 2004; Collings, Scullion, & Morley, 2007; Tahvanainen, Welch, & Worm, 2005), relational/marital problems due to the temporary absence of the secondee from his/her home location (e.g. Tahvanainen et al., 2005), the adaptation of the secondee to the new environment (e.g. Tahvanainen et al., 2005), or a lack of creation of practical opportunities for staff exchange (e.g. Marsden, 1997). However, these potential issues are not specific for (a) intersectoral PE or (b) the R&D context, nor are they (c) specifically attributable to the field of energy technology.

Therefore a research gap in terms of investigating factors influencing the implementation and especially associated barriers of PE in the context of
intersectoral energy R&D collaboration can be identified. This paper will address this gap and thus help to gain an understanding of the currently low uptake of existing intersectoral PE programs as well as support the development of appropriate measures facilitating PE implementation.

III. Research concept

The theoretical background of this study and the identification of the aforementioned research gap lead to three research questions. As mentioned above, the currently low uptake of intersectoral PE programs suggests that barriers impeding the implementation of intersectoral PE exist. Hence, the main objective of this study is (1) to investigate these challenges. In order to furthermore gain a broader and more fundamental understanding of PE in the intersectoral energy R&D collaboration setting, two more research questions have been formulated: (2) what is the extent and form of current PE measures in the aforementioned setting and (3) how do the relevant stakeholders (i.e. senior academic and industry executives) perceive PE?

These points will help to gain insights into who and what really matters in successfully implementing PE and will in particular shed light on specific difficulties and barriers impeding intersectoral PE from having a greater uptake. Figure 2 illustrates the three research questions of this paper in a conceptual context.
IV. Methodology

1. Participants

A pilot study on PE in the field of energy technology has been carried out between November 2011 and March 2012. The study comprises 24 semi-structured qualitative interviews (see Appendix A for an overview) with (a) companies active in the energy technology field (n=10), (b) energy technology-related chairs and/or institutes of universities (n=8) and (c) both industry (n=2) and academia (n=2) HR departments as well as (d) academic international offices (n=2). All interviewees hold senior positions in their respective organizations.

2. Design

The discussion guide for the interviews has been elaborated based on (1) examples drawn from relevant literature (e. g. Atzorn et al., 2010; Frank et al., 2007) and (2)
preliminary discussions with academic and industry executives involved in intersectoral R&D collaboration.

2.1. Interview details

The 24 interviews of this study were carried out via semi-structured interviews and the majority was held face-to-face (n=14). Face-to-face interviews are very effective for research interviews as the personal contact between the interviewer and the interviewee supports rapport building and therefore enhances the involvement of the interviewee and the quality of the responses (e.g. Gubrium & Holstein, 2004). Where face-to-face interviews were not possible due geographical distance, conflicting schedules or preference of the interviewees, in-depth telephone interviews (n=10) were conducted.

Interviews with industry managers (I) and university executives (A) lasted between 45 and 90 minutes, interviews with HR (HR_I and HR_A) and university international offices (IO) executives lasted between 20 and 45 minutes. The majority of the interviews (n=21, all I and A interviews) was audio-recorded and transcribed for analysis. In three cases (1 HR_I, 1 HR_A and 1 IO) audio-recording was not possible and was replaced by note taking.

2.2. Topics covered in the discussions

 Appendix B summarizes the topics and types of questions, which were addressed in the main interviews (I and A). The interview guide comprises two main sections. Section 1 was designed to gain insight into the types of R&D collaborations carried out by the respondents’ institutions, the incentives for participating in such projects, the types of interactions in collaborations and perceived success factors influencing the outcome of these projects. Section 2 explicitly addressed PE by questioning the interviewees about potential relevant experience, discussing different PE timespan concepts and framework conditions as well as barriers impeding the realization of PE.
HR (HR_I and HR_A) and IO interviews were conducted with shorter and modified versions of the questionnaire. All discussions were individually adapted to the respective experience, circumstances and settings.

V. Results

All interviewees collaborate on a regular basis with partners from different sectors. Collaboration projects vary from bilateral research agreements to large-scale joint research programs involving government funding and multiple, intersectoral partners. The findings presented in the following sections are structured as follows: (1) Results regarding the main research question, i.e. barriers associated with PE in R&D collaboration are presented first. This is followed by (2) a description of the current state of intersectoral R&D collaboration in the field of energy technology and finally (3) perceptions of PE by the stakeholders are reported.

1. Barriers impeding PE in intersectoral R&D collaboration

As the current and apparent low implementation level of PE suggests, different barriers impede it from being a routine HRM measure in intersectoral R&D collaboration. The barriers identified in our interviews can be categorized into: (1) missing personnel resources, (2) employee motivation, (3) career considerations, (4) IP/disclosure issues and (5) financial resources. Table 1 provides a summary of the revealed constraints.
Table 1: Identified barriers impeding PE in the context of R&D collaboration

<table>
<thead>
<tr>
<th>Barriers impeding PE in the context of R&amp;D collaboration</th>
<th>Details of barriers</th>
</tr>
</thead>
</table>
| (1) Missing personnel resources                         | - Secondments leading to staff shortage  
                                                        | - Visiting staff capturing internal personnel resources |
| (2) Motivation of the employees to be exchanged          | - Unwillingness to temporarily leave the personal social context (e.g. family)  
                                                        | - Unwillingness to temporarily leave the work position in the home organization |
| (3) Career issues                                       | - Post-PE career considerations |
| (4) IP/disclosure issues                                | - Risk of unintended knowledge transfer → need for sound contracts upfront |
| (5) Financial resources                                 | - Who pays when for whom and what? → uncertainties in terms of how to proceed |

1.1. Missing personnel resources

The nature of PE implies that involved institutions will either temporarily ‘loose’ (i.e. send someone on a secondment) or ‘gain’ (i.e. receive staff from a partner organization) staff members. The first case (secondments), i.e. when personnel is being sent to a collaboration partner for a specified period of time, implies that the sending institution has enough resources to cope with the employee’s absence during this period. Our survey reveals that this is actually seen as a crucial issue and perceived as the biggest constraint of PE. The following quotes highlight this aspect.

“If someone is strongly integrated in the company structure, there is no way I can do without this person for three months or so. It is theoretically possible but personally I have never seen such a case.” (I3)

“What we have done this year based on a request of the board is a co-operation agreement involving personnel exchange. But filling this with life is a problem. I always say: ‘This is where real life starts!’ At the moment the motivation is big, the purpose is understood but looking at the current staffing level I cannot say that I can easily send someone away.” (HR_I1)
The identified capacity problem is seen as especially prominent in the case of secondments. However, when staff is received in an organization in the context of PE, the interviewees feel that, despite the visiting employee being a highly skilled worker with marked competencies, he will require a training period and time to integrate in the new work environment. Internal staff will be necessary to provide this training and help the new team member to ‘find his way around’. Hence, some respondents are concerned that internal personnel resources might not be strong enough to cope with the supervision of externals and also identify this requirement as a capacity issue - although being less prominent than the perceived problems with secondments.

“... and – as opposed to sending people away – when I receive an external employee he has to be taken care of by our staff, which binds additional resources, too.” (I9)

1.2. Motivation of the employees to be exchanged

The discussions of our survey have been conducted with senior executives in the corresponding institutions, i.e. professors or equivalent in the academic setting and managers in leading positions in the industry. Regarding the implementation of PE, the role of these stakeholders is supervisory, i.e. it is their subordinates, who will participate in PE and not themselves. Hence, there is an important second stakeholder group: the employees to be exchanged. One particular issue raised in this context is the motivation of the concerned employees to accept PE assignments. The interviewed executives comment that in their view, the motivation depends to a great extent on the personal situation of the employees: marital status (i.e. unwillingness to temporarily leave the family) or degree of social integration in the home region (i.e. unwillingness to temporarily separate from friends and social activities) can play a role.

“If they are single, it is not a problem, but if they have a family it is more difficult.” (I3)
Furthermore the attachment to the current work place is raised as another determining factor regarding motivation for PE. This barrier mainly seems to be grounded on ‘convenience’ issues (i.e. unwillingness to temporarily trade their comfortable position in the original institution with an unknown situation) and issues regarding the advancement of the employees’ in-house projects, which will inevitably experience a delay in the case of PE.

“We once had a feedback round with our employees, who had been on assignments. In this round we have above all been told one thing: It would have been better for the employees if they had known that someone would be doing their work here, as, when they came back, too much had piled on their desks.” (I3)

“The employees, especially those working on a PhD thesis, rather want to stay here any work on the plant to finish their thesis.” (A1)

1.3. Perceived career issues associated with PE

Besides the ‘willingness to go’, re-integration of the exchanged engineers is another point of concern for the interviewed executives. Especially secondments of longer duration might have an effect of ‘out of sight, out of mind’ (e.g. Tung, 1988) and potentially lead to the respective employees to be overlook in terms of career advancement in their original organization.

“We have lean managerial structures and in the end you always have to fight for yourself in here. So you should not have the illusion that your chair will be kept warm for you if you are absent for six months…!” (I5)

“The worst case scenario would be that the employee comes back and does not even have a desk anymore.” (I5)
1.4. IP/disclosure issues

PE can accentuate IP and disclosure related matters as the direct contact between employees of different organizations in the premises of one of the partnering institutions opens wider opportunities for unintended disclosure and increases transparency regarding critical information. In our survey this issue was mainly addressed by industry-based respondents. However, the majority of the corresponding interviewees attenuates this observation by stating that such problems usually do not arise in collaborations if sound contractual agreements have been reached upfront, which is nearly always the case.

“By sending staff from A to B we are a lot more vulnerable regarding the disclosure of information.” (I5)

“There are agreements for such co-operations, in which the legal framework conditions are determined and signed. This is business as usual.” (I3)

1.5. Financial resources

Regarding PE funding mechanisms, i.e. clear schemes regarding who pays for what and whom at which point in time, it appears that mostly no specific concepts are used and that in the cases where exchange takes place, the corresponding conditions are mainly determined on a case-to-case basis. This leads to uncertainties regarding the way how to proceed in practice as well as funding shortages, especially in academia where potentially required extra money is hard to find due to budget restrictions (e.g. Etzkowitz, Webster, Gebhardt, & Terra, 2000; Nemet & Kammen, 2007).
“My university does not provide funding for external visiting staff, they have to bring their money. If anything, the university would probably withdraw funding from my department if someone from the industry worked with us! So principally I am interested in personnel exchange but I think the implementation remains problematic.” (A8)

2. Current state of intersectoral R&D collaboration

Discussions with the respondents of our sample confirm a low implementation level of intersectoral PE, especially in terms of (a) 'formal' programs such as the initiatives described in section 2.1.2. Exchanges in the context of such programs represent isolated cases in the sample of this study: only two such cases have been reported - one through the Marie Curie Industry-Academia Partnerships and Pathways (IAPP) and a second one through the ‘innovation assistants’ program of the Sächsische Aufbaubank (SAB). Further types of exchange activities raised by the interviewees (refer to table 2) can be categorized in (b) industry-sponsored PhD programs (as the apparently most common form of PE), (c) joint utilization of pilot and demonstration plants (mainly in the context of bilateral collaboration between academia and industry) and (d) exchange of information in the form of guest lecturers from the industry spending some time in academia with the predominant purpose to teach lectures with an applied focus.

<table>
<thead>
<tr>
<th>Types of exchanges</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) PE in the context of formalized programs</td>
<td>i.e.</td>
</tr>
<tr>
<td></td>
<td>- Marie Curie Industry-Academia Partnerships and Pathways (IAPP)</td>
</tr>
<tr>
<td></td>
<td>- ‘Innovation assistants’ program funded by the Sächsische Aufbaubank (SAB)</td>
</tr>
<tr>
<td>b) Industry-sponsored PhD programs</td>
<td>- PhD students carrying out research projects in the industry with a university supervisor</td>
</tr>
<tr>
<td>c) Joint utilization of pilot and demonstration plants</td>
<td>- Bilateral industry-academia agreements</td>
</tr>
<tr>
<td></td>
<td>- Joint projects with multiple partners from academia and industry</td>
</tr>
<tr>
<td>d) Guest lecturers</td>
<td>- Industry representatives holding lecture series in universities</td>
</tr>
</tbody>
</table>

Table 2: Types of intersectoral PE identified in the research sample
3. Perception of PE

In terms of perception of PE, two questions have been addressed in the interviews: (1) what is the perceived importance of PE as a success factor for R&D collaboration and (2) how relevant are a number of proposed concrete time span options for PE.

3.1. On the perceived importance of PE as collaboration success factor

In the interview questionnaire, pre-defined potential success factors were to be rated in terms of their perceived importance for collaborative R&D projects. For the rating a likert scale was used and figure 3 represents the corresponding results. This question was answered by A and I respondents (n=18) only as it was not applicable for respondents from HR and the international offices. The results demonstrate that PE is – based on the whole A and I sample – not seen as a critical success factor: it is rated as the second least important factor (see figure 3; averages of the individual ratings provided; average rating for PE = 2.8).

![Figure 3: Rating of success factors of R&D collaborations, A and I respondents only (likert scale: 1=not important, 2=rather not important, 3=rather important, 4=important)](image-url)
However, when differentiating the data into respondents with direct PE experience and respondents without direct PE experience a different picture is drawn: executives with PE experience value it much more and emphasize it as an important success factor compared to respondents who are PE-inexperienced (see figure 3; rating=3.6 by PE-experienced and rating=2.1 by PE-inexperienced respondents). Respondents with 'direct PE experience' are defined in this context as (a) having either participated in PE themselves in the past or (b) having personally supervised employees participating in PE.

The following quotes drawn from interviews with respondents having direct PE experience support the aforementioned observation:

“I have learned a lot about project management during my secondment, I have learned how the sometimes chaotic daily routine of a scientist can be structured in a better way.” (A7)

“This is absolutely valuable for our staff, it helps them to put themselves in the shoes of the scientists.” (I7)

“Personnel exchange should mainly focus on understanding the view and constraints of the collaboration partner. Once you understand these you can collaborate in the right way.” (I5)

3.2. Perceived relevance of suggested PE concepts (focus on time spans)

In this study, four different time span options for intersectoral PE concepts have been tested: (A) day-to-day, (B) short-term, (C) mid-term, and (D) long-term exchange. Each time span alternative was additionally differentiated in terms of secondment or reception of staff.

The tested options were discussed in depth and rated in terms of (a) interest and (b) feasibility of implementation. Figure 4 resumes the average ratings of the
respondents. The findings suggest that there is a rather high level of interest for each of the time span options but that the implementation is seen more critical, especially with an increasing duration of secondment. This can be put in relation with the identified barrier 'missing personnel resources' (representing the main barrier regarding PE in our sample), where most interviewees have expressed their fears that the staffing level of their organization might not allow sending key employees on secondments, of especially mid- to long-term duration.

![Figure 4: Rating of PE concepts; focus on time spans](image)

*Figure 4: Rating of PE concepts; focus on time spans
(likert scale for interest: 1=not interesting, 2=rather not interesting, 3=rather interesting, 4= interesting; likert scale for implementation: 1=difficult to implement, 2=rather difficult to implement, 3=rather easy to implement, 4= easy to implement)*

VI. Discussion

1. Discussion of results

As expected based on the low level of implementation of PE identified in chapter II., the findings of this study reveal a number challenges having an impact on the respondent's feasibility assessment regarding the implementation of intersectoral
PE. These barriers are (1) missing personnel resources, (2) employee motivation, (3) career considerations, (4) IP/disclosure issues and (5) financial resources.

Issues in terms of missing personnel resources emerge as the biggest concern. Our study has been carried out in the German energy sector, where highly skilled engineers are working on the development of complex technologies. These engineers are a ‘scarce resource’ on the recruitment market and many companies and research institutions have difficulties in gaining and retaining corresponding appropriate staff (e.g. Becker, 2010; Blau, 2011). Based on this shortage (and increasingly tight financial planning) staffing levels in companies and research organizations are usually rather low. This may lead to PE being seen as a difficult-to-realize measure – especially in the context of secondments, where the skilled personnel will not be available for a certain period of time in the original organization.

In terms of motivation of the employees to be exchanged, the respondents (having overall rather limited experience with intersectoral PE) seem to partly draw on their experience with international assignments and to transfer associated observations to PE. Family related issues come up as one perceived barrier, i.e. the fact that concerned employees will lack motivation to accept PE based on their personal situation. These observations are in line with published findings on the willingness of employees to accept international work assignments (e.g. Blau, 2011; Brookfield Global Relocation Services, 2012; Dickmann, Doherty, Mills, & Brewster, 2008; Tung, 1987), where particularly family considerations emerge as one of the main questions.

Regarding career considerations, the respondents express concerns in terms of re-integration of the exchanged staff in the original institution, especially in the case of PE of longer duration. This issue is mainly raised in the industry context, where competition between the employees and ‘career fights’ seem to play a more substantial role than in the academic setting. Again, this observation corresponds to findings in the international assignment literature, where repatriation issues are
discussed as one of the major associated HRM difficulties (e.g. Tung, 1988; Stahl, Miller, & Tung, 2002; Stahl, Chua, Caligiuri, Cerdin, & Taniguchi, 2009).

Furthermore interorganizational collaboration in highly specialized fields always brings up the question of mutual intellectual property (IP) protection between collaborating partners (e.g. Hertzfeld, Link, & Vonortas, 2006; Katz & Martin, 1997; Porath, 2010). This is particularly true for inter-firm collaborative agreements, especially if the partners are competitors on the same market (e.g. Hertzfeld et al., 2006). But also public research institutions, such as universities, increasingly adapt their IP policies in order to secure own exploitation rights (e.g. Monotti & Ricketson, 2003). This topic is also touched on as a potential barrier for PE. The respondents admit that PE makes them more vulnerable in terms of unintended disclosure. However, they also state that PI and disclosure issues are usually well addressed by putting into place sound contractual agreements right from the start of R&D collaborations. Therefore PI and disclosure appear as a more theoretical rather than practical barrier which seems easily resolvable in most cases.

The fact that funding issues also are discussed as a challenge for PE suggests that formal programs supporting and (at least partly) funding PE are not widely used. This is confirmed in the interviews when focusing on the different types of intersectoral PE being carried out. Overall, PE (still) appears to be a mainly anecdotal phenomenon. Experience drawn by the respondents from past or existing exchanges shows that PE is mostly initiated and organized on an individual, case-by-case basis and rarely formal concepts are applied. In our sample, only in two cases formal approaches have been used: (a) through the ‘Marie Curie Industry-Academia Partnerships and Pathways’ (IAPP) program (European Commission, 2012) and (b) in the context of the ‘innovation assistant’ program funded by the ‘Sächsische Aufbaubank’ (SAB) (Sächsische Aufbaubank, 2012). This also suggests that such formal approaches are not widely known, which is backed by discussions with university HR executives (HR_A) and international offices of universities (IO), who also can only cite anecdotic cases of formally organized PE. The findings of a study carried out by Beckert and colleagues (2008) support this assumed insufficient information flow in terms of the existence of formalized PE programs. Beckert and
colleagues underline that only very few scientists are actually aware of funding programs supporting intersectoral mobility. The authors have carried out a survey on "intersectoral mobility as a form of knowledge transfer between research and application" among scientists in the field of biosciences. In this study the scientists were questioned on their awareness of intersectoral mobility funding programs, which appeared to be very low.

In terms of perception of PE, it can be observed that primarily executives with direct PE experience view this measure as positively influencing collaboration outcome; non-experienced respondents are more skeptical. This suggests on the one hand that PE measures can live up to theoretical expectations and provide fruitful input for collaboration. However, the apparent lack of information mechanisms to communicate the availability and the benefits of such programs to relevant executives seem to impede their uptake. This also becomes particularly evident when respondents are questioned regarding their (a) interest in different (time span) PE concepts as well as their (b) perception of how easy or difficult these measures can be implemented. In all cases the interest is relatively high (see figure 4) whereas the realization is seen more critical, especially in terms of secondments of longer duration (i.e. three months or longer). This indicates an overall rather conflicting perception of PE among the respondents: they realize that PE can positively influence and support collaborative projects. However, their current (and in many cases only theoretical) assessment of intersectoral PE, their rather scarce experience with it and their limited knowledge in terms of existing formal concepts leads to fairly cautious views regarding PE implementation. Hence, there is a need to resolve this conflicting perception and provide executives with sufficient information and guidance to facilitate practical PE implementation. Specific ‘kick-off’ mechanisms to translate potential interest into action are needed. These will have to be developed and put forward based on the identified and aforementioned barriers so that the challenges the respondents associate with PE can be addressed upfront.
2. **PE implementation model based on findings**

Key factors influencing PE perception and implementation identified in this research can help to address the aforementioned conflict. Figure 4 proposes a model (based on figure 2) and takes into account the survey results to provide some practical implications. In this, we identify a number of factors on different levels, which can play significant roles in terms of successful implementation of PE.

![Figure 5: Model based on study results](image)

On the macro-level we identify a need for overarching framework factors to 'set the scene' for PE. Details include the identification existing PE programs in order to create appropriate frameworks (e.g. in terms of funding), addressing capacity issues, and explicit IP/disclosure handling. These points represent prerequisites to provide a setting in which further conditions can be defined. Formal programs, such as the 'innovation assistant' scheme of the SAB or the Marie Curie IAPP program for instance can provide adapted structures and funding support. On the meso-level, motivation and career issues need to be considered, and on the micro-level we find...
practical implications, such as the definition of concrete exchange schemes, their duration (the longer the more difficult to handle in the case of secondments) and direction of exchanges (receiving staff is easier to handle than secondments), which will have to be looked at on a more individual basis and be adapted accordingly.

VII. Conclusions

1. Implications of the findings
The specific aims of this survey, which has been carried out in the German energy technology R&D collaboration setting, were (1) to investigate challenges associated with the implementation of PE, (2) to understand the extent and form of current PE measures, and (3) to unveil how the interviewed stakeholders perceive PE in terms of (a) PE as a potential success factor for intersectoral R&D collaboration and (b) different PE (time span) concepts. Based on these objectives and the related findings, key factors influencing PE implementation in intersectoral collaborative projects have been derived and a model integrating these factors has been proposed. This information can serve to address practical implementation of intersectoral PE and help to build corresponding framework conditions.

Additionally a need to (i) raise awareness in a more reinforced way among concerned academia and industry executives regarding the value and benefits of intersectoral PE as well as to (ii) enhance information channels regarding already existing exchange concepts based on a currently still low uptake (e.g. Beckert et al., 2008; Lambert, 2003; Lo et al., 2005) has been deducted.

2. Limitations and suggestions for further research
The results of this research provide valuable insights into what matters when implementing PE in intersectoral R&D collaboration in the energy technology sector. This study has been carried out among leading, senior executives. These are
important stakeholders in terms of PE, as they create the relevant opportunities in their respective organizations and are key decision makers on a strategic level.

However, the employees to be exchanged should not be neglected in this process of understanding PE. Similarly to international assignments, PE will mainly be a voluntary measure, which employees have the right to refuse (e.g. Brookfield Global Relocation Services, 2012; Harvey et al., 2001). Therefore it is important to also gain their views on the matter in order to complement the present findings. It is planned to address this by conducting a further survey aimed at concerned employees in the industry and academic energy sector.
VIII. References


Hanebuth, A., & Lee R. P. Triple Helix research partnerships evidence from energy research organizations in Australia, Germany and USA, Conference proceedings from the Triple Helix IX International Conference, Stanford, USA, 11th-14th July 2011.


# Appendix A

## Respondent and interview details

<table>
<thead>
<tr>
<th>Key</th>
<th>Type of organization</th>
<th>Branch / research focus</th>
<th>Type of interviewee</th>
<th>Methodology</th>
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</thead>
<tbody>
<tr>
<td>I1</td>
<td>Business entity of large corporation</td>
<td>Energy provider (power plants)</td>
<td>Middle management</td>
<td>Face-to-face</td>
</tr>
<tr>
<td>I2</td>
<td>Business entity of large corporation</td>
<td>Energy provider (power plants)</td>
<td>Middle management</td>
<td>Telephone</td>
</tr>
<tr>
<td>I3</td>
<td>Company</td>
<td>Coal mining and processing</td>
<td>Top management</td>
<td>Face-to-face</td>
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<tr>
<td>I4</td>
<td>Business entity of large corporation</td>
<td>Gas processes and engineering</td>
<td>Top management</td>
<td>Telephone</td>
</tr>
<tr>
<td>I5</td>
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<td>Middle management</td>
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</tr>
<tr>
<td>I6</td>
<td>SMU</td>
<td>Fuel cells</td>
<td>Managing Director</td>
<td>Telephone</td>
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<tr>
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<td>Middle management</td>
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<tr>
<td>A1</td>
<td>University chair and institute</td>
<td>Energy engineering</td>
<td>Deputy professor</td>
<td>Face-to-face</td>
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<tr>
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<td>University chair and institute</td>
<td>Energy technology and related materials</td>
<td>Professor</td>
<td>Face-to-face</td>
</tr>
<tr>
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<td>University-associated research institute</td>
<td>Engineering materials</td>
<td>Head of institute</td>
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<td>International exchange programs specialist</td>
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## Appendix B

Main topics covered in IND and AC interviews

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
<th>Types of questions</th>
</tr>
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<tbody>
<tr>
<td>1) R&amp;D collaboration</td>
<td>Types of R&amp;D collaborations carried out</td>
<td>Open questions</td>
</tr>
<tr>
<td></td>
<td>Incentives for getting involved in R&amp;D collaboration</td>
<td>Open question and prompted quantitative rating scale</td>
</tr>
<tr>
<td></td>
<td>Types of interactions between the partners in R&amp;D collaborations (including a quantitative rating scale)</td>
<td>Open question and prompted quantitative rating scale</td>
</tr>
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<td>Success factors of R&amp;D collaboration (including a quantitative rating scale)</td>
<td>Open question and prompted quantitative rating scale</td>
</tr>
<tr>
<td>2) PE in R&amp;D collaboration</td>
<td>Experience (if at all) with personnel exchange in the institution</td>
<td>Open questions</td>
</tr>
<tr>
<td></td>
<td>Discussion of different personnel exchange timespan concepts</td>
<td>Open questions and prompted quantitative rating scale</td>
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<tr>
<td></td>
<td>Discussion necessary framework conditions for personnel exchange</td>
<td>Open questions</td>
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<td>Barriers for personnel exchange?</td>
<td>Open question and prompted quantitative rating scale</td>
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