



Business Innovation Observatory



Public Private Partnerships

Public Procurement of Innovation

Case study 7

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Business Innovation Observatory
Contract No 190/PP/ENT/CIP/12/C/N03C01

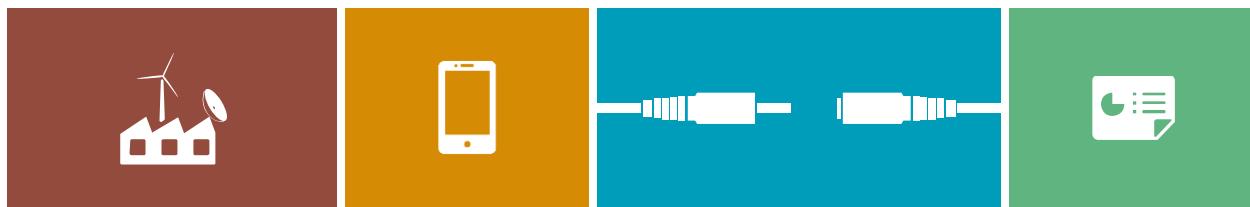
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European Union, September 2013.

Table of Contents

1. Executive summary	2
2. Public procurement of innovation	3
3. Socio-Economic Relevance	4
3.1. The market potential of the trend	4
3.2. The role of public procurement for the development of an innovation	6
3.3. The creation of new markets and jobs as a result of the public procurement of innovation	8
3.4. Realising competitive advantages through public procurement	8
3.5. Client perspectives and challenges related to the uptake of innovations developed as a result of public procurement	9
4. Drivers and obstacles	10
4.1. Public procurement as a facilitator of access to conventional markets	10
4.2. Public procurement of innovations makes innovative companies less reliant on external funding	11
4.3. Support and feedback received from public parties procuring an innovation can form a key driver	11
4.4. The nature of the application domain for developed innovations can form an obstacle	12
4.5. Regulation and needs of end-users that drive market uptake	12
4.6. Regional aspects that drive the development and commercialisation of publicly procured innovations	13
4.7. Challenges and drivers with regards to the workforce	13
4.8. Challenges with regards to internationalisation	13
4.9. Tendering procedures can form a barrier for public procurement	14
5. Policy recommendations	14
5.1. Policy gap analysis	14
5.2. Policy recommendations	15
6. Appendix	17
6.1. Interviews	17
6.2. Websites	17
6.3. References	17



1. Executive summary

For years, governments have sought to encourage innovation through supply-side measures in order to catalyse the generation of new knowledge and new technology. Over the last decade, governments have begun to accompany supply-side policy with demand-side policy measures, whether in the form of regulation, standardisation or the public procurement of innovation.

The **public procurement of innovation**, referring to the government's direct purchasing power towards innovation, **can increase demand for innovation** and help articulate demand for innovation. Moreover, the public procurement of innovation can: enhance the uptake of specific innovations; spur the development of new innovations; and increase the production and diffusion of innovation throughout the innovation chain.

Annual public procurement at European level is estimated at €400 billion although some estimates put this number even higher. Of this €400 billion, it is estimated **that €3.78 billion can be considered as the public procurement of innovation at the European-level**. Programmes focused on the public procurement of innovation can have a positive influence on jobs and can have significant impact on the success of innovative companies, both in terms of revenue and company size.

The degree to which companies actually derive a **competitive advantage** from the public procurement of their innovation on offer **differs according to the type of procurement programme** involved. For public procurements that focus on funding the development of the innovation, many competitive advantages can be seen as a result of the company's innovative capacity. Public procurements that also establish feedback loops between the innovating company and the users of the innovation offered a competitive advantage to the innovating company able to collect and analyse data from the real-world application of the innovation.

Programmes that focus on public procurement of innovation have specific drivers and face several obstacles. These **drivers** include the facilitation of access to conventional markets and the extent to which these programmes make innovating companies less reliant on external funding. Also, institutional factors such as the availability of an educated work force and the specific institutional drivers that shape the needs of end-users are helpful for the successful development and uptake of publicly procured innovations. Conversely, **obstacles** include the nature of the application domain for developed innovations, as commercial market development might occur at a rate that is too slow for the innovation to find market uptake outside public procurement.

For development programmes that focus on public procurement of innovation, it seems there is a lot of support yet to be offered by public policy in Europe. **Gaps in policy** are noted in the assessment and monitoring of public procurement programmes, for instance: the high upfront investments that discourage participation in broadly defined public tenders and calls; the extent to which they offer companies the opportunity to test their innovation in a real world context; and the differing difficulty encountered when seeking public support for incremental innovation as compared to radical innovation.

European governments can **address these policy gaps** by introducing hybrid versions of funding development and innovation procurement. This may be achieved by: co-procuring with private sector actors; combining procurement with free-of-charge access to university R&D hours and knowledge; introducing an Envy scoring mechanism for public procurement programmes; cutting up tender procedures in several (smaller) separate assignments; and using specific methods that can encourage or force tenderees to adopt certain innovations or technologies.



2. Public procurement of innovation

For the last three decades, innovation policy has been dominated by supply-side measures, supporting the generation of new knowledge and innovation. Since the late 1990s, demand-side policy measures have taken the form of product market regulation and standardisation as well as public procurement for innovation.¹²

As stated in the 2012 State of the Innovation Union report, demand-side policies, including public procurement of innovation, are crucial to the attainment of the 3% target and the stimulation of European Competitiveness.³ According to the report, a better balance between supply- and demand-side measures is needed, as supply-side measures alone will not generate the impact required.

The innovation union aims for procurement markets across the EU starting from at least €10 billion a year for innovations that improve the efficiency and quality of public services, while addressing the major societal challenges. The aim should be to achieve innovative procurement markets equivalent to those in the US.

conditions for the uptake of innovations in order to spur innovation and their diffusion into the marketplace, triggering and accelerating the production and diffusion of innovation throughout the innovation chain.⁴

The main objective of public procurement of innovation is to direct government purchasing power towards innovations. An analytical difference is made between public procurement that is responsive to existing innovation, and procurement that is proactive. In the latter case, innovations are triggered when a new need has been made apparent, to which a specific solution needs to be found. Pre-commercial procurement is seen as a variant of public procurement, which can include purchasing of R&D to benefit technological developments still in a demonstrator phase.⁵⁶

Societal challenges often can serve as a catalyst for implementation of procuring innovation. Perceived barriers to optimal implementation of public procurement of innovation include:^{7 8 9 10}

- Pressure on public budgets (especially in the case of public procurement of innovation);
- Technological risk, policy risk and the risk of introducing competitive disadvantages when intervening too far upstream, as well as the risk of lock-ins or to the acquisition of inappropriate and/or premature technologies;
- Lack of interaction between relevant ministries and agencies;

- Little articulation of innovation need;
- Little early communication of future trends;
- Unhelpful priorities in the minds of public procurers, who often focus on price and short-term satisfaction over innovation and long-term considerations.

Innovation procurement is slowly increasing across Europe. In 2012, Italy assigned more than €300 million to pre-commercial procurement (PCP). PCP will be deployed in Southern Italy with the support of structural funds, as has been done in other Italian regions. Moreover, the higher risk related to these purchases can be covered by a special risk-sharing facility established in cooperation with the European Investment Bank. Cross-border collaboration is also developing. The Nordic Ministers of Industry launched a 'lighthouse project' in health care to strengthen the collaboration between Norway, Finland, Sweden, Denmark and Iceland on innovation procurement.¹¹

Coordination of public procurement efforts can help to combat fragmentation in public procurement markets across Europe, to aid in linking specific procurers across Europe through procurer networks, to support risk taking and market transparency through training and awareness programmes as well as improved market discourse across Europe.

Transnational cooperation on innovation procurement is currently supported in a few areas with EU research and innovation funding. In 2012, 16 projects were launched to drive innovation procurement involving procurers from the majority of Member States. The projects will encourage public procurers to deploy more innovative solutions in the areas of lighting systems, energy efficient buildings, supercomputing technology, and better care for elderly, smart transport systems, intelligent border security control, and intelligent textiles for fire brigades. In 2013, such EU-level support is likely to more than double, approaching €100 million.¹²

The Lead Market Initiative

The Lead Market Initiative (LMI) for Europe was adopted by the European Commission in December 2007 following the EU's 2006 broad based Innovation Strategy. The LMI is a combination of different policies, mainly public procurement, standards, other legislation and complementary actions. It was adopted on December 21st 2007. The Commission identified six target markets:

- eHealth,
- recycling,



- renewable energy,
- sustainable construction,
- protective textiles and
- bio-based products.

All of those six markets are defined around 'broad market segments' rather than a concrete range of products. The basic idea as stated by the Commission is not to pick winners, but to support broad areas in which different kinds of innovations can flourish. All areas are linked to wider societal needs (sustainability, efficient and effective health care etc.) and for all of them the Commission sees a strong economic potential within Europe that can be realised through concerted, coordinated and flexible action.

According to its final evaluation in 2011, the LMI should be understood as a set of pilot actions aiming to shift the basis of an important area of policy, whose major strength was targeting interrelated policy areas for promising markets

that would not otherwise be picked up by other policy frameworks. The LMI fell short of the ambition of the Aho Report, which had raised expectations. The scope of the Action Plans was necessarily more restricted, especially given the limited nature of the budget available. Furthermore, the Initiative involved experimenting with various new procedures.

The six markets initially chosen as targets continue to show a marked potential for further growth and varying degrees of success were achieved in relation to the different Action Plans. A coordinated approach to the demand-side stimulation of innovation ought to continue to have an important place in innovation policy, while the links with supply-side measures should continue to be strengthened. The case for demand-side actions, especially relating to public procurement, remains strong, notably in the 'busy' policy areas of recycling and renewable energy. A balanced approach to support for the procurement of innovation needs to be developed across all phases of the innovation cycle.

3. Socio-Economic Relevance

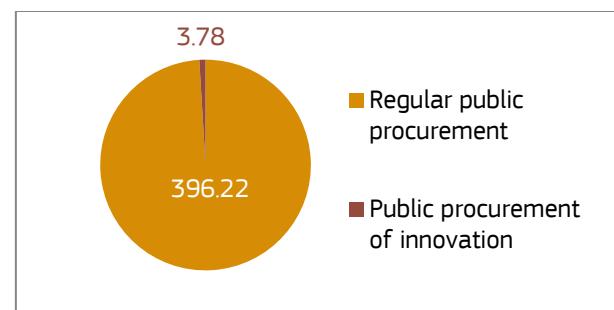
In recent years demand-side policy measures have taken the form of product market regulation and standardisation as well as public procurement for innovation. Especially in the current economic climate, it is hard to acquire funding and customers for (radical) innovations. Both capital investors and firms prefer to invest their funds in products, processes and services that have a relatively short return on investment. Therefore, in such a context, public procurement could be a valuable instrument to maintain innovative capacity in an economy. This however also forms a paradox, as most governments also have their funds limited as a result of declining economic growth.

3.1. The market potential of the trend

Innovative procurement describes the situation where a public body procures a product that does not yet physically exist, but that, based on research and development by the company offering the product, can be developed within a reasonable timeframe.¹³ It is a policy tool to that serves to encourage innovation via demand pull.

Annual public procurement at European level is estimated at €400 billion, although other estimates would put this number even higher. Of this €400 billion, it is estimated that € 3.78 billion can be considered public procurement of innovation at European level (Figure 1)¹⁴.

Figure 1: Annual public procurement at European level (in billion Euros)



Programmes focused on the public procurement of innovation can have significant impact on the success of innovating companies, and can have a positive influence on job creation, as can be seen from the example of the Small Business Innovation Research programme of the United States government.

Small Business Innovation Research programme – US government as a lead customer

In the Small Business Innovation Research programme, The United States government takes on the role of 'lead customer', providing for R&D funding to SMEs, representing over €750 million in research funds. Half of this budget is allocated to firms with fewer than 25 people and a third to firms of fewer than 10. SBIR funded firms have generated



five times the number of jobs compared to firms that did not receive SBIR funding. SBIR funded firms include Apple, Federal Express and Sun Microsystems.

To apply for SBIR funding, companies compete for Phase I funding, which would allow them to demonstrate the feasibility of their concept within six months. Companies that were successful in Phase I can apply for Phase II, which provides 24 months of funding for R&D and product testing. Companies that successfully finish Phase II can be admitted

to Phase III, wherein they can attempt to commercialise the product.

The cases taken up in this report (Table 1) demonstrate this dynamic, showing revenue growth, an increase in headcount, or the potential for such. AlertSolutions was able to commercialise their product and recently achieve a break-even point. Ashwoods is expected to grow from 3 to 28 employees and increase its revenue generation tenfold. KEMA and PHOTONIS demonstrate how public procurement of innovation can lead to additional commercial investments.

Table 1: Overview of the company cases referred to in this case study

Company	Location	Business innovation	Success signals
AlertSolutions	NL	Through public procurement of innovation, AlertSolutions was able to develop a real time system for monitoring the structural integrity of dikes. The company developed measurement instruments that are inserted into the dike structure. All measurement instruments are connected to one data acquisitions system, which provides live data access to customers anytime, anywhere. This provides customers with valuable data, besides the standard field inspections.	The company had to make significant investments in the first years. In 2012, the company was able to break-even for the first time. It is, however, still hard to fund R&D based on commercial revenue. The company currently employs 5 persons, of which 2 on a full-time basis.
Ashwoods	UK	Ashwoods has developed the so called "light foot driver behaviour technology". This technology can be installed to existing vehicles and encourages and supports drivers in real-time to drive in the most efficient way possible and makes sure they do not slip back into bad habits. The technology was developed as a result of public procurement for hybrid vehicles, a prequel aftermarket technology that facilitated the development of this innovation.	In 2008, when Ashwoods first engaged with the public procurement programme, they were generating a turnover of GBP 690,000 with 3 employees. In 2012, the company is prospected to generate GBP 6 million with 28 employees. According to Ashwoods managing director, this is largely enabled by public procurement. The technical success are about 10 to 15% fuel savings for hybrid vehicles and 10% for the light foot product, compared to vehicle lacking the technology.
KEMA	NL	KEMA acts as a partner in a consortium for the Nanoglows initiative. The Nanoglows initiative is conducted within a Sixth Framework Programme context. The project was conducted between December 2006 and December 2011.	The project substantially contributes to the European Union's (EU) aim of meeting the Kyoto protocol requirements to reduce greenhouse-gas emissions (6.0% in 2010). Since CO2 accounts for more than 80% of these emissions. It also enables the EU to become a more environmentally friendly and sustainable society. Currently the technology is being implemented in a Norwegian power plant, with associated investments of approximately EUR 24 million.
PHOTONIS	NL	PHOTONIS has developed night vision sensor technology.	PHOTONIS was awarded the Georgia Tech Sign Sponsored Research Agreement in 2012, is currently one of the world leaders in the design and manufacturing of state-of-the-art Image Intensifier Tubes for military, space and commercial applications, employs over 1000 people and boosts impressive revenues that exceed 160M.



Ashwoods' two key products are the hybrid vehicle and light foot driver behaviour technology. At the end of 2012, Ashwoods' sold hybrid vehicles had saved approximately 2,400 tons of CO2. For 2013, prospected sales of **hybrid vehicles** are about **450 units**. The company is the UK's leading supplier for light commercial hybrid vehicles, a market in which it does not have many competitors. Moreover, it is expected that at the end of this year, Ashwoods would have **sold approximately 5,000 units of light foot**. The prospected sales for 2014 are about 7,500 units of light foot, **a clear growth of 50% annually**. For every 5,000 light foot products sold, the company saves approximately 5,500 tons of CO2 per year.

At the moment, the light foot product is still only applicable to business fleets. In the near future, Ashwoods will introduce a consumer version of the product, retrofittable to any vehicle (e.g. diesel or petrol). **The market potential then encompasses basically anyone with a vehicle.**

The **current potential for AlertSolutions' innovation** in its national market is limited, as the market in the Netherlands is currently not large enough for the company to survive on. Regional authorities are slow to adopt the innovation and do not generate much revenue for the company. AlertSolutions has to rely on international markets to generate sufficient income. Future potential for the innovation is substantial though. On average, 0.5 to 1 % of construction budgets are spent on monitoring systems. For dike construction this share is approximately 2%. Currently, a large share of the monitoring budget for construction projects is acquired by engineering agencies. AlertSolutions aims to capture a part of the market from engineering agencies. This will be challenging, because engineering agencies form part of the customer base for AlertSolutions.

The market potential for the Nanoglows technology developed by **KEMA** and partners depends on regulation on CO2 emissions. Carbon market programmes are a means to control and reduce carbon dioxide emissions by having a regulatory authority set a quantitative limit on absolute or relative carbon emissions by major emitters, such as industrial factories and power plants. For each ton of carbon emitted over the cap, the emitter needs to buy allowances to be able to legally exceed the limit. As KEMA's technology allows emitters to reduce their CO2 emissions, they would possibly need to buy fewer allowances or might even sell residual permits on the market. The global market for carbon trading approximated USD 176 billion in 2011.¹⁵ The World Bank estimates that by 2025, the global carbon trading market will equal approximately **USD 1 trillion**. Furthermore, it appears that by 2015-2020, most of the world's major economies, and many developing ones, will have some form of carbon trading programme in place.¹⁶

PHOTONIS is a proven case of the market potential for their innovative night vision solutions. As more and more combats take place by night, night vision has become a key opto-electronic technology in modern warfare. PHOTONIS is currently one of the world leaders in the design and manufacturing of state-of-the-art Image Intensifier Tubes for military, space and commercial applications. Their products are in use in all of the NATO countries and are largely deployed on a worldwide scale. Moreover, their Image Intensifier Tubes are integrated into equipment of the world's leading suppliers of optical systems. The market potential is also evidenced by the notion that PHOTONIS currently employs over 1000 people, generating revenues that exceed 160M on a global scale.

3.2. The role of public procurement for the development of an innovation

The innovations described in this case were all developed and/or commercialised as a result of public procurement. The rationale for developing these innovations is that in all cases a government body perceived a certain market need which was not yet sufficiently met. Whether the requirements for the innovation, as outlined in the public procurement programme (tender), complied with actual needs in the market differs per case. This already illustrates the first opportunities for improvement.

Problem 1 – The UK Small Business and Research Initiative launched a public procurement programme for the development and deployment of hybrid light commercial vehicles. Through the procurement programme, the CO2 emissions of the business fleets of 15 selected public organisations (e.g. Royal Mail) had to be reduced.

Innovative solution 1 – As a result of the procurement programme, Ashwoods not only developed a hybrid light commercial vehicle, but also became a supplier of hybrid components and the novel driver behaviour technology.

Public procurement did not provide Ashwoods with funding for development, but with initial launch customers. At the time Ashwoods participated in the public procurement programme, its technology was at a low production volume stage. The procurement programme was aimed at proving the performance of new technologies in practice, and provided a launch market to realise this. Effectively, the procurement programme allowed Ashwoods to further invest in the production process the technology, and preparing the technology for wider market uptake.

The direct effect of the procurement programme was that is subsidised the purchase of approximately 160 hybrid vehicles made by Ashwoods. These vehicles were put into operation at fifteen of the most demanding publicly owned fleets in the UK. The product received substantial



exposure, and proved its durability and real-world performance, in practice. The revenue generated as a result of these sales was put into the development of other hybrid technologies and peripheral products. Several of these peripheral products became a commercial success.

For development of the first hybrid technology, Ashwoods in-sourced all required components from external suppliers. With the second generation of the hybrid technology the company was able to come up with improved components and peripheral telematics instruments that were developed in-house. This was enabled by public procurement of the first generation technology. This all eventually led to the current situation, where Ashwoods is not only selling its hybrid vehicles consisting of in-house developed components, but is also selling the components and peripheral instruments as stand-alone products. Thanks to public procurement, Ashwoods is now able to supply the OEM market with components for hybrid vehicles, and fleet managers with telematics systems that stimulate drivers to be more fuel efficient and provide fleet managers with monitoring instruments.

A graphical representation of the driver behaviour technology interface of Ashwoods.

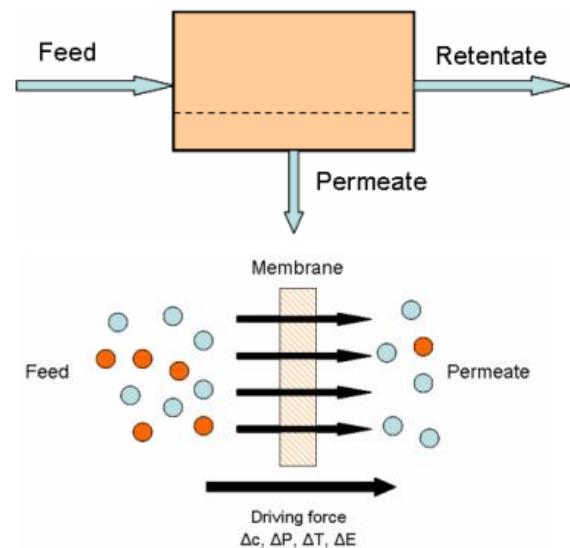


Problem 2 – The objective of this project was to develop optimal nano-structured membranes and a large variety of installations for various CO₂ capture applications at power plants. The use of this technology for gas separation processes has the potential to reduce CO₂ emissions, one of the Kyoto protocol recommendations. Development and usage of cost-effective membranes to remove CO₂ from expelled gases in industrial applications enables the reduction of the energy costs associated with CO₂ separation to less than € 20 per ton. Other specific objectives for this project were to test and develop smart-design modules, with a long life and low degradation and contamination. These were to be tested in both the laboratory and the field and combined with integrated performance monitoring. Another innovation goal for this project was to enable the liquefaction of the gases after separation, which results in reduced transportation costs.

Innovative solution 2 – After several years of lab testing at different sites in Europe, developed membrane modules have been installed in three different operating power plants (both European and non-European) to test the working of the membranes in an actual flue gas stream.

Laboratory tests showed that out of five types of membranes, two types proved to have the most promising performance. These were the Diffusion Transport Membranes and Fixed Site Carrier Membranes. These two types have been integrated into modules which were used in the industrial tests.

A graphical representation of the membrane technology developed as a result of the Nanoglowa initiative, KEMA was participating in.



Problem 3 – It is often difficult to successfully commercialise an innovation on international markets. Especially in the industry of defence and security, innovative concepts can suffer early-stage setbacks related to funding and the opportunity to demonstrate a proof of concept. Acting as a launching customer, the Ministry of Defence procured night-vision sensors from PHOTONIS, which allowed them to enter new markets.

Innovative solution 3 – As a result of the procurement, PHOTONIS was able to develop and commercialise their innovative night-vision sensors that complies with international military standards. The procurement of these sensors by the Ministry of Defence provided PHOTONIS with a concrete market opportunity that could drive the development of the new sensors.

Although the subsequently generated revenue was not stellar, this market opportunity was an important driver, as in its development trajectories PHOTONIS needs to include both its development partners and its end-users.

PHOTONIS





Problem 4 – The Dutch national government foresaw the need for a real-time monitoring system for the structural integrity of dikes. Currently, dikes are still mainly monitored based on visual inspection by field investigators. Therefore, the Dutch ministry of economic affairs, and ministry infrastructure published a public procurement programme for the development of a novel real-time monitoring system for dikes. AlertSolutions submitted a proposal for this tender and eventually received the funding to conduct a feasibility study and to develop the technology.

Solution 4 – The monitoring system AlertSolutions developed is called GeoBeads and consists of **an integrated system of sensors**, coupled through field networking. The sensors measure (underground) water pressure, movement and temperature. Based on this data, structural integrity of dikes can be determined.

Field networking facilitates the data collection and transmission by literally hundreds of sensor instruments. Data is stored locally and transmitted wirelessly. This means that local data can be accessed by an investigator in the field, but also through an **online data panel** displaying real-life data. This **live data access** provides a valuable addition to existing monitoring methods.



3.3. The creation of new markets and jobs as a result of the public procurement of innovation

The degree to which the public procurement of innovation in this case has resulted in the creation of new markets and jobs differs per company. There is a clear difference in procurement programmes that mainly provided funding for the development of an innovation (AlertSolutions and KEMA), those that facilitate access to the market through a launching customer (PHOTONIS), and those that provide both (Ashwoods). In this case, the last type of programme has had the most significant effect on the creation of a new market and prospective jobs.

Effective public procurement allowed Ashwoods to carve out a niche for its specialised products and components. Public procurement created a first market for the hybrid technology that Ashwoods had developed. This hybrid technology was sold as a complete product that could be equipped to existing vehicles. At this time, both the complete system and separate components were not yet economically interesting for commercial parties. Further development of the technology, facilitated both in terms of funding and real-world feedback through public

procurement, resulted in enhanced system components that can be sold as stand-alone products. Whereas Ashwoods was first acting as a supplier of hybrid vehicles, it is now also a supplier of components for hybrid technology to OEMs in the automotive industry, and fleet managers.

Ashwoods was given access to real life market data, which would not have been there in the commercial sector, at that time. In essence, the company was able to build up experience and collect real-world feedback, in advance to its competitors. This enabled it to develop superior components and peripheral equipment for hybrid technology, which is now sold to a wider marketplace. As mentioned afore, in the near future the light foot product will also be sold on the consumer market. At the moment there is no competition for retrofitted driver behaviour technology for consumers.

Finally, Ashwoods aims to get their light foot product installed in stock cars by OEMs, straight from the factory. It is currently negotiating options with UK representatives of European vehicle manufacturers.

AlertSolutions' technology can be seen as an addition to existing dike inspection methods. The innovation will never completely take over the market for dike inspection. The company has already expanded its market to the UK, Germany and also China. Although the Netherlands is a lead market for dike inspection methods, other European countries can also benefit from this technology.

Moreover, the company's innovation can also be deployed to other markets. AlertSolutions is currently also conducting monitoring projects for customers that operate, own or build civil infrastructures like bridges and tunnels, and a substantial number of other structures.

3.4. Realising competitive advantages through public procurement

The degree to which case companies derive competitive advantages as a direct result of public procurement differs per type of programme. For a company like AlertSolutions, which mainly received funding for development, the established competitive advantages are a result of the company's innovative capacity. Apart from funding, public procurement did not provide additional inputs for development and market access. For Ashwoods, public procurement did not only provide funding for development and facilitation of launching customers, the programme also established valuable feedback loops from launch customers on real-world application of the innovation.

Public procurement allowed **Ashwoods** to further develop their hybrid technology into stand-alone products. Development and exploitation of the hybrid technology taught the company about the need for driver behaviour technology. It is easier to achieve fuel consumption savings



on the driver's side than on the vehicle side. Ashwoods is now no longer competing with other (hybrid) vehicle manufacturers, but has become a key supplier to them. The light foot product, one of Ashwoods most promising applications, is operating in the telematics instruments market.

Currently, there are not many competing products. Conventional telematics instruments are aimed at providing fleet managers with as much data on driver behaviour as possible. The fleet manager has to analyse this information and identify which drivers are showing undesirable behaviour and how this behaviour could be altered. Ashwoods light foot product is not only collecting information, but based on this data is also providing drivers with indications on how to improve fuel efficiency, reduce accidents and minimise idling time. At the same time, the instrument is sending periodical reports to the fleet manager to show the realised improvement.

Initially fleet managers simply wanted as much data on driver behaviour as possible. Practice, however, showed that customers did not have the resources to analyse all this data. This is why Ashwoods light foot product is so successful. It is unburdening fleet managers substantially.

Conventional **monitoring methods for dikes** are largely limited to manual inspections by field staff. Structural integrity is determined based on the expertise and experience of field staff. There have been initiatives that were aimed at a more quantified and objective monitoring of dikes. These initiatives were, however, limited to local and temporary measurements. Data generated by these measurements had to be manually extracted and imported to a computer for analysis. Through **AlertSolutions'** technology, **monitoring of dikes can be conducted continuously at a larger scale against substantially lower costs and levels of effort**. A dike monitoring system, however, will never completely replace manual and visual inspection. Moreover, this technology can also be deployed for other application fields.

Another competitive advantage for AlertSolutions is that its monitoring system can be installed into multiple layers of a structure simultaneously. All sensors are installed on one string of wiring, which can be easily inserted into a structure. This feature was the reason the company acquired a substantial assignment for the construction of a new metro tunnel in the Netherlands. AlertSolutions is the only company that can currently supply such an application.

3.5. Client perspectives and challenges related to the uptake of innovations developed as a result of public procurement

For innovations that were developed as a result of public procurement there are two different client perspective related to the uptake. There is the client perspective of the public organisation purchasing the innovation through a procurement programme, and the client perspective of market organisations purchasing the innovation.

In 2010, when the first generation of **Ashwoods'** hybrid technology was ready, the client perspective on uptake of the innovation was negative. At that time the technology did not provide a sufficient performance improvement in relation to its cost. Moreover, the technology had not yet proven its real-world worth. This has to be seen in combination with the context that, due to the financial crisis, most customer companies were short on funding for unproven novel technology. In such a context the majority of decisions are based on a financial consideration. According to Ashwoods' managing director it would therefore have been highly unlikely that market uptake would have taken place, in 2010.

In 2010, the client perspective of the fifteen leading public organisations participating in the public procurement programme was completely different. They were provided with a substantial amount of funding, which they could spend on a selection of hybrid technologies to make their fleet more sustainable. Normally, these customers would like to give priority to environmental friendly gains, but were limited in their choices by budget cuts. Due to the fund of the public procurement programme, however, these organisations could now pick the best hybrid technologies out of a shortlist, without having to look at economic returns.

Currently, the client perspective is still the same. Clients first want to hear the economic/financial results of investing in the innovation. The environmental gain has less priority. The innovation, however, has changed. Due to further development of the technology, its fuel saving potential now outweighs its cost. Furthermore, Ashwoods was able to develop a product with a relatively high fuel saving potential, low investment costs and that can be easily installed on the existing vehicle fleet. Fleet managers, for instance, can more easily justify towards the board the purchase of hybrid technology and driver behaviour technology. The largest obstacle for market uptake, costs outweighing benefits, has now been taken away.



Customers of **KEMA** face the same main difficulty for adopting the technology, as KEMA does for developing and commercialising the technology. This difficulty constitutes uncertainty with regards to CO2 regulation. As the market for CO2 trading derives its existence from corresponding regulation, investments from customers in related technology also depend on this same regulation. Absence of clarity on this matter in a particular market deters clients from adopting the technology, simply because their return on investment is uncertain.

For **PHOTONIS**, it has sometimes been challenging to market disruptive innovations on international markets. As commercialisation of these kinds of innovations generally require good contacts and active involvement of different stakeholders, entering a new international market can be difficult. For PHOTONIS in particular, they not only need to establish good relationships with end-users, but also with partners who will use their sensors in the end products. While they currently have two offices in the United States, accessing the different niche markets there, for instance,

was more difficult because they had no existing contacts. When the Ministry of Defence procured the innovative night vision sensors, this not only boosted sales of the night vision sensors, but also allowed them to access new contacts in international markets through the Ministry of Defence. This has particularly allowed PHOTONIS to help establish contact with partners in new geographical areas.

For **AlertSolutions**, the main obstacle to client uptake is the lack of real-world proof of concept of its technology. The regional authorities tasked with monitoring dikes are hesitant to have companies conduct tests on their dikes. This is simply due to the nature of the infrastructure, being directly correlated with national security. National authorities do not want to be held responsible for damaging dike's structural integrity, and possible negative consequences. Moreover, in the rare occasions that they do allow real-world tests on dike infrastructure, the control criteria are too ambitious for a novel technology to immediately comply with. In short there is a clear lack of supportive launching customers.

4. Drivers and obstacles

Programmes that focus on public procurement of innovation have specific drivers and face several obstacles. These drivers and obstacles impact both technology companies developing solutions and public bodies looking to procure.

Drivers include the facilitation of access to conventional markets and the extent to which these programmes make innovating companies less reliant on external funding. Also, feedback from the public procurer to the innovating company can be very helpful towards the development process. Moreover, the needs of end-users and the institutional drivers for this need can lead to high demand after a public procurement of an innovation has been successful, as well as the availability of an educated work force.

Obstacles include the extent to which the nature of the application domain for developed innovations, as commercial market development might occur at a rate that is too slow for the innovation to find market uptake outside public procurement.

4.1. Public procurement as a facilitator of access to conventional markets

Ashwoods initially started as a producer and supplier of hybrid vehicles to public organisations, which was purely facilitated by public procurement funds. The real world data collection and feedback from launch customers provided the

company with required input for further development of the technology. The revenue created by public procurement of the first generation technology funded the development work for the second generation technology. Components and products that were developed as a result of the second development phase are currently sold on commercial markets to for instance fleet managers and OEM in the automotive industry. Effectively public procurement allowed Ashwoods to carve out a niche for its specialised products and components.

The public procurement programme that Ashwoods was involved in ensured that the company could fully focus on development of its technology.

A dedicated party was appointed to coordinate the programme and facilitate all communication and other aspect related to customer contact. For a relatively small organisation the influence of this unburdening is significant.

Ashwoods was only able to significantly improve their technology in cooperation with the support of lead customers. The revenue generated by their purchases provided the funding to further advance development. Moreover, feedback on real-world application of the innovation provided the company with the required input to

"Having the lead customers provided us with a real competitive advantage as it allowed us to significantly improve our technology in cooperation with them. The revenues that we eventually generated through this channel also provided further opportunities to improve the product." – Ashwoods



make improvements. Without access to launch customers, Ashwoods would not have been able to improve its innovation to a level where it would become economically attractive to buy. However, in the current economic climate commercial parties do not invest in technologies that lack a relatively short-term return on investment. Without public procurement facilitating a launch market for the company, this technology would not have been developed by Ashwoods.

PHOTONIS has had different experiences with public procurement. Specifically, PHOTONIS has made use of the opportunity to have public institutions as launching customers. By being a launching customer, public institutions step in to facilitate the diffusion process of the innovation. This secured PHOTONIS of an early adopter of their technology, essentially facilitating access to markets. While this has been very helpful for PHOTONIS, they find that typically the innovations that have a more direct market demand tend to commercialise successfully more swiftly. Nevertheless, they underlined the potential of the instrument and expect this channel to become increasingly more important in the near future to facilitate access to international markets.

For **AlertSolutions**, public procurement did not provide the desired access to dike inspection authorities. After having developed the innovation, the company had to acquire access to regional authorities (tasked with dike monitoring) without the support of the national government. Although the company has been able to build up relationships with these customers, national government could have made this process easier. Public procurement of innovations makes innovative companies less reliant on external funding

4.2. Public procurement of innovations makes innovative companies less reliant on external funding

Ashwoods is owned and funded by its management, staff and an investor. The company did not only receive money for development, but public funding also allowed launch customers to purchase a first generation of the technology. It was therefore less reliant on external funding sources to commercialise the technology. The company has looked at options for financial support from banks and private equity providers. Due to public procurement of the innovation the company was not forced to approach a private equity party. Such a party, if not completely necessary, was considered undesirable to approach as it would then dilute ownership and control of the company.

For **AlertSolutions**, public procurement did not fund a launching customer for the innovation. The company therefore had to rely on a private equity party to seed commercialisation of the innovation, in 2010. This funding

allowed the company to further develop its technology, but took them 9 months to acquire. The Dutch Greentech Fund, part of a large Dutch bank, has also invested in the company. Both parties were given company shares in return for their investment. Other sources for funding have been the founder's family and friends.

For **KEMA**, public procurement could help companies to close the so called "valley of death" for radical innovations. Private parties are hesitant to fund radical initiative with uncertain and long-term returns on investments. However, public procurement in some member states appears to be oriented on supporting incremental innovation, whereas the support for radical innovation would better complement private investments.

"We are currently making investments in our technology in Norway, as the policy landscape provides more clarity on CO2 regulation and financial support than is the case in the domestic markets".

- **KEMA**

PHOTONIS is primarily financed with private equity, which includes venture capital funding. As we have seen in other cases, venture capital funding can put substantial pressure on the commercialisation process. The main reason for this is that venture capital funds tend to invest in companies that show high business potential. While they provide the necessary funding, they typically expect returns in 3-4 years. This potentially limits both the innovation and commercialisation process. Public procurement, and public funding in general, can alleviate some of this pressure by having different expectations on particularly the time-to-market of disruptive innovations. As PHOTONIS is primarily financed with private equity, the public procurement they have benefitted from has had little impact on the overall commercialisation process of the company.

4.3. Support and feedback received from public parties procuring an innovation can form a key driver

To fully exploit these opportunities provided, companies need to be able to deploy a demand-driven approach to innovation. Interviewees indicate that this would probably be harder in a large corporation.

For **Ashwoods**, all customers and suppliers (Ashwoods and three other beneficiaries) involved in the procurement programme were fully engaged in development of the innovation. Through quarterly review meetings the company was provided with a constant flow of feedback generated by putting the innovation into use. Intensive monitoring of the performance of the hybrid vehicle by customer companies generated valuable data.

In fact, the new and successful light foot product was developed in a response to a demand of the Royal Mail,



expressed during one of the meetings. Launch customers clearly indicated their desires and needs, which helped Ashwoods to fine-tune their technology. This does not mean that private parties do not support the company in further developing its products. Currently, a commercial customer is highly involved with tailoring the light foot product to its particular needs.

Contrasting to the above, **KEMA** did particularly receive support and feedback from public parties, but has actually subject to competition from public parties. There are several national public research institutes which conduct similar activities like KEMA, but which receive public funding for conducting their business.

4.4. The nature of the application domain for developed innovations can form an obstacle

For **AlertSolutions**, the demand and requirements of the public procurement programme formulated by the national government did not match the needs amongst regional authorities.

"We operate in a highly conservative industry, as monitoring equipment for e.g. dikes that in operation needs to work flawlessly. New solutions pose a risk to end-users, as the solution may turn out to be e.g. unreliable. It is therefore key to proof your innovation in practice, which is a process that takes time."

- AlertSolutions

associated with conducting test in dikes that are in "operation". There is always some risk associated with inserting monitoring equipment into a dike. Local authorities do not want to be responsible for possible damages to the dike's structural integrity. This process takes time. Small success stories help to convince other customers to also adopt the innovation.

For **KEMA** being a service provider, it is hard to apply for government support for innovation. Support programmes are largely oriented on product innovation. KEMA is forced to participate in consortia in order to indirectly benefit from government support programmes. This means that in most instances KEMA is forced to find partners for developing and commercialising an innovation. Absence of these parties could pose another obstacle for developing and commercialising innovation within the company's sphere of influence.

For **Ashwoods**, market adoption moved rather slowly. Thanks to public procurement the company was able to boost the development speed of hybrid technologies. Market uptake in the commercial sector, however, cannot match the speed at which the company is able to develop new technologies.

Ashwoods aims to have its driver behaviour technology installed to stock cars already in the vehicle manufacturer's plant. Realisation of this aim is stalled because development cycles for cars take approximately 5 to 7 years. For the technology to be incorporated in a stock car, it has to be tested throughout the vehicle's development cycle. Meaning that it could take another 5 years before the first stock vehicles with pre-installed light foot technology will be sold.

4.5. Regulation and needs of end-users that drive market uptake

For **Ashwoods**, rising oil prices and strict European regulation on vehicle emissions are significant drivers for market uptake. OEMs are forced to keep the overall carbon footprint of their product offering below a certain level. Moreover, fleet owners and consumers are demanding higher fuel efficiency with every new development cycle. These two aspects drive the adoption of Ashwoods light foot product and hybrid components amongst OEMs, but also directly amongst end-users.

KEMA, particularly for the Nanoglowa project, is highly reliant on **stable long-term regulation**. Prices of CO₂ trade are highly susceptible to regulation, as this artificial market is solely facilitated by regulation. Firstly, for this market to be able to come up with innovation, prices of CO₂ have to be significant. Secondly, established regulations have to be in force for a substantial period of time for businesses (or consortia for that matter) to make investments in a related technology. Currently, this is a substantial obstacle for KEMA to conduct its businesses in the domestic market.

End-users also form an important aspect of the commercialisation trajectory of **PHOTONIS**. Although the nature of PHOTONIS' business requires them to establish good contacts with partners, they also need to create awareness at the end-user level. This is particularly important if the company is looking for a good market uptake of the innovation. This approach was referred to as a push and pull process. To a certain degree, PHOTONIS pushes the technology on the market, but ensure successful commercialisation by creating demand pull. The latter is influenced by familiarising potential end-users with their new components and by involving some of the end-users already in the research stage.



4.6. Regional aspects that drive the development and commercialisation of publicly procured innovations

For **Ashwoods**, the UK was a suitable region to develop and commercialise their hybrid and driver behaviour technologies. Fuel prices in the UK are amongst the highest in the world, creating substantial incentive for users to adopt the technology. Moreover, telematics instruments for business fleets are already widely used in the UK. Both drivers and fleet managers are used to working with the technology.

AlertSolutions is strategically located in the Delft region. Delft is home to the Netherlands' most prominent technical university. The university is amongst the world's leading institutes in the field of water management and water related civil engineering. AlertSolutions can acquire all its employees and interns conveniently from this university. In the early stages of development, the company made use of research facilities offered by the university. Although this support was helpful, the acquired benefits were not substantial, due to related costs and inefficiencies associated with outsourcing of R&D activities.

Furthermore, the Delft region is located in an area of the Netherlands that houses the largest sum of invested capital beneath sea level in the country. Investments in dikes and related infrastructure are therefore significant. This therefore forms one of the company's lead markets.

4.7. Challenges and drivers with regards to the workforce

Having access to a highly skilled and specialised workforce is considered to be crucial by most of the interviewed

companies. The degree to which they find it difficult to attract and retain such a workforce varies among the companies.

Ashwoods has not encountered any obstacles with regards to the availability of an educated workforce. The company is already

working together with the universities of Bath and Bristol for doing research. Moreover, there are several government initiatives aimed at educating the next generation of automotive engineers.

AlertSolutions is currently employing 2 full-time employees. At the peak of development the company generated enough work for 5 FTEs. After the development stage, the company had to let go 3 of its full-time employees.

For **KEMA**, a company historically oriented on electronic appliances, it has been challenging to attract the necessary electro-technical expertise. Policy makers could make a beneficial contribution through increasing awareness of technical education programmes amongst high school students.

4.8. Challenges with regards to internationalisation

Ashwoods' innovation has to be applied to stock vehicles for it to be functional. As vehicles specifications differ between various EU member states, additional adjustments need to be made before the innovation can be brought to international markets. This forms the most significant barrier to internationalisation.

The United Kingdom Trade and Investment agency (UKTI) helped Ashwoods to access international markets. The agencies international network and connections have put the company into contact with potential customers. Especially the entry they provided to embassies in the territories Ashwoods wanted to explore, were useful. Moreover, the UKTI organises road shows and network events that help to generate exposure for Ashwoods' innovation.

The United Kingdom Trade and Investment agency (UKTI) played a crucial role for Ashwoods. They put the company into contact with potential customers, and especially the entry they provided to embassies in the territories Ashwoods wanted to explore were very useful.

AlertSolutions mainly makes use of the network of third parties to gain access to international markets. The company was recently invited by another Dutch firm, to participate in a project in China. Moreover, AlertSolutions also gained access to the German market via the invitation of a large Dutch firm conducting a project there. Finally, the UK market was accessed through a European programme for monitoring.

To really establish a foothold in international markets like the USA, AlertSolutions needs to have a local subsidiary with a full-time sales representative. The company currently lacks the funds to finance such an operation.

PHOTONIS showcases the potential for internationalisation through public procurement. In specific cases, having e.g. the Ministry of Defence as a launching customer has allowed them to gain better access to international markets. This can be attributed to the ability to make use of the public institution's network, gain direct market access to new markets and have a showcase for their innovative solution. For PHOTONIS this has been particularly helpful, allowing them to access new niche markets and gain access to new partners in the United States.



4.9. Tendering procedures can form a barrier for public procurement

Increasingly more cases can be identified by the companies in which the procurement of innovation is facilitated through official tendering procedures. While tendering procedures open up transparency of the opportunities to many of these companies, they sometimes also impose barriers.

For **PHOTONIS**, finding a launching customer in the Ministry of Defence can be characterised by a more relationship-based approach. There was no formal tendering procedure that led to the contract. This had a number of clear advantages to the company. Firstly, as Photonics produces highly technical components, it is sometimes difficult to fully explain the concept in a tendering procedure. Secondly, a tender document and possible agreement often requires companies to disclose sensitive company information. Moreover, they typically require a consortium of partners. As **PHOTONIS** is highly conscious of the information they want to share with their potential competitors, this poses a substantial risk to them. Finally, consortia agreements typically require you to share the resulting Intellectual Property (IP). In light of that, it could be more attractive to develop a solution privately.

Through direct public procurement, different conditions may apply. In the case of **PHOTONIS**, there was no need to share

their IP. Moreover, they did not have to draft the administrative documents, which companies sometimes perceive as being resource intensive. The direct approach therefore has had significant advantages for **PHOTONIS**, but other companies that are particularly concerned about IP face similar trade-offs.

AlertSolutions also faced a number of difficulties in participating in tenders. Being an SME, they are faced with very specific barriers as well. As they have limited resources, they continuously need to balance between bringing their innovation a step further or by drafting a proposal.

Moreover, as an SME they need to involve other partners, which can be challenging as well. This poses additional difficulties, as not only do they have to draft a text for the proposal, but also negotiate on their position in the final contract. Furthermore, in their experience some of the larger contractors are often focused on coming up with the cheapest solution that just meets the tender requirements. These solutions, however, not necessarily result in the most desirable project outcomes, but are favoured in the review process due to the competition on price. This leaves less room for small innovative companies like AlertSolutions to participate in tenders, as such companies often offer relatively expensive high value added solutions that possibly exceed the tender requirements.

5. Policy recommendations

Public procurement of innovation can benefit European companies as well as the EU economy and labour market, as the development and management of innovative technologies and processes requires highly skilled workers in a multitude of fields. However, CEOs of innovating companies have named several obstacles that could be addressed by government policy.

5.1. Policy gap analysis

Concerning the development programmes that focus on public procurement of innovation, there is a lot of encouragement yet to be offered by public policy in Europe. Gaps in policy are noted in assessment and monitoring of public procurement programmes; discouraging upfront investments for participating in public tender and calls that are often broadly defined; the extent to which they offer companies the opportunity to test their innovation in a real world context; and the difference in difficulty of acquiring public support for incremental innovation as compared to radical innovation.

Case companies see the need for strict assessment and monitoring of public procurement programmes, as it involves tax payers' money. There is, however, also a need for a less burdensome administrative procedure. An approach that would fulfil both needs would be desirable.

The upfront investment for participating in a public tender is significant, especially for smaller companies. These costs, amongst others, consist of substantial administrative requirements related to submitting a proposal. The chances of actually winning a public procurement tender are, however, relatively slim. This might discourage start-ups and SMEs to make use of public procurement programmes.

Measures that help to lower labour cost, particularly of R&D personnel, are considered to be highly beneficial. In several EU member states, however, existing measures are not providing sufficient support. For instance the Dutch WBSO (law on support for R&D activities) helps to alleviate the burden of R&D related personnel costs for companies, but does not provide enough support to hire additional employees.



For public procurement through research funding programmes like FP7, it is beneficial for smaller companies to have narrowly defined calls for proposals. A broadly defined call for proposals usually results in a high number of contenders, while it decreases the chance of precisely addressing call requirements. This demotivates participation of smaller companies to such programmes, because the upfront investments outweigh the slim chances of winning a tender. Smaller companies do not have the resources to spread their efforts across several calls.

A clear difference in procurement procedures that case companies participated in is the degree to which they offered the company to test their innovation in a real world context. Companies that were offered this opportunity, like Ashwoods, indicate that this significantly helped them to proof their concept and generate market exposure. Companies lacking this aspect in the public procurement programme indicate that, although they were able to develop the innovation, they lacked the support to swiftly access the market. It takes these companies significantly more time to acquire the required seed capital to commercialise the innovation, and find a launch customer to conduct real-world tests.

Finally, it is significantly easier to acquire public support for incremental innovation compared to radical innovation. It is hard for smaller parties to close the valley of death without government support. To get from technology development to commercialisation requires substantial funds, while at the same time potential for quick returns on investment are relatively low. Private parties might therefore be hesitant to invest, making public procurement of these innovations key. Public procurement measures specifically aimed at closing this valley of death for radical innovations would be beneficial.

5.2. Policy recommendations

European governments can address these policy gaps by introducing a hybrid version of funding development and as well as procurement of innovation, by co-procuring with private sector actors, by combining procurement with free access to university R&D hours and knowledge, by introducing an Envy scoring mechanism for public procurement programmes, by cutting up tender procedures in several (smaller) separate assignments, and by using specific methods that can encourage or force tenderees to adopt certain innovations or technologies.

Currently, government initiatives are mainly aimed at funding either the development of an innovation or the procurement of one. Interviewees indicate that a **hybrid version** of both types of funding would be highly beneficial. Such a programme would provide funding for the development of an innovation that has a guaranteed market. Governments could identify public needs and contract

commercial parties for meeting those needs, using a hybrid procurement programme.

Policy measures aimed at the **commercial demand-side of innovation** would be beneficial to reduce perceived return on investment for companies and consumers. These measures could take the form of public funding matching the investments of commercial parties in innovative green or safety enhancing technology. Other measures could be tax breaks or exemptions for companies and consumers investing in these innovations.

Another beneficial policy measure that is already deployed by public research institutes, in for instance the Netherlands, is the combination of funding and free-of-charge R&D hours and knowledge. TNO, a public research institute in the Netherlands, offers companies the possibility to further develop one of the institute's ideas or technologies. Companies are not only supported with funding, but also with a number of free research hours they can use for having the institute's staff conduct R&D activities.

Another policy recommendation entails the use of an Envy scoring mechanism for public procurement programmes, which provides better opportunities for small innovative firms. Conventional tender scores often have a strong price component, which dilutes some of the effectiveness of scoring high on aspects such as innovation, creativity and quality. An Envy scoring mechanism, however, allows high quality and innovative proposals a deduction in price, making them more competitive in a tendering procedure. This could stimulate the number of high quality proposals that are submitted, further streamlining the process.

Small innovative firms often participate in tender procedures as subcontractors to large contractors. These contractors are often focused on coming up with the cheapest solution that meets all tender requirements, which might not necessarily result in the most desirable project outcomes for society and thus governments. Moreover, this leaves no room for small innovative companies to participate, as these often offer relatively expensive high value added solutions, possibly exceeding tender requirements. Policy makers could make a clear distinction between products and services that can be procured solely based on price, and those for which increased quality and innovative solutions are desirable. Moreover, by cutting up the tender procedure in several separate assignments, smaller companies are less dependent on large contractors for participating in public procurement programmes.

A novel tendering approach that is applied by policy makers in for instance the USA is a two stage process. In the first stage, tenderees have to submit the best possible solution to a certain problem. The tenderer selects the proposal that offers the most desirable result. In the second stage, tenderees have to submit a price against which they are willing to execute the selected proposal. Such a procurement



procedure does not only result in more valuable outcomes, but also leaves room for the contribution of small and innovative firms.

Finally, there is another measure that could support the adoption of innovative approaches in tender proposals, and its execution. Tender specifications could be less oriented on

result related requirements, and could put more emphasis on the use of certain methods or processes. This would be beneficial for smaller companies, which often only participate in tender procedures as a subcontractor to a bigger party, as the main contractor would be obliged to adopt input from innovative companies in its proposal.



6. Appendix

6.1. Interviews

Company	Interviewee	Position
AlertSolutions	Pepijn van der Vliet	CEO/founder
Ashwoods	Mark Roberts	Managing director
KEMA	Theo Bosma	Department Manager New Energy Technologies Department
PHOTONIS	Fred Lalkens	Programme Director

6.2. Websites

AlertSolutions	http://www.alertsolutions.nl/
Ashwoods	http://www.ashwoods.org/
KEMA	http://www.dnvkema.com/nl/Default.aspx
PHOTONIS	http://www.PHOTONIS.com/en/

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