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MISSION REPORT

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This Mission Report is presented for information only and does not represent the official view of the Assembly. It was prepared by Henrik Bliddal, Director of the Science and Technology Committee.

I. INTRODUCTION

1. Over the last two years, the Science and Technology Committee (STC) has focused extensively on technological risks and opportunities and on how NATO must adapt to an era of rapid technological change. As part of this renewed focus, 13 members of parliament from eight Allied states and two partner countries (Georgia and Serbia) spent a week in Germany to focus on the civilian and military technologies of the future, along with the opportunities and risks that accompany them. The delegation was led by Jean-Christophe Lagarde (France), Vice-Chair of the Sub-Committee on Technology Trends and Security of the STC. In Berlin, members were greeted and welcomed by the German Head of Delegation Karl A. Lamers.

II. KEY THEMES IN GERMAN RESEARCH FOR INNOVATION

2. During meetings in Berlin, Herbert Zeisel, Head of the Key Technologies for Growth Directorate in the Federal Ministry of Education and Research, took delegates on a *tour d'horizon* of German innovation research.

3. "Innovation is not about research alone", argued Mr Zeisel. To focus its efforts, the German government has therefore launched "light house projects" in nine technology sectors, which bring together all relevant players inside and outside the government (see Figure 1). The funding for this higher-risk research is allocated a) through grants covering up to 100% of expenditures/costs of universities and public funded research organisations and up to 50% of costs of commercial enterprises and b) in special programmes for Small & Medium-sized Enterprises (SMEs).

4. Mr Zeisel highlighted international cooperation as a crucial factor in driving Germany's innovation research. Such cooperation was not just about research achievements, but it often became be a springboard for cooperation in development and production between partners, he argued.

Figure 1: Key Enabling Technologies	**Direct funds allocated**
New Materials: Batteries	80 Mil EUR
Production & Services : Future of Work	117 Mil EUR
Quantum Technologies : Photonics	95 Mil EUR
Data Science, Information Technologies : *Industrie 4.0*	141.5 Mil EUR
Security Research	57 Mil EUR
Electronics: Autonomous Electric Driving	128 Mil EUR
Human-Machine Interaction: Demographic Change	75 Mil EUR
Communication Systems: IT Security	73 Mil EUR

III. GERMAN RESEARCH AND DEVELOPMENT FOR THE ARMED FORCES

5. Ralf Schnurr, Deputy Director of the Equipment Division in the Federal Ministry of Defence (MOD), explained to delegates how Germany conducted defence research and development (R&D).

6. German defence research rests on three pillars: departmental research; government-funded basic research; and contract research. The MOD has 12 departmental research facilities, which cover research and technology (R&T) activities in areas, where civil research does not provide

solutions. For government-funded basic research, the MOD employs institutions of the Fraunhofer Group (see below for more information); the German Aerospace Centre (DLR); and the ISL (French German Research Institute) in Saint-Louis, France. Fraunhofer and the DLR are non-profit organisations with institutional funding. Of the Fraunhofer family of institutions, the MOD primarily works with seven to ten institutions, with a total of 2,500 employees and an annual budget of EUR 250 million. The DLR has 800 people across 40 research institutes. The ISL, founded in 1958, has 380 employees and an annual turnover of close to 50 million EUR. The MOD also contracts many research projects. This could either take place at Fraunhofer, DLR or ISL or at other institutes, companies or universities.

7. Mr Schnurr highlighted the work with Fraunhofer Technological Trends Analysis in identifying capability gaps and emerging technology trends. He gave the examples of big data and space infrastructure as two areas where Fraunhofer believes more MOD attention is warranted. Whereas big data analytics holds large opportunities to exploit, space infrastructure is coming increasingly under threat (for more, see below). The MOD has reacted to this call and spent more time, attention and money on these two areas.

8. Mr Schnurr expressed his contentment with the German defence research landscape. In particular, he is satisfied that the MOD has succeeded in raising the political profile of defence R&D by developing a new strategy with the current MOD state secretary. Moreover, the success rate of research projects was above 95%, he noted.

9. Mr Schnurr was optimistic about future R&T cooperation at the European level. Over the next year or two, lessons learnt during the Preparatory Action on defence R&D would become apparent and would provide the basis for the European Defence Fund (EDF). He noted that the European Union still needed to decide on the EDF governance structure, including the role of the European Defence Agency (EDA). In general, Germany advocated a strong role of the EDA in the EDF, he said. He underlined that European R&T cooperation did not compete with NATO and would be complementary.

IV. ARTIFICIAL INTELLIGENCE

10. Artificial intelligence (AI) was another important topic of the visit. Germany has funded AI research for 20 years, but until real AI could emerge another 20 years had to pass, Mr Zeisel of the Federal Ministry of Education and Research told the delegation.

11. During the visit, the delegation visited two sites of the German Research Centre for Artificial Intelligence (DFKI) – the biggest AI research laboratory worldwide. Started in 1988 with only five people, the organization has doubled its turnover every ten years and now has 450 employees. At three main sites (Kaiserslautern, Saarbrücken and Bremen), 512 researchers worked in ten research departments. With its EUR 44.1 million in linearised order volume, the DFKI is a medium-sized research institution. It has no basic funding, as it is only project funded.

12. “We want to develop computers with eyes, ears and common sense”, said Christoph Lüth, Vice Director and Research Administrator of Cyber-Physical Systems, about the DFKI’s vision. The DFKI covers the complete innovation cycle from “blue sky” basic research to commercialisation. However, the DFKI was mostly interested in technologies that could be applied right now, Mr Lüth said. The DFKI is thus not just about basic research, but is very much focused on applied research. Indeed, DFKI researchers have spun out many companies.

13. Dr. Sven Schmeier, Associate Head of the DFKI Language Technology Lab in Berlin, took delegates through the work of the DFKI as well as his work on language technology. Language technology is absolutely crucial to AI. Google, Facebook, Apple and other internet giants would not be where they were today without the immense advances in language technology, Dr. Schmeier

argued. At the DFKI, researchers were focusing on machine translation for smaller languages and on language technology for social inclusion, for example.

14. A particular feature of the DFKI is its living laboratories, i.e. demonstrators that were continuously running. The delegation was able to visit some of these living laboratories in Bremen, the youngest of the three main sites, founded in 2006. It hosts 140 researchers and staff and 75 student workers at a EUR 13.5 million linearised order volume.

15. One of the risks of AI, in combination with robotics, was discussed with Anja Dahlmann, Security Policy Research Division at the German Institute for International and Security Affairs (SWP). She addressed the Committee on one of the dangers of AI: lethal autonomous weapons. Autonomous weapons can be defined as weapons that can, once activated, execute a broad range of tasks without human intervention. These weapon systems do not and might never exist, but the decline of human control is an ongoing trend preluded by remotely piloted drones and certain air defence systems.

16. Weapons with autonomous functions have several military advantages. For example, they can execute certain tasks faster than human and they do not need a constant connection to communicate with the operator. However, these military advantages come at a price as they raise legal, ethical, and security concerns.

17. Many aspects of international humanitarian law, for example the principles of distinction, proportionality, and military necessity, require human judgement. This was lacking if the machine engaged targets without any human supervision or if the human operator had a short timeframe to veto based on highly filtered information, Ms Dahlmann argued.

18. As any new type of weapon, they might lead to an arms race between certain states, making conflicts more likely, Ms Dahlmann cautioned. There was also the danger of proliferation, as the technology was based on software and elements that can be procured on the civilian market, she said. In a conflict, the increased speed and lack of human judgement could stimulate escalation, she posited.

19. Lethal autonomous weapons are not truly autonomous in the sense of intention or purpose. When human control is removed from the targeting cycle, the use of lethal force will not be based on the decision of an entity but on statistical methods. This might constitute a violation of human dignity and would therefore be highly unethical, Ms Dahlmann argued.

20. The international debate about regulation currently takes place in the framework of the UN Convention on Certain Conventional Weapons (CCW). The focus of debate is the use of these weapons in compliance with international humanitarian law. The main obstacles in the debate are the lack of a definition and the hesitation to restrict existing weapons and civilian/commercial developments, Ms Dahlmann noted. A possible, although not probable, outcome would be a new protocol to the CCW banning the development and use of weapons that lack meaningful human control over the use of force. So far, the CCW States Parties have discussed the issue in three informal experts meetings since 2015. In November 2017, a new phase in the negotiations had begun, Ms Dahlmann told delegates: a Governmental Group of Experts with a mandate for binding recommendations. She urged that members pay attention to these debates going forward.

V. CYBER-PHYSICAL SYSTEMS

21. Germany is working hard on an evolutionary process towards *Industrie 4.0* (Industry 4.0), with EUR 500 million spent since 2012. Cyber-physical systems (or the Internet of Things (IoT)) are at the heart of *Industrie 4.0*, which aims for smart control and connection of plant and machinery. It centres around the reconfigurability and self-optimisation of such systems; flexibility; and producing individual products and services. Closely connected to *Industrie 4.0* are efforts on the future of work – a future where digitalisation and close human-machine interaction fully enter the picture.

22. In Berlin, the delegation visited the premier institution for *Industrie 4.0*, the Fraunhofer Institute for Production, Systems and Design Technology (IPK). Holger Kohl, Head of the Corporate Management Division, presented an overview of the Fraunhofer Model of application-oriented research supporting industries and governments; the work undertaken at the Production Technology Centre in Berlin; and *Industrie 4.0* as seen by Fraunhofer, which had already invented *Industrie 3.0*. The delegation also visited select projects of the IPK.

23. The Fraunhofer Institute is the largest applied research institute in Europe, with over 5,000 patent families. Founded in 1949 in Munich, Fraunhofer now has 69 institutes and research units in Germany with more than 24,500 employees and an annual budget of more than EUR 2.2 billion. Around EUR 1.9 billion comes from government or industry. Its most famous patent was the MP3 music format, which garnered license fees of over EUR 80 million per year.

24. The Fraunhofer Institute works for industry, which is rare in the research world. A third of its projects are financed by industry and thus demand-driven, without government subsidies. The particular character of the institute was developed in the 1970s and 1980s, when they received more funding in line with their successes in industry. While the university sector is strong in Germany and innovative companies create new products at good rates, research and technology organisations like Fraunhofer bridge the innovation gap in R&D. This is in clear contrast to many other national models. In the United States and the United Kingdom, this function is mostly assigned to universities, for example. Overall, two thirds of Research and Technology expenditures are invested by the industry.

25. The IPK and the collocated Institute Machine Tools and Factory Management (IWF) of the Technical University of Berlin has over 800 employees, with an annual budget of EUR 35 billion. The IPK and IWF are heavily invested in work on personalized manufacturing, which is tremendously complex, according to Mr Kohl. Additive manufacturing also plays a big part in this.

26. The term *Industrie 4.0* was introduced in 2012, as research turned to cyber-physical systems (or the IoT). *Industrie 4.0* centres on digitalisation along the entire process chain. Internet-enabled devices are at the heart of this, as objects are tagged with barcodes, Radio-Frequency Identification (RFID) tags or eGrains, Mr Kohl told delegates.

27. Mr Kohl argued that, today, humans tell the systems what to do. In the future, however, systems would tell humans what to do. Today, production was managed “top down”. When changes occurred, the top needed to do a re-planning of the processes. This created a lot of inefficiencies, in personalised manufacturing especially. In *Industrie 4.0*, functions were shifted down. For example, raw materials would communicate with machines in the future, and IT would move into industrial

clouds. A key drawback, however, was that no standards existed for the protection of the industrial cloud, Mr Kohl argued.

28. The benefits for industry would be time savings and production cost reductions, which would translate into productivity increases, Mr Kohl told delegates. Manufacturing would become a lot more productive, which was the key reason the government strongly supported the IPK.

29. Of course, many other countries were working on similar activities, in particular in the United States, Mr Kohl argued. However, even China was beginning standardisation work. In Germany, SMEs were unfortunately very risk adverse. The industry was currently not able to pay for the investments by itself. It could only be done through government support.

30. Discussion on cyber-physical systems continued at the DFKI's Cyber-Physical Systems Research Department in Bremen. At the Department, 22 researchers work on how to merge the physical and the virtual world in an adaptive and mobile as well as autonomous and cooperative way. Challenges, according to Mr Lüth of the DFKI, included guaranteeing the correctness of behaviour in safety-critical applications, managing the growing complexity and ensuring safety and security.

31. The delegation was briefed and saw technology demonstrations of a number of cyber-physical systems. For example, the Bremen Ambient Assisted Living Laboratory (BAALL) is a fully furnished apartment, which adapts to the needs of the inhabitants, based on new intelligent technologies. The big challenge was to make the concept human-centred, Mr Lüth argued. Today, it was still very technically centred: technologies did not combine and interact very well and voice interaction was particularly challenging. In an ideal world, the users would not even notice the technologies.

32. Another example includes Project SIRKA, where the goal is to help avoid postural deformities from heavy physical work, in order to extend the useful working life of the labourer. A shipbuilding company and an emergency medical provider have initiated the programme. Pointing to the value of privacy and data control, Mr Lüth told delegates that the data was only stored locally and thus could not be used to evaluate the worker.

VI. ROBOTICS

33. Robotics is a key enabling technology in Germany's eyes. The country is focusing on human-robot interaction for supporting humans in daily living and working situations. Robots should become "cautious partners", Mr Zeisel of the Federal Ministry of Education and Research argued. Safety systems and radar sensors to build an outer virtual skin for a robot became crucial conditions

to advance robotics. The advances technology can bring to health and elderly care were another topic discussed throughout the visit.

34. In Bremen, the delegation visited the DFKI's Robotics Innovation Centre, where Jens Mey, its Deputy Director, took delegates through the Centre's work and guided them on a tour of their laboratories.

35. The Centre's main areas of research and application were in the following fields:

- Underwater robotics
- Space robotics
- Search and Rescue and security robotics
- Logistics, production and consumer services
- Rehabilitation robotics
- E-mobility

36. The Centre's main competencies are in development, design and simulation; autonomous systems; software tools; interfaces; and testing.

37. In total, the Centre has developed about 60 robotic systems. The delegation had a chance to see a multitude of new systems in development. For example, members could see an autonomous football robot in action. Other robots shown in Bremen included an ape-like robot with vastly improved freedom of movement, robots destined to explore other planets and moons, and optionally autonomous smart connecting cars. They also heard about a project on the development of an innovative and mobile full-body exoskeleton, and of an active subsystem as an independent unit for robot-assisted rehabilitation of neurological diseases.

38. DFKI researchers pointed out that collaboration between humans and robots had arrived: in about five years, human-robot collaboration would be standard on the factory floor. The technology for autonomous cars was ready, too, but legal concerns held the development back so far. All-purpose household robots were very far in the future, however, as the required "common sense" was a very difficult problem.

VII. BIG DATA ANALYTICS AND DEEP LEARNING

39. Germany is investing heavily in big data analytics and deep learning. As the amount of data available rises, a need for smart usage goes hand in hand. Germany has thus established two competence centres: the Berlin Big Data Centre, which combines data management and machine learning, and the Competence Center for Scalable Data Services and Solutions, which focuses on data quality, data integration, visual analysis and efficient architectures.

40. Members had the opportunity to visit the Berlin Big Data Centre, founded in 2016. The Centre's Smart Data Forum and the colocated Innovation Centre for Immersive Imaging Technologies hosted the delegation and explained their work to members, including through technology demonstration in areas such as crisis management, energy, health and mobility.

41. Antje Nestler, Showroom Manager at the Smart Data Forum/Fraunhofer Heinrich Hertz Institute (HHI), told members that they wanted to make smart use of big data for the benefit of the economy and society. The Smart Data Forum gives smart data innovators a place to meet – from enterprises, associations and initiatives involving politicians and civil society to researchers.

Innovators could work on new business models at the Forum. The Forum also hosted conferences and provides training.

42. The sharing economy was a key theme at the Smart Data Forum. Aware of the privacy issues at stake, members engaged in extensive discussions on data security and data sovereignty, i.e. how to ensure that data is secure and how to keep users in control of their data.

VIII. AEROSPACE TECHNOLOGIES

43. In Bremen – the “city of space” – the companies OHB SE and Airbus briefed members on the most recent advances and the next steps in space technology. The delegation deepened their discussions during tours of OHB’s and Airbus’ production facilities as well as of the DFKI in Bremen, which focuses heavily on robotics for exploration of planets and moons in the solar system.

44. Fritz Merkle, member of the OHB Management Board, welcomed the delegation at the OHB site in Bremen and took members through the company’s portfolio, which encompasses both space and aerospace systems. OHB was founded in 1981 as a start-up company, but has since become a mostly family-owned company with about 2,400 employees and EUR 728 million revenue (2016).

45. OHB builds satellites for telecommunications, navigation, reconnaissance, earth observation, early warning and space situational awareness as well as science and exploration. For example, 11% of the rocket hardware in the Ariane programme are produced by OHB, and 34 of the Galileo satellites are also produced by OHB. The company has also developed and produced earth observation reconnaissance satellites for the German Armed Forces.

46. “Space is part of our daily infrastructure”, stressed Mr Merkle. Security, economy growth and navigation all depended on space assets. As other countries were building up their anti-satellite capabilities, the risks to space assets were increasing, Mr Merkle argued. Space debris – with around 4,000 active and inactive satellites and another 30,000 objects in orbit around earth – was becoming a danger to space assets as well. The sustainable management of space was becoming increasingly important. “In space, we all drive on the same road,” he said. A code of conduct was needed, especially as new companies were pushing into the market, with often lower quality standards.

47. At Airbus Defence and Space, Executive Assistant Thomas Zisik presented an overview of Airbus Defence and Space’s work in Bremen, which hosts all branches of Airbus except for its helicopter business.

48. One of Airbus’ big projects in Bremen is the fuselage and cargo hold systems work on the A400M programme, the multi-national, four-engine turboprop military transport aircraft first introduced in 2013. The delegation had an in-depth tour of the factory floor.

49. Airbus is also the centre in Europe for the upper stage and integration work of the Ariane programme. With the new Ariane 6, the company was moving into the industrialisation of launcher production, with the aim of moving to similar processes as in the aircraft or car assembly production systems. This would enable the company to stay competitive with new private space companies pushing into the market. Airbus also conducted work for the International Space Station as well as a new Automated Transfer Vessel for it. Other areas of work included on-orbit services and exploration – working on NASA’s Orion mission –, space robotics, novel space tugs, deep space gateways, lunar exploration and additive layer manufacturing.

50. Jörg Plaß of Airbus’ Security & Defence Space Programmes Germany talked about current topics of interest for security and defence. As the space domain becomes increasingly vital for armed forces (for example for ballistic missile defence, critical infrastructure protection, navigation as well as command and control), “space infrastructure needs to be protected”, he argued. Three big themes

were emerging for Airbus: big data, robotics, and general preparedness for the future. Big data management was urgent and important. Airbus was thus working on a “space data highway”, quantum cryptology and on-board processing. Robotics needed to be deployed for traffic in space, debris management and non-cooperative scenarios. For the future, interconnections, systems of systems as well as rules and regulations were needed. He also mentioned that cyber-attacks were becoming a concern for space operations.

IX. CYBER SECURITY AND DEFENCE

51. Germany is substantially upgrading its cyber security and defence efforts. Colonel Rainer Simon, Head of Branch – Cyber IT Strategy, Cyber Policy, International Cooperation at the MOD, therefore addressed Germany’s evolving cyber defence and security policies.

52. The cyber world was changing rapidly, he argued, *inter alia* because of the burgeoning IoT. He thus called cyber security and defence “the defining issue of the 21st century”. Cyber-attacks on states and CI were no longer a fiction, he argued: states and non-state actors could produce effects for conventional warfare and hybrid warfare. Internal and external security could no longer be separated. Criminal attacks could have real military consequences, for example for NATO Allied host nation support, he told members. The 2017 Wannacry ransomware attack shut down the German railway system, for example, which would be a huge military problem during wartime.

53. NATO underlined that cyber-attacks could, under certain circumstances, lead to the invocation of Article 5. The Alliance has also declared cyberspace a domain of operations. Colonel Simon told delegates that the Alliance was therefore busy adapting its command structure to these new circumstances, as was Germany as a nation. The costs and work involved in implementation would be very large, he added.

54. The German armed forces were charged with three types of cyber operations to provide friendly freedom of manoeuvre in cyberspace and project power in and through the domain: network operations to establish security to defend the information environment; reactive defensive operations; and active offensive operations.

55. In Germany, two important documents with important implications for the MOD’s and the armed forces’ cyber defence and security were released in 2016. For one, the government released a new defence and security White Paper. Also, the German Ministry of the Interior released a Cyber Security Strategy for Germany 2016.

56. The new White Paper sought to:

- “Strengthen whole-of-government capabilities, that means whole-of-government cooperation and networking with science, industry and allies.
- Strengthen Cyber capabilities of the [German armed forces], thereby consolidate and make the security architecture of the IT system of the [German armed forces] more resilient.
- Temper weapon-systems, command posts as well as the procurement supply chains.
- Recruit key personnel by creating attractive cyber-careers and innovative recruiting strategies.
- Consolidate fragmented responsibilities and structures in order to build up robust capabilities, concentrate IT capabilities and establish a single point of contact for other departments and allies.”

57. As a consequence, in the MOD:

- a new directorate general on cyber/IT was established;
- a new military service for the cyber and information domain was stood up;

- a new Fusion Centre for the Cyber and Information Domain was being stood up to provide a common operational picture.

58. The MOD also established a cyber cluster in Munich; was building up a cyber reserve force; conducted cyber hygiene check-ups; and adapted procurement and innovation processes.

59. International cooperation was another key effort, with the most important partners being NATO, the EU, the OSCE and the UN.

60. During the discussion with members, Colonel Simon highlighted the difficulty of recruiting and retaining cyber experts in the MOD. New career paths still had to be defined, but he underlined that the MOD provided very good education and training.

X. GERMAN ENERGY POLITICS

61. The STC has had a long-standing focus on energy politics and energy security. Hence, the delegation took the opportunity to be briefed on the latest developments in Germany's *Energiewende* (energy transition). The delegation was delighted to be addressed by Uwe Beckmeyer, Parliamentary State Secretary at the Federal Ministry for Economic Affairs and Energy, and former member of the German Delegation to the NATO PA.

62. Mr Beckmeyer argued that the *Energiewende* means nothing less than a complete overhaul of Germany's energy supply. Three imperatives must be met: the new energy system must be more environmentally friendly, guarantee security of supply and remain competitive. This was a huge challenge that goes beyond one legislative term, he said.

63. The first version of the Renewable Sources Act was passed in 2000. It is a simple system with fixed subsidies for renewables, which has driven up the share of renewable sources in power generation from 6% in 2000 to 35% today. At the same time, the cost of generating one kilowatt-hour has fallen from 50 cents to 5 cents. By 2022, Germany aims for a share of 40-45% of renewable sources in power generation. In 2050, the number should reach 85-90%.

64. However, the subsidies were costly, Mr Beckmeyer argued. Another reform in 2017 thus addressed some of the faults in connection with the steep learning curve associated with the *Energiewende*. The funding rates are no longer determined by the state, but by market-based auction schemes, i.e. those who demand the lowest subsidy get the right to supply the power.

65. While it was easy to absorb 20% of renewables in the system, it was harder to go beyond that number in legacy energy systems, Mr Beckmeyer underlined. In the past, generation followed consumption. Today, however, the wind was blowing in the north, but the power was needed in the south, he noted. Germany is thus building several north-south high-voltage lines. However, while the *Energiewende* enjoyed high overall approval, he said, politicians faced stiff headwinds when it came to the construction of new powerlines, due to the 'not-in-my-backyard' phenomenon.

66. Two pressing issues needed to be dealt with in the near future, he told delegates: first, meeting the ambitious targets and, second, the reduction of coal and lignite in the system. A gap existed between the success of building up renewables and not reducing the old ones, he argued. Especially the phase-out in coal was difficult. Mr Beckmeyer argued that the people in the producing regions should not be left alone, but helped in the transition away from coal and lignite. Renewable energy in the heating and transportation was another problem, as these sectors still rely heavily on fossil fuels. He urged for CO_2 taxation, if Germany wanted to be serious about its climate targets. Energy efficiency was another crucial piece of the puzzle. He saw broad consensus across parties on the *Energiewende*. Political discussions were more about how than if.

67. In Magdeburg, the delegation had the opportunity to visit Enercon, a leading company in the wind energy industry, in order to study the practical implications of the *Energiewende*. A company with over 20,000 employees, Enercon has nine national and 30 international sales offices. Founded in 1984, Enercon has since installed 43 GW of power. In Germany, it is the market leader with 39.9% of installed power. In Europe, it has a market share of close to 25%, and 5.1% worldwide. The delegation also received briefing on how the MOD works together with the wind energy industry to ensure wind farms do not interfere with military operations.

XI. CLIMATE CHANGE AND SECURITY

68. In Berlin, the STC continued its focus on climate change and security. Benjamin Pohl, Senior Project Manager at Adelphi (a leading independent think tank and public policy consultancy on climate, environment and development), spoke to the delegation on climate change as a security threat.

69. Adelphi focuses on the risks and conflict dynamics that are already observable today. Climate change would converge with other pressures and shocks and increase the risks to the stability of states and societies, Mr Pohl argued. However, no simple causal link existed between climate change and state fragility. The fact that there are a multitude of causal pathways made it hard to prove effects, he noted, but it also gave more entry points for policymakers to mediate the effects.

70. Climate change was part of a number of global pressures, according to Mr Pohl: increasing resource demand; population growth; uneven economic development and inequality; environmental degradation; and urbanisation. All of these together led to seven compound risks that threaten states and societies:

- local resource competition;
- livelihood insecurity & migration;
- extreme weather events & disasters;
- volatile food prices & provision;
- transboundary water management;
- sea-level rise & coastal degradation; and
- unintended effects of climate policies.

71. Today, key policy sectors were insufficiently integrated, he argued:

- Climate change adaptation plans rarely addressed fragility and conflict comprehensively.
- Climate finance did not reach most states experiencing fragility.
- “Climate-proofing” development work was not yet standard, especially in fragile situations.
- Fragile countries often lacked absorptive capacity and faced higher aid volatility.
- Climate change was not yet sufficiently incorporated into peace and conflict assessments.
- Decision-makers and practitioners had little experience in linking peacebuilding and climate change adaptation.

72. To realise synergies and co-benefits, the international community needed to break down sectoral barriers and integrate approaches across key communities, Mr Pohl urged. It also had to translate good policy into widespread implementation. In this, the concept of resilience could provide a common goal.

73. The G7 had commissioned Adelphi and partner organisations in order to explore global actions that could produce local results on climate change and security. Their report recommended to

partner with and support local actors, governments, and NGOs in countries facing fragile situations and to ensure that global initiatives improve local resilience to climate-fragility risks, Mr Pohl noted.