



# LUXEMBOURG

## A PIONEER IN SPACE

**LU**  **EMBOURG**

LET'S MAKE IT HAPPEN

The background image is a composite of several views from inside a space station, likely the International Space Station (ISS). It shows multiple windows looking out at the Earth, which is covered in white clouds and blue oceans. In the upper left, another satellite or module is visible in orbit. The interior of the station is dark, with some equipment and structural elements visible. A large, solid blue diagonal shape is overlaid on the right side of the image, containing white text.

**THE LUXEMBOURG  
SPACE INDUSTRY  
HAS GROWN FROM  
NOTHING INTO  
PROBABLY THE  
MOST DYNAMIC  
IN EUROPE.**

## AT A GLANCE

### SIZE

2,586 sq km / 999 sq miles

### POPULATION

590,700 inhabitants  
(48% foreigners)

### LANGUAGES

Luxembourgish (national language), French, German, English is widely used, especially in the high-tech and financial sectors

### CURRENCY

Euro

### POLITICAL SYSTEM

Constitutional monarchy /  
Parliamentary democracy

### HEAD OF STATE

HRH Grand Duke Henri

### EUROPEAN UNION CAPITAL

European Commission Services (translation, publications, statistics) / European Court of Auditors / European Court of Justice European Investment Bank / European Investment Fund / European Stability Mechanism / Secretariat of the European Parliament

### FOUNDING MEMBER OF MAJOR INTERNATIONAL ORGANISATIONS

Benelux / Council of Europe / European Union  
/ NATO / OECD United Nations / WTO

### ECONOMIC HIGHLIGHTS

- An open, diverse, stable economy
- Top GDP growth performance
- AAA-rated country
- Sound macroeconomic fundamentals
- State-of-the-art infrastructure
- Excellent ICT connectivity to markets in the EU and worldwide
- Central location within a day's reach of 60% of EU markets

### DISTANCE FROM CAPITAL TO

Paris: 380 km  
Frankfurt: 250 km  
Brussels: 200 km





**In just three decades, the Luxembourg space industry has grown from nothing into probably the most dynamic in Europe.**

Today, the country is home not only to global satellite operator SES, but also to around 30 other highly advanced technology companies, including Lux-Space, Euro-Composites, Gradel and HITEC Luxembourg. All these companies are active in one or more of the space, ground and services segments and fully engaged in research, development and service provision in areas such as satellite communications and infrastructure, microsatellites, electric propulsion, Earth Observation, satellite-based air and marine traffic monitoring, navigation and security. Luxembourg is a European Space Agency member and is currently participating in a number of high-profile ESA programmes.

Unusually in this industry, the birth of the space sector can be credited to the Government, which – in a move described by the current head of the Luxembourg

Space Cluster as “one of the most fantastic, innovative, successful diversification policies ever in Europe” – took the decision in 1985 to invest in and set up SES. This is the model for the other public-private partnerships that Luxembourg is building today.

The success of SES brought with it an added determination to create a true innovation economy. Six public research laboratories at the University of Luxembourg and the Luxembourg Institute of Science and Technology are involved in space-related research in close partnership with the local industry. Promising research and development ideas can receive substantial funding from the Government.

Each Luxembourg Government has backed that initial courage, drive and commitment by continuing to do everything possible to expand the sector and drive it forward. Companies with strong commercial ideas draw on a full

range of support: finance, premises, research resources and a collaborative international network of contacts and potential partnerships. Even better, in the words of SES' Romain Bausch, "Policies and initiatives are launched between government and companies - it is very easy to access key government members. Ministers come to SES to discuss developments, needs and ideas, and are actively trying to support companies like us and their economic missions."

The recent government initiative SpaceResources.lu, which aims to establish Luxembourg as a centre for the exploration and utilisation of space resources by supporting advanced research activities and technological capabilities, is yet another audacious step forward. As private companies play an increasingly important role in space exploration, Luxembourg is also among the first countries to offer a legal framework that secures property rights for space resources. The initiative has already attracted extensive interest from international companies and opened new development and cooperation perspectives for the national space sector.

Luxembourg is keen to welcome high-tech, ideas-driven organisations and has put many measures in place to attract innovative companies looking for an HQ in Europe. In line with its focus on innovation, it has built a secure, state-of-the-art communications infrastructure, a culture of trust and security and a legal system highly conducive to business development.

Luxembourg is renowned for its strong financial centre and business infrastructure, its location, stability, high standard of living, outstanding multilingual workforce and attractive legal and fiscal framework. Among global companies with headquarters in Luxembourg are SES, Amazon, eBay, PayPal, Intelsat, broadcaster RTL and ArcelorMittal, the world's largest steelmaker.

## SPACE SECTOR DEVELOPMENT

Luxembourg has invested heavily in its space industry in the years up to and since it became a European Space Agency member in 2005. Substantial government spending on the sector places the country in the ESA's top five in per capita terms.

Around 30 companies and several public research laboratories are currently active in the space sector. The added value of the sector constantly increases, as well as the number of people working in the sector. The public research organisations report a similar trend concerning staff engaged in space-related research.

## THE LUXEMBOURG SPACE POLICY

In line with its determination to create a solid, vibrant and innovative space sector, Luxembourg has developed an overarching space policy. The objectives are to:

- contribute to the diversification and sustainability of economic activities in Luxembourg,
- consolidate and enhance existing skills in the field of telecommunications and media as well as ground systems,
- extend skills in the sector, and
- give an international dimension to the activities through an access to international networks.



# SpaceResources.lu

EXPLORING NEW FRONTIERS



## **LUXEMBOURG AIMS TO PLAY A LEADING ROLE IN THE EXPLORATION AND UTILISATION OF SPACE RESOURCES.**

The identification and utilisation of space resources is fast becoming a reality, driven by a revolution in space technology, accelerating exploration of outer space and the eventual scarcity of certain resources on Earth. Building on its long history at the forefront of the commercial satellite communications industry, Luxembourg aims to play a leading role in the exploration and utilisation of these resources.

### **BENEFITING FROM SPACE RESOURCES ON EARTH**

Celestial bodies – including the Moon or near-earth objects (NEOs) such as asteroids – contain a rich diversity of inert physical substances such as metals, along with gases and water that could be used as energy sources and means to sustain human life as we venture deeper into space. Many of these metals are already scarce on Earth and might one day be used not only to construct equipment in space but be transported back to support terrestrial activities, employing on Earth the technologies developed to explore and mine resources in space. But for now, the clearer and more immediate benefits from mining resources are for use in space.





Luxembourg's goal is to ensure that space resources explored under its jurisdiction serve a peaceful purpose, are gathered and used in a sustainable manner compatible with international law and for the benefit of humankind. Luxembourg's vision is built on support for advanced research activities and technological capabilities, drawing on the country's existing expertise in the space sector and its ongoing strategy of economic diversification into future-oriented high-tech industries.

### **ATTRACTIVE OPPORTUNITIES FOR SPACE INDUSTRY**

Not long ago, space exploration was the preserve of national governments and international agencies with access to the necessary financial resources. Today, private investors and companies utilise lower-cost technologies – including nano- and microsats – to build innovative systems and services in Earth observation or satellite communications, and have at their disposal the financial resources to launch satellites to explore the opportunities for mining resources on NEOs or the Moon. In doing so, they increase the knowledge on these bodies and may also contribute to help defend Earth against asteroid impacts, preventing material damage and human casualties.

In the years to come, the focus on space resources exploration and utilisation will generate attractive opportunities in Luxembourg for established and start-up players in areas including materials science, additive manufacturing, remote sensing, communications, robotics, data analytics and artificial intelligence. Several international companies have already set up a presence in the country following the launch of this initiative. Luxembourg also aims to provide the legal certainty that investors, explorers and miners need and set out the procedures for authorising and supervising mission to explore and harvest space resources in accordance with international treaty obligations.

## “Absolutely the right environment for SES“

As Europe's first private satellite operator SES began with one single TV satellite broadcasting to European homes. It now provides the world's leading TV distribution platform via satellite, reaching 325 million households, and today goes beyond only TV distribution. Now SES provides enterprise and telecommunications services as well. These include VSAT networks, broadband internet access, mobile backhaul and trunking, and maritime and aeronautical communications, plus a wide range of secure and reliable communication links for government, military and civil organisations and first response teams in emergency situations.

***Romain Bausch, SES President and CEO 1995-2014 and current Chairman of the Board of Directors, talks about the birth and development of the Luxembourg space industry.***

Back in the 1970s, the use of satellites in telecommunications was in its very early stages, but the Luxembourg Government was keen to develop satellites to support the country's media activities. Since there were no private companies operating in this area, the Government decided to pioneer the business model. It went to the UN and asked for orbital positions and frequency rights, and

in 1985 set up SES as a private company, with the Luxembourg Government and the two Luxembourg public banks among the founding shareholders.

SES launched its first satellite in 1988 to provide direct-to-home TV services for Europe. This was an incredibly risky endeavour; had that first launch failed, SES would have failed with it. Over time, the company diversified into regions such as Asia and Latin America, and added data and telecoms services. This expansion was fuelled by acquiring Americom (one of the US's two biggest satellite operators), and later the Dutch company New Skies, which significantly expanded its global reach. SES now has a fleet of over 50 geostationary satellites, 12 medium earth orbit satellites and a global network of teleports and offices.

The Luxembourg Government of today is totally committed to the space industry and has created an excellent environment for R&D. This especially applies to the University of Luxembourg, which has centres of excellence in both ICT and space activities and provides scope for private companies such as ourselves to collaborate on academic partnerships. SES has a contract with the University to sponsor a chair in Space Law and we are very committed to supporting and

investing in projects with its Interdisciplinary Centre for Security, Reliability and Trust (SnT). The SnT has researchers and PhD students engaged in research into terrestrial and data communications. These academics benefit from the use of SES resources and facilities and develop applications on the spot.

All of this contributes significantly to creating and retaining a highly-skilled workforce. People who come to Luxembourg as students or post-graduates gain experience, contribute to public research or space sector company projects, and are likely to want to continue into the workplace. The workforce here is extremely international, with 70% coming from outside of Luxembourg. Mostly they are European, but we also have colleagues from the US, Africa, Latin America and Asia.

With a population of only half a million, the workforce in Luxembourg is very interconnected – people know each other, talk to each other, and share ideas. Government members, ministers and key civil servants are very easy to access and discuss ideas with, and ministers come to companies like SES to discuss developments and needs, actively trying to support companies and their economic missions. There is also a very important



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network of ambassadors, whose job it is to identify areas of economic interest and make links with relevant companies.

The focus in Luxembourg is on development and the balance is very good, with excellent terrestrial networks and perfect international connections. In every way, Luxembourg is absolutely the right environment for SES.

# The keys to success

As a small country, Luxembourg cherishes pragmatism and flexibility. Political decision-makers are very accessible and keen to listen to companies' concerns with a view to developing tailor-made strategies to support investment, research and development.

## **ATTRACTIVE BUSINESS ENVIRONMENT**

Luxembourg's economic policies are based on the strengths of private initiative and innovative spirit. This free market approach gives businesses freedom to act free of red tape. The Luxembourg Government actively encourages investment and innovation through a legal and regulatory framework designed to support business creation and economic development.

## **HIGH PRODUCTIVITY**

The vitality of the Luxembourg market is for a large part due to the competencies and hard-working mentality of its people. Cross-border thinking, mobility and the cosmopolitan nature of its workforce, of whom one third commute each day from the three neighbouring countries, contribute to the country's high productivity. The language skills of the workforce are such that our companies can legitimately claim to speak the language of our customers.

## **PREMISES**

Several incubators – centres of business and innovation – can offer premises and support to entrepreneurs or technology-based companies wishing to establish a new and innovative activity in Luxembourg. They are also used as a temporary location by international companies setting up business here. Alternatively, premises may be available at favourable rates at one of the country's industrial sites or parks, all fully-equipped and located close to major international motorway, railway and airport networks.

## **FINANCIAL SUPPORT**

Financial support may be granted to specific projects to complement equity and bank financing. In addition, assistance may be available to small and medium-sized companies and firms located in development zones. There are also opportunities to secure funding for research, development and innovation investment, environmental protection and energy-saving measures. Government loans are available in addition to medium and long-term loans from the public-law banking institution, the SNCI.





# 10 good reasons why Luxembourg

1. **Strategic central European location**
2. **Open and safe**
3. **Easy access to decision-makers**
4. **Business-friendly legal and regulatory framework**
5. **A leading financial centre**
6. **Competitive business costs**
7. **Highly skilled, multilingual workforce**
8. **State-of-the-art infrastructure**
9. **Investment and R&D incentives**
10. **High quality of life**

## “The essential advantage of Luxembourg: an SES perspective”

*Karim Michel Sabbagh, President and CEO of SES, talks about the Luxembourg business environment and how he sees the future of SES.*

The journey of SES, past and present, is a good reflection of the essential role the Luxembourg Government plays in enabling companies from their start-up phase and well into their evolution into global leaders. In the case of SES, more than 30 years ago the Luxembourg Government had the foresight to embrace a nearly unproven technology, a non-existing regulatory environment, and an untested business model. SES challenged conventional wisdom in Europe about what satellite technology could achieve. It also tested the regulatory limits of communications and broadcasting as well as creating a winning business model that few understood. Here we are more than 30 years later, with SES the leading global satellite operator, representing a great achievement for the Luxembourg Government to have had such foresight.

In thinking about the enablers that were offered to SES in Luxembourg, we could consider three critical ones.

First, SES had access and the possibility to attract and develop world class

human capital in Luxembourg. SES is an institution encompassing nearly 2,000 employees, with more than 500 based in Luxembourg. And, many of the capabilities, as those based in Betzdorf, rely on highly qualified skills in technical, commercial, legal, strategy, and overall management areas. Over the years SES developed the best workforce in the industry thanks to the high potential talents it could recruit in Luxembourg as well as the differentiated talents it could attract from around the world to work in Luxembourg. With more than 35 nationalities under its roof in Betzdorf, SES has a first-hand appreciation of the environment provided in Luxembourg to find these talents as well as to recruit them from outside. SES also has a genuine appreciation for the support received in Luxembourg to invest in the development of its human capital. In return, the company is actively engaged with the University of Luxembourg, supporting research and academic programmes that produce world class talents in technology and regulatory fields.

Second, Luxembourg provided SES with a regulatory framework that allowed the company to define a brand new industry and business, grow it into a global leadership position, and manage

its operations in an integrated manner with the rest of the world. Spearheading the development of regulations that sit at the intersection between technology, media and telecommunications is no small achievement. This foundation was in fact an indispensable element that gave a long-term reassurance about the sustainability of the business and encouraged investors and clients to commit to SES. The regulatory framework also facilitated the seamless expansion of the business internationally, and the integration of SES' operations in the most efficient manner. The SES fleet currently covers 99% of the world population, its operation serves clients in 130 countries, and the company has more than 20 offices around the world. The stature of Luxembourg internationally was a significant contributor to SES' successful development.

Third, in Luxembourg SES has established the core of its global system to manage its fleet of more than 60 satellites along with the related ground segments offered from 14 countries. This is possible through the superior quality telecommunications networks in Luxembourg that enable connectivity to the rest of the world. SES operates in a 24x7 environment and its business requires uncompromised business



**“LUXEMBOURG PROVIDED SES WITH A REGULATORY FRAMEWORK THAT ALLOWED THE COMPANY TO DEFINE A BRAND NEW INDUSTRY AND BUSINESS.”**

continuity. This is greatly aided by the robust and secure infrastructure that is accessible in Luxembourg. Beyond the connectivity factor, the quality of the infrastructure combined with the progressive regulatory framework has enabled SES to set-up its proprietary top tier facilities in Luxembourg to host and manage the zettabytes of

content carried on behalf of clients on its network.

Building on the “SES factor”, Luxembourg has fuelled the emergence of a strategic cluster in the space industry. This is enabled by those elements in the ecosystem that have supported the SES journey, and in return were supported by the development of SES. Over the past 10 years nearly 50% of the SES satellites were manufactured in Europe, and a total of 40 missions were completed on the European Ariane launcher. As well, SES is pursuing a number of R&D and industry shaping ventures with the European Space Agency and other institutions in Europe. Similarly at a local level, the Luxembourg Space Cluster is comprised today of 30 private institutions and six public research laboratories. And institutions within this cluster have on-going joint developments, including SES. While it would be difficult to judge what came first, it is reasonable to state that Luxembourg created the optimal conditions to develop and attract different players in the space ecosystems and where they can complement and reinforce each other presently and in the future.





# State-of-the-art ICT infrastructure

## **OUTSTANDING CONNECTIVITY**

Luxembourg has high capacity, secure, redundant fibre optic links to the main European data traffic exchange centres including London, Amsterdam, Frankfurt, Brussels, Paris and Strasbourg. Public-private partnerships ensure a choice of high quality, competitively priced services.

## **ULTRA-HIGH BANDWIDTH**

Nearly the entire population has access to 100 Mbps internet links. Connections of 1 Gbps are widely available, with national coverage planned for 2020.

## **LU-CIX: DEDICATED TO LUXEMBOURG**

At the Luxembourg Commercial Internet exchange (LU-CIX), carriers have access to high-capacity lines offering very competitive round-trip times without congestion. Thanks to its proximity to other international hubs, LU-CIX is a smart alternative.

## **FIRST-CLASS DATA CENTRES**

A first rate supply of modern data centre facilities provides sufficient quality and capacity to meet every need. A range of respected operators offer high

quality data processing services and low latency, fibre-optic connections to all major European hubs using leading edge infrastructure and technology.

Most data centres are recently built and either offer the highest (Tier IV) or second highest (Tier III) levels of security. They have fully redundant power, cooling and components, with controlled access zones and competitively priced, guaranteed power supply.

The country hosts 40% of all European Tier IV data centres. Green energy sources are available, and Luxembourg's data centres comply with tough energy saving guidelines. This blend has attracted several public and private enterprises, including the European Commission and many financial institutions.

## **TRUST AND SECURITY**

Luxembourg makes information security accessible and affordable, including to small and medium-sized organisations. Very high security standards are driven by the needs of the country's sophisticated, international financial sector. This expertise in protecting individual client data and systems is essential for e-businesses and the economy at large.

There are many levels to the country's resilient and secure ICT environment:

- Physical security comes thanks to high levels of redundancy, resilience and emergency recovery services. Data centres meet maximum security requirements. Bandwidth suppliers offer closed-loop control systems, and the country has a highly resilient local loop that interconnects national and international telecom operators;
- Digital security features include encryption, and digital signing;
- Organisational factors are optimised by the country's expertise in risk management;
- Legal protection is provided by well-designed laws;
- Cutting edge research in information security and high performance telecommunication networks figure among the country's core research priorities.

## LUXTRUST

National certification authority LuxTrust S.A. is managed by the Government and major private sector players. Luxembourg was the first European country with a national Public Key Infrastructure, providing online certification both for e-government applications and for the private sector (e-banking, e-commerce, etc.). LuxTrust meets a need for increased security in electronic commerce through the adoption of globally recognised standards.





## UNIVERSITY OF LUXEMBOURG

The Interdisciplinary Centre for Security, Reliability and Trust (SnT) at the University of Luxembourg contributes to the country being the European centre of excellence and innovation for secure, reliable and trustworthy ICT systems and services. Their interdisciplinary approach not only takes technical aspects into consideration, but also addresses business, human and regulatory issues.

The Laboratory of Algorithmics, Cryptology and Security (LACS) is part of the University of Luxembourg's Computer Science and Communication Research Unit. It focuses on cryptography, building secure public-key cryptosystems, and network and information security.

## “Luxembourg and LuxSpace, a perfect match”

*Dr Thomas Görlach, Managing Director of LuxSpace, talks about how a space company can thrive in Luxembourg.*

LuxSpace is an atypical case in the OHB group, because it has been created and not acquired. It was created ten years ago to blend the positive characteristics of the parent company with the flexibility and innovative potential of a small company.

LuxSpace has a mandate to think differently, to explore new ideas, to find niches and to provide new services for our customers, while doing this in a very efficient manner. I have been managing LuxSpace since the beginning of 2015 and it is extremely exciting to be able to help carry out this strategy. It is also energising that the Luxembourg Government is very open to and supportive of convincing new ideas. It also enables things to happen quickly, often an essential prerequisite to being successful in new markets. LuxSpace in many ways is a reflection of Luxembourg: compared to their competitors they are small and need to be smart to succeed. It is a perfect match.

The strategy of LuxSpace from the beginning was to develop smart, cost

efficient products and services. It will continue to focus on microsatellites, particularly for commercial markets. The challenge is to develop a streamlined implementation process that differs from processes for large space programmes. The key objective here is to limit cost whilst managing risk. In 2014, LuxSpace completed 4M, the first ever privately funded moon mission. We used a 14 kg microsatellite carried on a Chinese moon probe. We proved that with the microsatellite approach, moon missions do not need to cost billions.

Luxembourg offers the perfect conditions for our small company to be successful and to achieve our objectives, including opening the doors at ESA. Moreover, the closeness of and cooperation with SES helps us to understand the commercial environment.

The microsatellite market is still not fully defined but it is dynamic and will continue to evolve. It is entirely possible to create new markets with innovative ideas, which means that our creativity can help shape future markets. The challenge we face is to be able to compete with large companies and other small firms around the world.





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With the on-going support of the Luxembourg Government and ESA, and the inspiring environment fostered by the presence of SES and other emerging companies, we are optimistic that the next ten years will also be successful for us.

## Research, development and innovation

The emphasis on promoting and supporting new and innovative businesses has attracted several global companies to Luxembourg, especially in the areas of ICT, e-commerce, media, logistics and environmental and health technologies. Research and development (R&D) receives substantial funding and support from the Government. Direct financial support of up to 50% of the cost of an industrial research project is available and up to 25% for a pre-competitive development project.

The rapid growth of the space sector would not have been possible without the close cooperation between the public and private sectors. The enthusiasm for research that characterises Luxembourg's public and academic institutions creates a lively science and technology environment and helps businesses take a visionary approach. Several companies, including IEE, ArcelorMittal, SES and Paul Wurth, undertake all or part of their R&D activities in Luxembourg.



## PROGRAMMES

### **LuxIMPULSE & LuxYGT**

Luxembourg supports two programmes managed by ESA. LuxIMPULSE, which will run until 2021 and has €49 million in funding, helps companies investigate innovative ideas and develop them into products. LuxYGT is designed to provide the space sector with a new generation of experts by offering training to young graduates in space-related technologies. The programme includes the opportunity for a participant to conduct a specific project under the guidance of an ESA staff member.

## KEY ORGANISATIONS

### **Luxembourg Space Cluster**

The Luxembourg Space Cluster brings together enterprises and research laboratories. This increases the visibility of its members, stimulates cooperation at international level and identifies and develops new business opportunities through collaborative projects. The Cluster also has a strong presence at international conferences and fairs, and it organises events which provide opportunities to meet potential partners from other countries. It also assists companies from abroad that are interested in establishing activities in Luxembourg.

### **Groupeement Luxembourgeois de l'Aéronautique et de l'Espace (GLAE)**

GLAE is an industry group for the aeronautic and space industry whose members include all the leading companies in Luxembourg's space sector. It identifies untapped niche markets, supports the introduction of new technologies and services, and facilitates partnerships via its extensive international network. In addition, the group is an information-sharing resource and promotes the interests of the industry at home and abroad.

### **Luxinnovation**

Luxinnovation contributes to the economic development of Luxembourg by fostering innovation, fuelling international growth and attracting foreign direct investment. It helps stimulate the competitiveness of the space sector, in particular by bringing companies and research laboratories together under the aegis of the Luxembourg Space Cluster.

Luxinnovation also acts on behalf of the Government, representing Luxembourg on the committees in charge of implementing ESA programmes as well as on those leading the space-related activities of the EU. Luxinnovation's role is to promote the interests of national stakeholders, suggest R&D topics of particular relevance to the

Luxembourg space sector and facilitate contacts with ESA and European Commission representatives. As a national contact point, the organisation provides information and support to those willing to participate in European R&D projects and find suitable partners for developing their space activities.

### **Collaboration is key**

The Government also encourages companies to collaborate with research institutes. The University of Luxembourg and the Luxembourg Institute for Science and Technology are publicly-funded institutions engaged in research that supports the local space and aeronautical industries. They are centres of expertise that boost R&D activity, technical and scientific cooperation, and technology transfer. The Space Cluster also plays a role in this, facilitating meetings with research specialists with new ideas and skills, plus giving access to local staff training facilities.

### **National Research Fund (FNR)**

The publicly-funded FNR was established in 1999 to promote research and innovation and foster links between private and public organisations and the international research community. Projects supported by the FNR are peer-reviewed and frequently take the form of

partnerships between businesses and public research centres. The emphasis is on sustainable, business-oriented research of relevance to Luxembourg. The Fund's CORE and OPEN programmes support high-quality research projects, and PEARL and ATTRACT are designed to attract international research talent. Other schemes encourage international cooperation with Luxembourg academics.

### **University of Luxembourg**

*Interdisciplinary Centre for Security, Reliability and Trust (SnT)*

The SnT contributes to the country being the European centre of excellence and innovation for secure, reliable and trustworthy ICT systems and services. Its particular area of expertise is in the safe operation of interconnected communication networks and software systems, an area of crucial importance for the space industry. The SnT works in partnership with industrial, international and government partners to enhance the reliability and security of vital systems. Research activities in satellite systems include application and services, satellite hybrid networks, transmission and reception technologies and legal and regulatory challenges.



### *Research unit in engineering science*

This is an interdisciplinary group active in civil, electrical and mechanical engineering and a centre of technological expertise for the benefit of companies in Luxembourg. The main focus of research is on the development of technological solutions and the sustainable and economical use of resources.

### **Luxembourg Institute for Science and Technology (LIST)**

LIST has scientific expertise that relates directly to the space industry. The centre has a strong relationship with ESA and the French space agency CNES.

### *Materials Research and Technology department (MRT)*

The role of the MRT is to translate cutting-edge materials research into applicable technology.

The department is a reference in the fields of nanomaterials and nanotechnology composite materials. These research activities are supported by a central materials laboratory, which mutualises the department's expertise and equipment in several important fields including thin film coating and

engineering, polymer processing, prototyping, nano-particles, organic chemistry, nano-fabrication and functional measurements.

A further research activity focuses on the development of scientific instruments based on charged particle beams, covering fundamental research, instrument development and applications. Research projects are conducted in direct cooperation with leading international instrument manufacturers and with specialised research groups, covering a large range on the Technology Readiness Level (TRL).

The department's expertise has particular relevance to the space industry. Projects have included optimisation of the structures and materials used in the ESA Solar Sails Materials programme, resin properties improvement (by CNT insertion) for new Kevlar honeycombs being developed by the Luxembourg-based firm Euro-Composites, and work with ESA and Thales Alenia Space on nano-composites to enable the evacuation of static electric charges in satellite cables.

The department cultivates close relationships and joint projects with



academic and industrial partners, and contributes to Luxembourg's and Europe's innovation agenda in materials research and technology.

### *Environmental Research and Innovation department (ERIN)*

In the space sector, ERIN is active mainly in the use of Earth Observation (EO) data for environmental and risk management applications. The focus of the research unit "Remote Sensing and Eco-hydrological Modelling" is geared towards a better use of EO data in operational water resources and ecosystem management tools. They also integrate remote sensing data (satellite, airborne and ground) together with global navigation satellite systems for near real-time eco-hydrological and hydraulic modelling.

The overall objectives are to improve numerical model-based hydrological and hydraulic predictions of stream flow. This will improve flood and drought management and integrate advanced remote sensing technologies and environmental modelling. This latter technology will improve understanding of plant-soil-water interactions across different spatiotemporal scales.

The results of the research are used mainly activities find their main applications in flood forecasting and mapping, damage assessment, risk analysis, as well as in water-related ecosystem or agriculture processes (food security, drought stress, precision agriculture, etc.).

ERIN has participated in a significant number of joint EO projects in cooperation with funding from organisations such as the European Space Agency, Canadian Space Agency, Belgian Science Policy Office, European Regional Development Fund and the Centre National d'Etudes Spatiales (CNES, the French National Space Agency).

# A good place to live

Moving to Luxembourg increases quality of life. Luxembourg City offers the vibrant, cosmopolitan atmosphere of a European capital and yet is only a few minutes from sweeping forests, splendid views and picturesque historical sites. Luxembourg regularly ranks among the world's top cities for personal safety and security, making it a great place for families.

It is also centrally located between Germany, France and Belgium. So whether on a business trip, or going on holiday, travellers have rapid access to numerous European destinations by air, rail and road. London, Paris, Frankfurt, Brussels and Amsterdam are just one hour away.

Multilingualism is a national trait. English is widely spoken even though French and German are the official languages on top of Luxembourgish, the national language.

Photo: Tristan Schmitt

## EDUCATION

Luxembourg is proud of its high educational standards. The establishment of the University of Luxembourg with its Faculty of Science, Technology and Communication, Faculty of Law, Economics and Finance and Faculty of Humanities, Arts and Educational Science has brought an extra dimension to the country's educational system. The cosmopolitan character of the country is reflected even further through other established international schools, among them the European School, the French Lycée Vauban, the British St. George's School and the English language International School.

## CULTURE AND SPORT

Luxembourg offers first-class theatre, music and cultural programmes. The Neumünster Abbey, the Philharmonic Hall, the Rockhal, the Kirchberg Sports and Cultural Centre, and several varied museums are just some examples of newly-built infrastructure for cultural and social activities. Luxembourg is also a very sporty country, with well-funded facilities for a wide range of activities.



**LUXINNOVATION**  
TRUSTED PARTNER FOR BUSINESS



THE GOVERNMENT  
OF THE GRAND DUCHY OF LUXEMBOURG  
*Ministry of the Economy*



THE GOVERNMENT  
OF THE GRAND DUCHY OF LUXEMBOURG



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