EUROPEAN CLUSTER COLLABORATION PLATFORM

Clusters meet Regions event "Clusters as key drivers of regional development and growth" – the case of Lithuania

The new ECCP series of events "Clusters meet Regions"

Input paper to the event "Clusters as key drivers of regional development and growth" – the case of Lithuania and the Baltic Region

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Executive summary

The paper presents observations on the Lithuanian clusters' ecosystem and outlines some key considerations for the future development of the country. These considerations may pose some open strategic questions, which can be addressed in the workshop of the "Clusters meets Regions" event. The following key takeaways are summarised:

Context: Economic profile of Lithuania and value chains

- Predominantly a services-oriented economy, Lithuania has developed with digital technology trends, marking steady economic growth in the 2000s and 2010s. As Lithuania consists of two distinct regions, *Vilnius County* (LT01) and *Central and Western Lithuania regions* (LT02), there are differing predispositions with the former defined by its creative and technology focus, whilst the latter focuses mostly on the agri-tech sector. With 'Agricultural innovation' and 'ICTs' standing out as priority areas in Lithuania's S3 Strategy of 2014-2020, the sectoral focus of the respective regions embodies Lithuania's long-term directive.
- On a national level, Lithuania is defined as a "Moderate Innovator" in the European Innovation Scoreboard 2021 rating, with remarkably high statistics in digital skills and innovativeness in SMEs. Vilnius county (LT01) is the more sophisticated and established region and therefore earns the tag of a "Strong Innovator". This is exemplified with exceptional Regional Innovation Scoreboard statistics pertaining to indicators such as 'Business process innovators', 'Innovative SMEs collaborating', and 'Non-R&D innovation expenditures'.
- A complex picture emerges regarding Lithuania's foreign trade with Russia being the most important trading partners outside of the EU. Meanwhile, China and Ukraine also play an important role for many Lithuanian sectors. Overall, raw materials imported from Russia and Ukraine contribute significant to the Lithuanian economy.

Clusters in Lithuania and their importance for regional economic development

- With almost 50 active cluster organisations, Lithuania is the Baltic country with the highest number of cluster organisations of which the majority is located in the capital. This multitude of cluster organisations covers a broad range of industries and industrial ecosystems.
- Empirical insights from the European Cluster Panorama 2021 and Ketels & Protsiv (2021) prove how clusters can have a striking impact on economic growth and innovative business activity within regions.

Cross-border cooperation and the involvement of the Lithuanian clusters in European networks and support initiatives

- Compared with the other Baltic States, Lithuanian clusters have been more strongly involved in EU cross-border support programmes such as the European Strategic Cluster Partnerships (ESCP) and the INNOSUP-1 initiative.
- The most common countries of origin of consortium partners were either Spain and Latvia (ESCP consortia) or Belgium, Germany, and France (INNOSUP-1) proving that cooperation of Lithuanian clusters have been geographically spread across Europe.
- Projects have been successful in supporting cluster members to define business opportunities, to match with business partners, to enhance the integration of new businesses and to create new value chains.

From the S3 Strategy 2014-2020 to the S4 Strategy of Lithuania

- The Lithuanian S3 Strategy 2014-2020 covered seven priority areas in the updated version and in its policy formulation, a relatively broad range of regional stakeholders was included. In the implementation of the Lithuanian S3 Strategy 2014-2020 a high share of ERDF innovation project budget was connected to the S3 priority areas. Overall, the Lithuanian S3 Strategy 2014-2020 is rated above average among EU Less Developed Regions.

- The cluster survey shows the increasing importance of the upcoming S4 priority areas such as the priority area of *new production processes*, *materials and technologies.* With regards to the cross-cutting support fields, *value chains*, *skills* and *innovation* are the most important fields with regards to its future importance.

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Context: Economic profile of Lithuania

EUROPEAN CLUSTER COLLABORATION PLATFORM

Strengthening the European economy through collaboration

1. Context: Economic profile of Lithuania

This section will provide context about the socio-economic profile of Lithuania and will inform about foreign trade as well as value chains of the country. Thereby, a special focus is put on Lithuania's trade with China, Russia, and Ukraine.

Lithuanian sector specialisations and employment levels

The economy of Lithuania is predominantly based on the services sector, contributing to 60.3% of overall GDP, whilst employing a total of 68% of the active population. Industrial sectors also play a significant role in the country, accounting for 24.9% of its GDP and employing 24.9% of the active population.[1] While the GDP per capita accounts for 25.100 and is below the EU average of 30.800, Lithuania's annual GDP growth in % performs above the EU average, with SME output turnovers playing a significant role in this process[2]. Given the sectoral predominance of services, companies dedicated to ICT and digitalisation-oriented business fields have played a significant role in Lithuania's growth in recent years.

When building a knowledge and understanding of the economic profile of a country and its regions, it is important to pay close attention to the representation of sectors, as these can determine the trade routes and partners of a national or regional economy. In reference to the European Cluster Panorama Report (2021), Lithuania ranks first in "Land Transportation systems". Given their ICT-oriented directive, ca. 37,000 employs have come to work for more than 2,000 ICT companies in Lithuania, whilst hosting 13 of the 20 largest IT companies among the Baltic States[3]. In the context of the services sector, tourism has also grown rapidly in recent years, despite its reduction during the COVID-19 pandemic. On a mere economic level, the financial sector is advanced, regionally integrated, and subject to few stifling regulations[4].

Figure 1illustrates the top ten full-time equivalent employment by sector, with Retail trade, Public administration & defence, Crop & animal production, Education and Food & beverage service activities ranked among the five most valuable. The second graph in Figure 1, labelled "GVA productivity by sector, complements the former, as it showcases the highest level of contributions to the respective sectors, by corporate subsidiaries, companies, or municipalities.

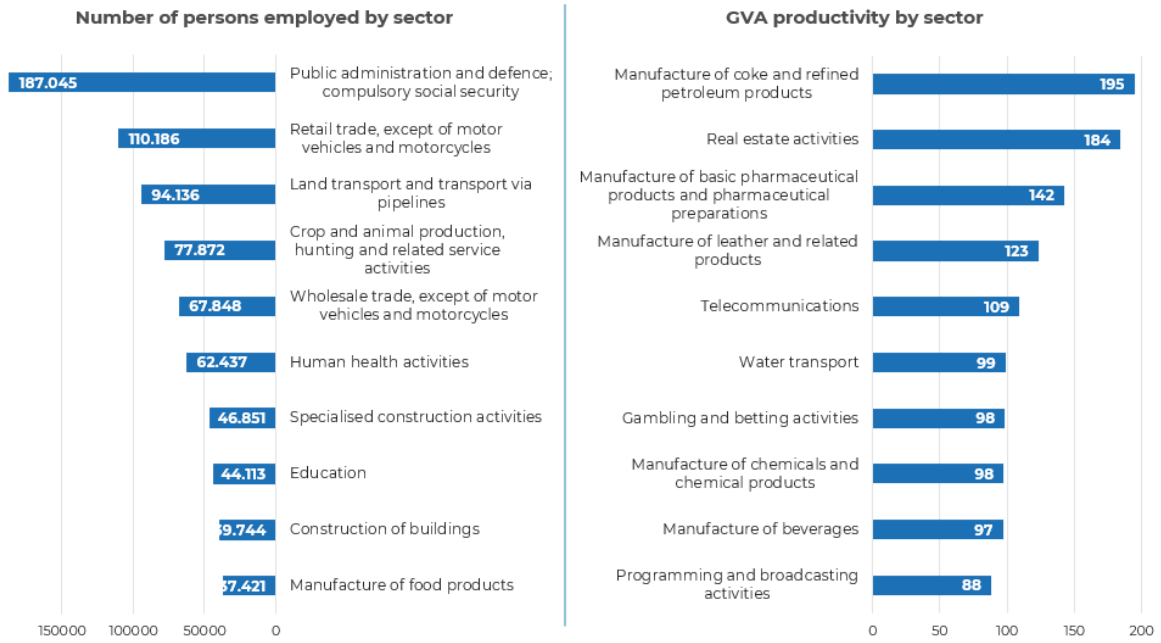
[1] Dagiliene, L., Varaniute, V., Bruneckiene, J. (2021): Local governments' perspective on implementing the circular economy: A framework for future solutions. Available under: Local governments' perspective on implementing the circular economy: A framework for future solutions - ScienceDirect

[2] European Commission (2020): European Innovation Scoreboard 2021. Lithuania. Available under: European innovation scoreboard | European Commission (europa.eu) (last access on 18. 03. 2022).

[3] Fiscutean, A. of ZDNet (2015): The rise of Lithuania as a force in IT: Why Google and Nasdaq are investing here. Available under: The rise of Lithuania as a force in IT: Why Google and Nasdaq are investing here | ZDNet (last accessed 18. 03. 2022).

[4] Commodity.com (2020): Lithuania's Economy: Who Are Their Biggest Trade Partners Post Communism? Available under: Lithuania's Economy: GDP, Exports/Imports + Trading Countries - Commodity.com)last accessed 18. 03. 2022).

Figure 1: Employment and GVA productivity by sector in Lithuania

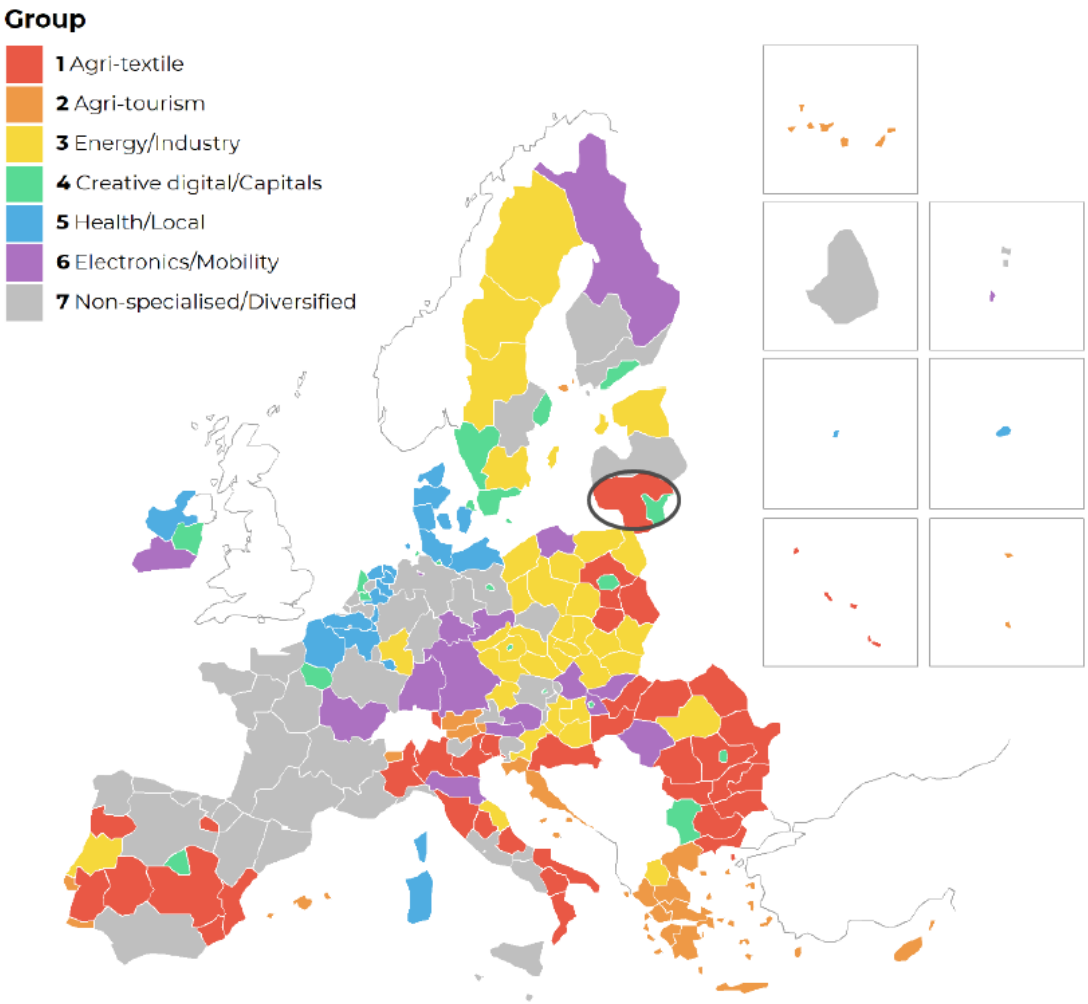


Source: ECCP (2022). Note: GVA productivity defined as k€/employee FTE

The statistics pertaining to the graph illustrates a compelling takeaway, with the majority of employment pertaining to sectors of public administration & defence; Retail trade; and Land Transport. The number of persons employed in the construction of buildings sector is mirrored in the GVA productivity of "Real estate activity", signalling a high degree of support in fostering development and employment in this sector. Other sectors that rank high in Lithuania's GVA productivity are Manufacturing of refined petroleum, pharmaceutical, and leather products. Telecommunications is also represented in the upper half, which altogether points to a generally diversely oriented economy in term of its employment levels and GVA productivity by sector.

In reference to the European Cluster Panorama report of 2021, one can see how specialisation patterns are visualised in the different respective regions. This allows one to analyse not only the cluster organisation presence based on certain typologies but gain an insight on how these can differ from region to region and country to country. As seen in Figure 2, Lithuania can be subcategorised into two distinct regions, LT01, "Vilnius County" and LT02, "Central and Western Lithuania regions", where the former is categorised as a Creative digital / Capitals – specialised industrial ecosystem and the latter as an Agri-textile specialised industrial ecosystem.

Figure 2: Regional typology based on industrial ecosystem specialization



Source: European Cluster Panorama (2021)

Particularly in the realms of growing industries, Lithuania can build on these highly relevant and forward-thinking foundations and foster more innovativeness, for example in its (laser) technologies. Furthermore, these findings generally align with Lithuania's long-term aspirations to integrate further within EU networks as seen in projects like the S3 Strategy 2014-2020, with "Agricultural innovation" and "Information and communication technologies" as stand-out priority areas.

Finally, Lithuania is a compelling case of a country with two distinct regions, where well-established industries, educational trajectories and employment structures can contribute to continued growth. On a further note, this also opens opportunities in which economic and cluster structures can support said growth on a regional level.

National innovation level of Lithuania / Regional innovation level of Lithuanian regions

In the course of this paper, we will investigate the economic performance of Lithuania in the context of clusters and how these are organised. As a fundamental pillar, one can look at the level of innovativeness in Lithuania on a country-level via the European Innovation Scoreboard. We will then make region-specific observations as we investigate regional level-innovativeness via the Regional Innovation Scoreboard. The European Commission-defined scoreboards measure how innovative a

region/country is on the basis of indicators like "digital skills level"; "innovation expenditures" and "employment of ICT specialists"[5].

In Table 1 one can see how Lithuania performs above the EU average in a myriad of indicators pertaining to innovation. For example, under the umbrella category "Digitalisation", Lithuania has seen considerable above-average statistics in regard to 'Broadband penetration' and 'People with above basic overall digital skills'. Broadband penetration is crucial to connect individuals to the internet and the skills to make full use of the opportunities that emerge from internet-based services help in creating innovation-oriented as well as digitally inclusive societies[6]. This, including their high scoring in "Population with tertiary education", categorised under "Human resources", potentially has a knock-on effect on Lithuania's high degree of "Employment in innovative enterprises" as well. On a further note, one can see how Lithuania performs very well in the category of "Innovators", whether it is "Product innovators (SMEs)" or "Business process Innovators (SMEs)", which signals a well-intact but also balanced prioritisation of both Innovation process.

Table 1: European Innovation Scoreboard - Lithuania in comparison to Baltic Nations

	Lithuania (LT)	Estonia (ET)	Latvia (LV)
SUMMARY INNOVATION INDEX	**92.1**	**128.3**	**55.9**
Human resources	**112.7**	**136.4**	**76**
Doctorate graduates	42.6	77	19.6
Population with tertiary education	259.5	157	165.3
Lifelong learning	67.8	214.4	72.2
Digitalisation	**158.7**	**141.8**	**109.1**
Broadband penetration	184.4	130.4	130.4
People with above basic overall digital skills	127.8	155.6	83.3
Innovators	**151.1**	**217.7**	**56.6**
Product innovators (SMEs)	152.4	238.8	59.7
Business process innovators (SMEs)	149.8	199.2	53.8
Linkages	**162.9**	**241.7**	**78.6**
Innovative SMEs collaborating with others	162.4	347.8	66.9

[5] see European Commission: Regional Innovation Scoreboard (2022). Available under: Regional innovation scoreboard | European Commission (europa.eu) (last accessed 09.02.2022).
[6] Van Deursen, A.J.A.M., Helsper, E. & Eynon, R.: Measuring digital skills: From Digital Skills to Tangible Outcomes project report. Available under: http://dx.doi.org/10.13140/2.1.2741.5044 (last accessed on 22. 03. 2022).

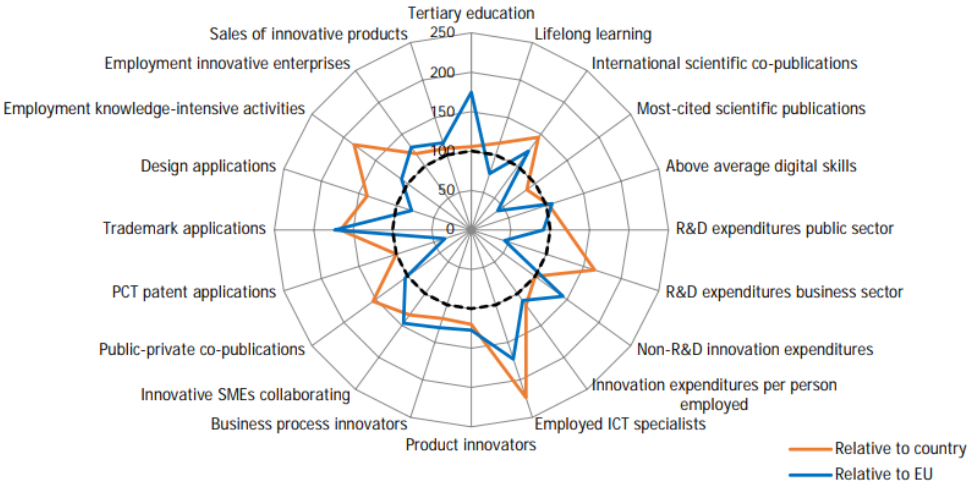
Public-private co-publications	87.4	172.7	88.4
Job-to-job mobility of HRST	220.5	217.9	79.5
Employment Impacts	**91.6**	**150.4**	**53.4**
Employment in knowledge-intensive activities	70.7	113.3	70.7
Employment in innovative enterprises	106.5	176.6	41.2
Environmental sustainability	**108.9**	**68.8**	**23.2**
Resource productivity	70.8	25.5	87.4
Air emissions by fine particulate matter	120.2	35.4	0
Environment-related technologies	117	137.3	14.8

Source: ECCP (2022) own elaboration based on European Commission (2021): European Innovation Scoreboard 2021.

The European Innovation Scoreboard performance of Lithuania is particularly striking if one draws comparisons to its neighbouring Baltic states. A notable statistic is Lithuania ranking first among the Baltic states in Tertiary education obtainment. This could be an indicator of Lithuania building a significant size of human capital and the development employment in innovative enterprises, even if that sector does not score as high in comparison to Estonia (106.5 < 176.6). Furthermore, it is striking how Lithuania has a high level of "Innovative SMEs collaborating with others", whilst outperforming Estonia and Latvia in "Job-to-job mobility in Human Resources and Science & Technology". This potentially points to a well-intact employment network in Lithuania, where exchange and collaboration blooms. On a final note, Lithuania makes an impressive case for not only ranking high in "environment-related technologies", whilst scoring highest in "Resource productivity" and "Air emissions by fine particulate matter". This underlines not only a green and circular economic trajectory of Lithuania, but a phased plan in which the steps to creating said technologies involve sustainable and low emission-practices.

While Estonia appears to be largely more "innovative" than Lithuania in the grand scheme of things, one must consider how the data measures Estonia as a single region, whilst Lithuania's respective regions showcase varying levels of innovativeness. The specific region of "Vilnius County" is the region in Lithuania where most growth and development sets foot. Particularly in areas like "Innovative SMEs collaborating" and "Innovation expenditures per person employed", this region in Lithuania places an emphasis on innovation-oriented practices across for businesses. On a further note, the high scoring of "Employed ICT specialists" and "above average digital skills", showcases how the education and expertise in ICTs is well-established in this region. Altogether, this region is considered a "Strong Innovator", as it saw a 47.8% increase in Innovation between 2014 and 2021 (see in the Annex).

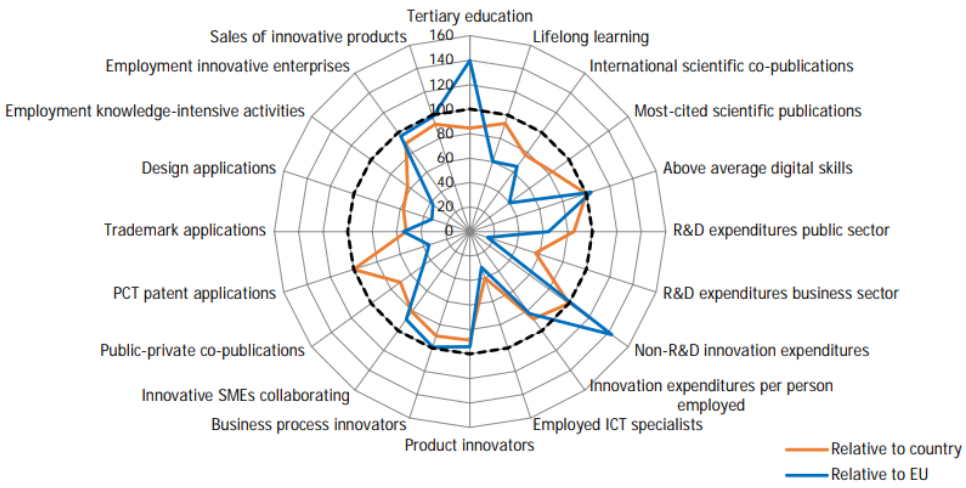
Figure 3: Innovation performance of the Lithuanian region LT01: "Vilnius County" in the Regional Innovation Scoreboard (2021)



Source: European Commission (2021): Regional Innovation Scoreboard 2021.

While the Central and Western Lithuania regions are considered an "Emerging Innovator", with an industrial ecosystem predominantly focusing on agri-textiles, this Lithuanian region has seen remarkable increase by 31.3% its innovativeness from 2014 to 2021. On a specific note, the Central and Western Lithuania regions also perform above the EU average in "Tertiary Education" and "Above average digital skills", which could point to the widespread opportunities in learning opportunities, even if individuals do not live in the highly networked Vilnius area. On a further note, "Non-R&D Innovation expenditures" also performs high in this region, underlining an unwavering financial support for innovative activity.

Figure 4: Innovation performance of the Lithuanian region: "Central and Western Lithuania regions" in the Regional Innovation Scoreboard (2021)



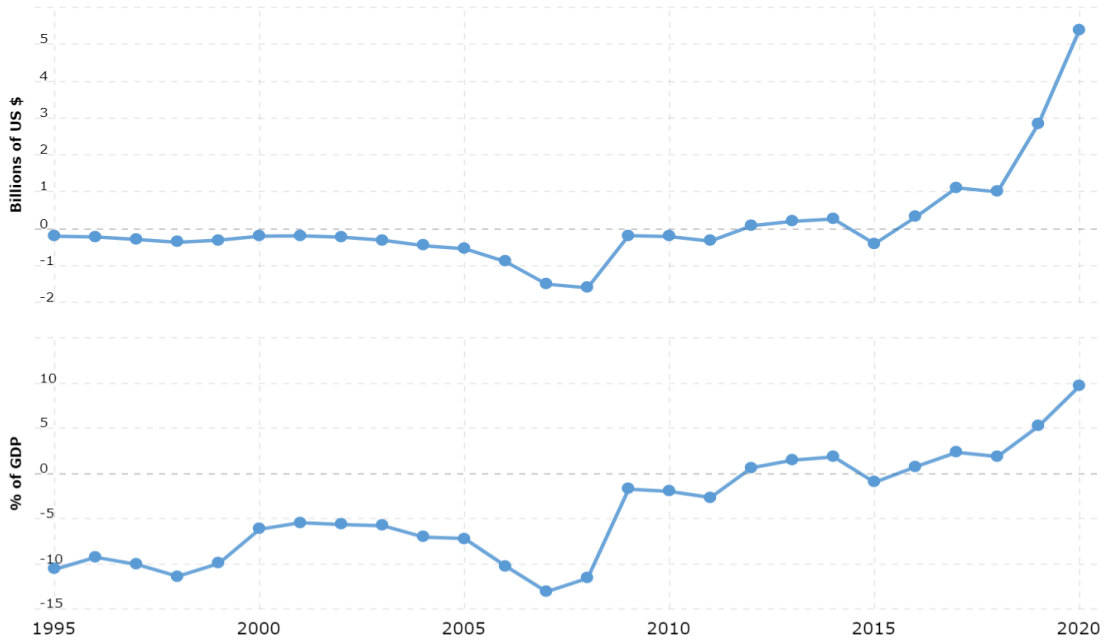
Source: European Commission (2021): Regional Innovation Scoreboard 2021.

All in all, Lithuania on a national level is considered a "Moderator Innovator", given its strengths in "Digitalisation" and "Innovators". Particularly in aspects regarding Education and Environment-related technologies, Lithuania has also improved its capacities and capabilities and become a leader among the Baltic states.

Lithuania's foreign trade structure and value chain linkages

Given the country's shift from a planned economy to free market economy upon the fall of the iron curtain in 1990, Lithuania developed to an open economy that thrives in its business activity and elevated level of fiscal and financial freedom[7]. Foreign trade represents 138.5% of Lithuania's annual GDP[8]. This has contributed to the rapid growth of its economy and increased establishment of MNCs in, for example, Vilnius.

Figure 5: Lithuania Trade Balance 1995-2020



Source: Macrotrends (2022) More information and details on socio-economic indicators of Lithuania, in comparison to other EU member states can be found in the Annex.

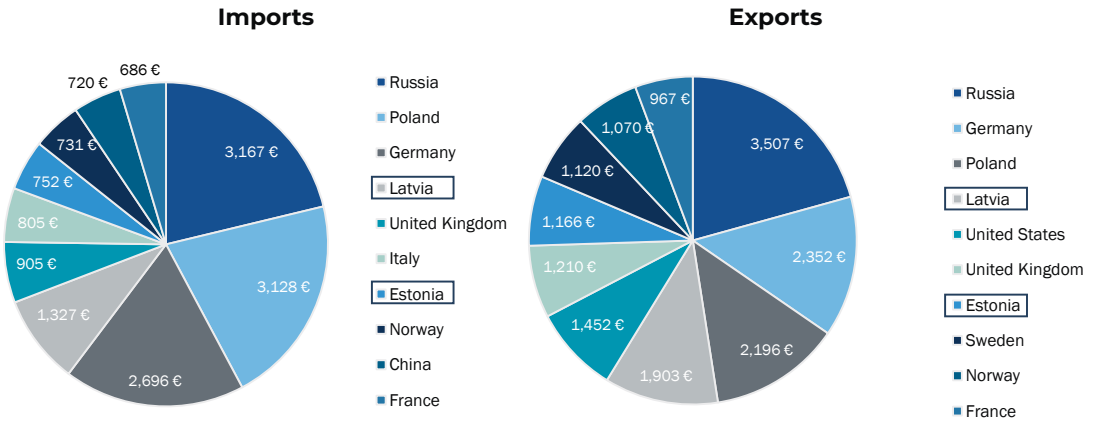
Before analysing the role of clusters in Lithuania, it is important to specify how Lithuania's value chain networks currently look like and on which these trade relations relate to. Beyond the EU-based partners, countries such a China and Russia stand out as their biggest individual trading partners, with the two making up nearly a half of Lithuania's imported goods & services. Russia is also a significant partner in regard to Lithuania's export power, totalling a €3.5 billion and a quarter of their exported goods & services.

[7] Macrotrends (2022): Lithuania Exports 1995-2022. Available under: Lithuania Exports 1995-2022 | MacroTrends (last access on 18. 03. 2022).
[8] Crédit Agricole Group (2022): LITHUANIA ECONOMIC AND POLITICAL OVERVIEW. Available under: Economic and political overview in Lithuania (groupecreditagricole.com) (last access on 18. 03. 2022).

Overall, in 2019 the Lithuanian imports amounted to a value of around €25.8 billion and the Lithuanian exports to €28.3 billion.[9] The analysis of these imports and exports of 2019 by country underlines the importance of Russia as a trading partner for Lithuania (Figure 6) since around 12% of both Lithuania's imports and exports are exchanged with Russia. Moreover, the analysis demonstrates the embeddedness of Lithuania in the European economy since the majority of trade occurs with EU Member States. On the import side, almost 30% of the imported products originate from Poland, Germany, and Latvia. In 2019 Estonia was placed the 7th most important import country for Lithuania. These three countries are also important trading partners when considering Lithuania's exports yet to a smaller extent. Although imports from the United States do not play a major role for Lithuanian imports the United States are the fifth most important target country for Lithuania's exports. China on the other hand played a smaller role for Lithuania's trade in 2019. In 2019 imports from China amounted to €720 million which constitutes a share of 3% of total Lithuanian imports in 2019. With €292 million exports to China only account for 1% of Lithuania's exports.

The comparison of Lithuania with Estonia and Latvia shows that Lithuania has the highest imports and exports of the Baltic countries. In 2019 the Lithuanian imports of €25.8 billion exceed the Estonian (€17 billion) and Latvian (€13.4 billion) imports. Likewise, the Lithuanian exports of €28.3 billion exceed the Estonian (€18.8 billion) and Latvian (€14 billion) exports. The three most important trading partners for Estonia in terms of imports are Finland, Russia and Germany and Russia, Italy and Germany for Latvia. In terms of exports the three most important trading partners for Estonia are Finland, Sweden and Russia. With Lithuania and Estonia followed by the United Kingdom being the most important export countries for Latvia, it can be stated that the Latvian exports have a strong focus on the Baltic countries

Figure 6: Overview of 10 most important trading partners for Lithuania, by Imports / Exports in 2019, values in Million EUR



Source: ECCP (2022), own calculation based on EXIOBASE Database. Note: No specific information on Ukraine in the database. Framed countries highlight the Baltic countries.

The examination of **Lithuania's trade in 2019 by sectors** shows that the majority of the imports can be assigned to the mining and quarrying (Figure 6). Here the value of the imports amount to more

[9] The data shown here is based on data from EXIOBASE. For more information see https://www.exiobase.eu/ (last accessed 22.03.2022)

than €3 billion of which the majority is processed by intermediate demand. Next to mining and quarrying Motor vehicles, trailer & semi-trailers are second most significant imported goods in 2019. The majority of these products is consumed by the private and public sector (final demand). The analysis also points out the relevance of imports for the Agri-food sector (food products; Agriculture, forestry and fishing), plastic sector as for computer, electronic and optical products. On the export side, refined petroleum products account for the majority of exports. With around €2.65 billion food products, it constitutes the third most important exported products in 2019. The majority of these food products is exported for final demand in the export countries. The agriculture, forestry, and fishing sector as well as the plastic sector also play a significant role in Lithuania's exports.

Disruptions in trade and supply chains can affect the production capacity of firms, create price pressures, and also have an impact on wages.[10] To assess the impact of the trade dispute with China and the impact of the war in Ukraine in the following the Lithuanian trade with China and Russia will be examined closely.[11] Unfortunately, the EXIOBASE data does not provide information for trade between Lithuania and Ukraine. Information on the Lithuanian trade with Ukraine will be presented on the level of commodities at the end of this chapter. In interviews with Lithuanian cluster organisations held in March 2022 the cluster organisations generally mentioned the increases in raw materials as a consequence of the war in Ukraine. On a general level the trade dispute with China has a negative impact on the branding of Lithuania since China refuses to buy final products when they contain Lithuanian components. Hence, some companies like in Germany, or the US now lean towards purchasing from other suppliers outside Lithuania. In some cases, such as in the automotive sector[12], companies try to redirect their exports from Lithuania to other countries in the EU in order to avoid the export ban from China. In the following a more detailed examination of Lithuanian foreign trade with Russia and China will be presented.

Around 50% of the Lithuanian imports that originate from Russia are related to mining and quarrying (€1.57 billion). Other important imports from Russia are in the field of transporting (€450 million) and Chemical products excl. plastics in primary forms (€215 million). The most important exports from Lithuania to Russia in 2019 occurred in the field of transporting (€690 million). Beverages and food products together accounted for €515 million which underlines the importance of the Russian market for Lithuania's food industry. This finding is complimented with information from interviews held with Lithuanian cluster organisations in March 2022 where clusters mentioned that biggest market losses are experienced in beverages (beer, water, etc.) and dairy products. Rubber and plastic products (incl. plastics in primary forms) in the value of €230 million were exported to Russia in 2019.

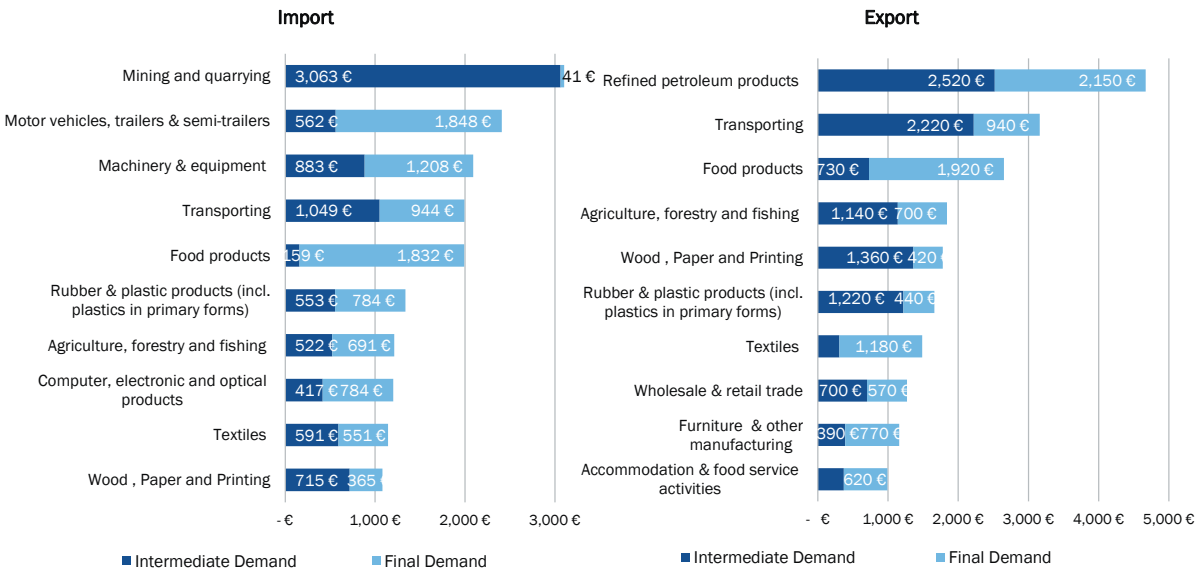
Computer, electronic and optical products (€106 million) constitute the most important imports of Lithuania from China in 2019 followed by textiles (€105 million) and Machinery & equipment (€95 million). Rubber & plastic products (incl. plastics in primary forms) in the value of €50 million were imported from China. On the export side agriculture, forestry and fishing with €45 million is the most important sector for Lithuanian exports to China followed by furniture (€37 million) and Wood, Paper and Printing (€30 million).

[10] European Commission (2022): Detecting and Analysing Supply Chain Disruptions. Available online https://ec.europa.eu/docsroom/documents/49114 (last accessed 21.03.2022)

[11] It needs to be noted that the sole analysis of imports and exports by intermediate and final demand does not fully capture the relevance of foreign countries for value added. For more information see Bertelsmann Stiftung (2019): Globalization of the German Automotive Industry: Where Does Added Value Occur? Available online https://www.bertelsmann-stiftung.de/fileadmin/files/BSt/Publikationen/GrauePublikationen/MT_Policy_Brief_2019_1_Globalization_Automotive_Industry.pdf (last accessed 21.03.2022)

[12] see also https://www.reuters.com/world/china/exclusive-china-asks-germanys-continental-cut-out-lithuania-sources-2021-12-17/ (last accessed 21.03.2022)

Figure 7: Overview of 10 most important sectors Lithuania, by Imports / Exports in 2019, values in Million EUR



Source: ECCP (2022), own calculation based on EXIOBASE Database

In addition to and complimenting prior sectoral analysis the UN Comtrade database[13] can be used to assess Lithuania's foreign trade on the level of traded commodities. Compared to the data shown before it needs to be noted that the UN Comtrade database shows the values of traded commodities in US dollars and provides data from 2021. Moreover, specific information regarding Lithuania's foreign trade with Ukraine is provided.

The **ten most important commodities** imported from China, Russia, and Ukraine in 2021 are displayed in Figure 8 as well as the respective shares relative to all imports. In 2021 the most important commodity imported from China were telephone sets with a value of around $105 million. This commodity is also characterised by a sharp increase in imports compared to the $34 million imported telephone sets in 2019. Electronic circuits (integrated and printed) total to around $82 million worth of imports and other parts & accessories of motor vehicles account for almost $45 million. Diodes, transistors & similar (photosensitive) semiconductor devices which, for instance, play an important role in the photovoltaic sector, were imported from China in the value of $34 million. The commodity imported with the highest share relative to all imports are oxygen-function amino-compounds. 82% of this commodity, which is used to produce hormones, neurotransmitters, and enzymes[14], are imported from China. In addition, Lithuanian cluster organisations mentioned that sector specific infrastructure and hardware solutions that were previously imported from China are now substituted with products from the US and Canada. However, it was also reported by these clusters that various components or materials like chips, solar cells, wafers, solar glass were imported from China and that it is now difficult to find cost-effective alternatives.

Regarding the imported commodities from Russia the significance of energy imports stands out. Here the top five commodities are oil and gas in various forms as well as electric current. Thereby, crude petroleum with imports of almost $3 billion (65% of all crude petroleum imports) in 2021 as well as natural gas in gaseous state with a share of 85% of all imports of this commodity play an especially

[13] https://comtrade.un.org/ (last accessed 21.03.2022)
[14] see https://oec.world/en/profile/hs92/oxygen-amino-compounds (last accessed 24.03.2022)

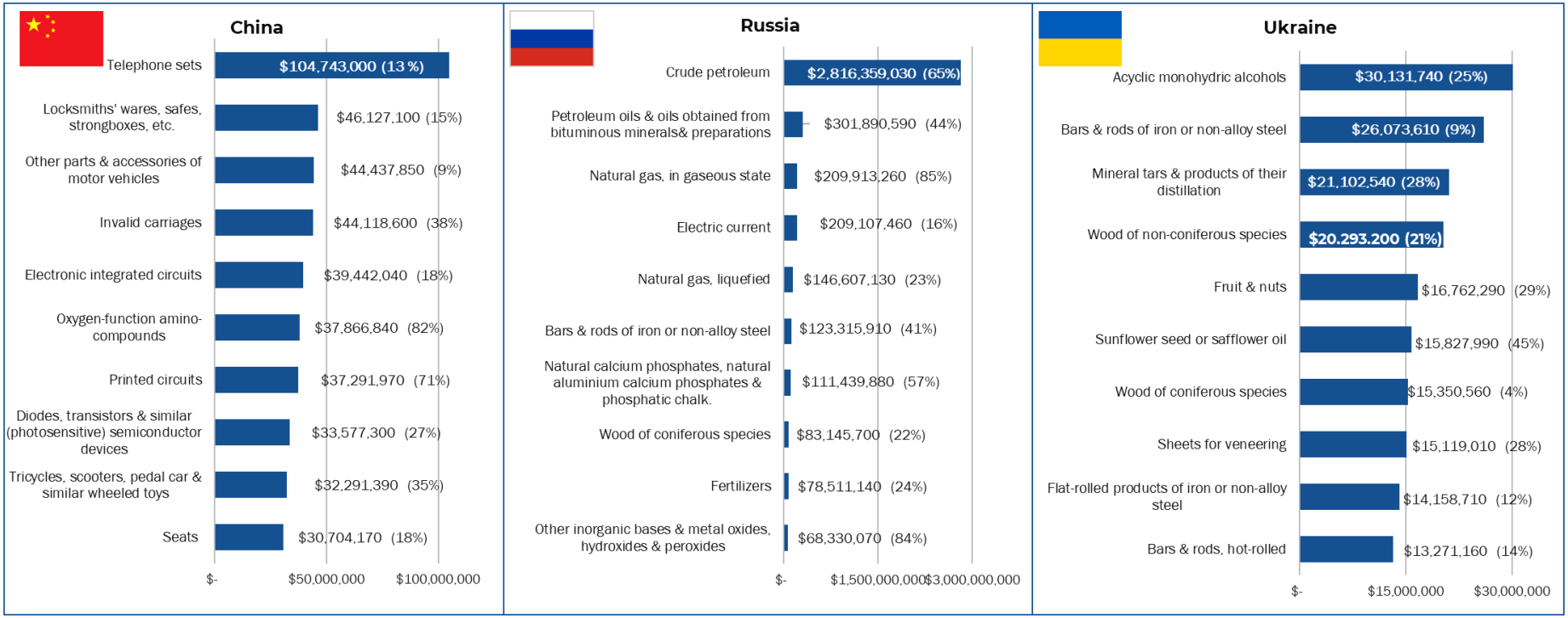
significant role. Compared to 2019 decreases in Lithuanian imports from Russia can be found. However, these decreases could be explained by economics shocks that occurred in the context of the COVID-19 pandemic. The Lithuanian imports of other inorganic bases and metal oxides, hydroxides, and peroxides from Russia account for around 85% of the total Lithuanian imports of this complex commodity[15] which indicates the importance of Russia for this supply. Moreover, in interviews with Lithuanian cluster organisation held in March 2022 the cluster organisations highlighted the problem of increasing prices linked to the war in Ukraine. For Lithuanian companies this can lead to losses when previously placed orders have to be fulfilled at the agreed conditions. Moreover, cluster organisations also underlined the importance of fertilizers being imported from Russia. This is supported by the figure below which ranks fertilizers as well as different phosphate products which can be used in the production of fertilizers among the most important commodities imported from Russia. Moreover, Lithuanian cluster organisations reported in March 2022 that plans for importing solar cells from Russia (HTJ came to a halt).

Lithuanian imports from Ukraine totalled to around $526 million in 2021 and have significantly risen compared to the $358 commodities imported from Ukraine in 2019. Thereby the most important commodities imported in 2021 are acyclic monohydric alcohols which are used as solvents, detergents, and industrial lubricants as well as bars & rods of iron or non-alloy steel followed by mineral tars. These figures also underline the importance of Ukraine for the Lithuanian food sector with fruits & nuts as well as Sunflower seed or sunflower oil being among the most important commodities imported from Ukraine (accounting for 45% of all Lithuanian imports of this commodity). With Ukraine being the most important supplier of sunflower oil, the war in Ukraine already has led to significant effects around the globe.[16]

[15] for more information see https://oec.world/en/profile/hs92/metal-bases-oxides-hydroxides-peroxides-nes (last accessed 24.03.2022)

[16] https://www.reuters.com/business/energy/ukraine-crisis-threatens-sunoil-supply-fuels-vegoils-rally-2022-02-23/ (last accessed 21.03.2022)

Figure 8: **Overview of the 10 most important commodities imported from China, Russia and Ukraine in 2021, Value in USD**



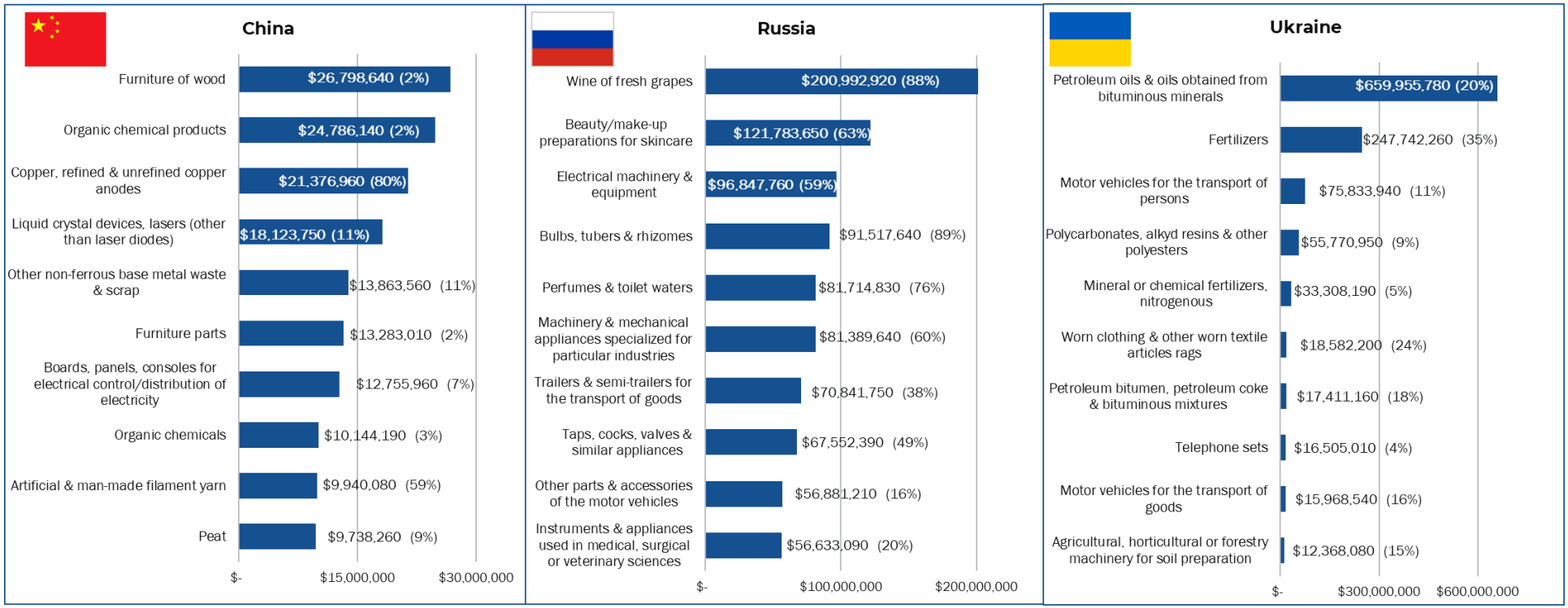
Source: ECCP (2022), own calculation based on UN Comtrade Database. Note: Share of respective imports in relation to all imports in brackets.

Similar as discussed before Figure 9 shows the 10 most important commodities exported to China, Russia and Ukraine in 2021. As analysed before, China a general level plays a rather subordinate role for Lithuania's exports on. The most important exported commodities are furniture of wood ($27 million) followed by organic chemical products ($25 million) and copper, refined & unrefined copper anodes ($21 million). Liquid crystal devices, lasers (other than laser diodes) with a value of $18 million are the fourth most important commodity exported to China in 2021. However, when looking at the shares of Lithuanian commodities exported to China relative to all exports of that commodity a different picture regarding the relevance of the Chinese market for Lithuanian exports emerges. With 80% of all copper, refined and unrefined copper anodes as well as 60% of Lithuanian artificial and man-made filament yarn being exported to China the relevance of the Chinese market for some Lithuanian industries is emphasised. In addition, in the interviews with Lithuanian cluster organisations held in March 2022 the cluster organisations highlighted that the Chinese export market is of utmost importance for the Lithuanian laser segment. According to the cluster organisations currently one third of Lithuanian laser exports go to China which means that a major distribution market is lost. Yet this has an extended knock-on effect on other EU-countries like France, Germany and Sweden who are dependent of Lithuanian supply chains.

The analysis of exported commodities to Russia further substantiates the importance of the Russian market for the Lithuanian food sector with wine being by far the most important exported commodity to Russia. The share of Lithuanian wine exports relative to all Lithuanian wine exports amounts to almost 90%. Compared to the Lithuanian wine exports to Russia of $167 million in 2019 this commodity has also significantly increased in importance over time. The next two most important commodities in exported to Russia in 2021 include preparations for skincare and electrical machinery and equipment. Here, the relative share of exports amounts to 63% and 59% respectively. Next to those commodities the share of Lithuanian exports to Russia relative to all Lithuanian exports amounts to 50% or higher for four other commodities: Bulbs, tubers, and rhizomes (89%), Perfumes and toilet waters (76%), Machinery and mechanical appliances specialised for particular industries (60%) and Taps, cocks, valves and similar appliances (49%).

In 2021 Lithuania's exports to Ukraine amounted to $1.6 billion. Compared to the Lithuanian exports to Ukraine in 2019 of $1.2 billion this constitutes an increase of around 30%. Thereby, petroleum oils & oils obtained from bituminous minerals with a value of almost $700 million account for more than half of the Lithuanian exports to Ukraine in 2021. Fertilizers are the second most important commodity exported to Ukraine and correspond in sum to almost $300 million. Whereas other commodities exported to Lithuania have decreased compared to 2019 this is not the case for fertilizers. In 2019 the value of fertilizers exported to Ukraine amounted to $86 million. The analysis also points out the importance of Ukraine for the Lithuanian automotive sector with motor vehicles for the transport of persons and goods being among the important exported Lithuanian commodity to Ukraine. Since polycarbonates, alkyd resins and other polyesters which are commodities from the plastic sector are among the four most important commodities it can be constituted that the Ukraine constitutes an important market for various different sectors in Lithuania. However, compared to the Lithuanian commodities exported to Russia the share of the exported commodities to Ukraine relative to all exports are relatively low. Here, the highest shares can be found in the fertilizers which account for 35% all Lithuanian exports of this commodity.

Figure 9: **Overview of the 10 most important commodities exported to China, Russia and Ukraine in 2021, Value in USD**



Source: ECCP (2022), own calculation based on UN Comtrade Database. Note: Share of respective exports in relation to all exports in brackets.

02

Clusters in Lithuania and their importance for regional economic development

EUROPEAN CLUSTER COLLABORATION PLATFORM

Strengthening the European economy through collaboration

2. Clusters in the Lithuania and their importance for regional economic development

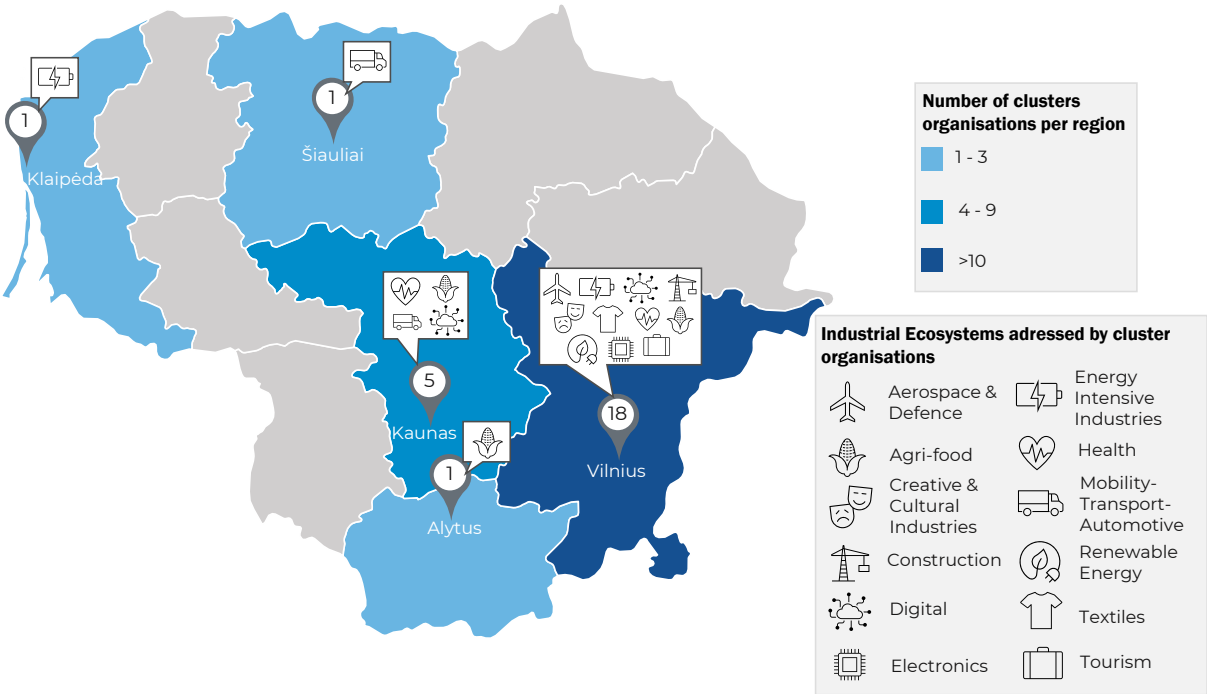
The involvement of clusters in regional economic governance, policy design and implementation at the regional level, is crucial. This chapter will provide an overview of the cluster landscape in Lithuania and will aim to describe their activity at the regional level within its governance and policy.

Cluster organisations in Lithuania

The European Cluster Collaboration Platform serves as a one-stop-shop for cluster organisations at the European level. Therefore, the number of registered cluster organisations and other innovation actors in Lithuania on the ECCP gives the first impression on the intensity of cross-border activities and cooperation of Lithuanian clusters in European networks. Out of the total 1,051 registered EU-27 cluster organisations on the ECCP, there are 26 cluster organisations for Lithuania.

Figure 10 displays the geographical distribution of the cluster organisations in Lithuania. The majority of the cluster organisations (18 cluster organisations) are centred in the Lithuanian capital of Vilnius. Five of the 26 cluster organisations registered on the ECCP are concentrated near Kaunas. The three remaining cluster organisations are situated in Alytus, Šiauliai and Klaipėda. Looking at Lithuania in the context of the Baltics Lithuania stands out with a relative high number of cluster organisations. While there are 26 Lithuanian cluster organisations registered on the ECCP Estonian and Latvian cluster organisations both account for 14 registered cluster organisations.

Figure 10: Overview of registered cluster organisations as well as regional and sectoral distribution of active cluster organisations in Lithuania



Source: ECCP (2022). Own elaboration based on https://reporting.clustercollaboration.eu/all; last accessed 03.02.2022. A full overview of the Lithuanian clusters is provided in Table 7 in the Annex.

The cluster organisations in Lithuania can be related to 12 out of 14 different EU industrial ecosystems[17] (see also Table 7 in the Annex). The ECCP data presented in the map above is complemented with information provided from the regional authorities[18] and includes 20 cluster organisations that are currently not registered on the ECCP. The EU Industrial Ecosystems that are the most addressed by Lithuanian cluster organisations registered on the ECCP are Digital, Agri-food and Creative & Cultural Industries.

Similar to the majority of European cluster organisations registered on the ECCP cluster organisations in Lithuania are rather small.[19] The majority of the Lithuanian cluster organisations have between 1 – 5 employees and less than 30 members. There are a few larger cluster organisations with more than 80 members such as the Lithuanian Apparel and Textile Industry Association (120 members) AgriFood Lithuania DIH (94 members), and the Smart Digital Solutions cluster (83 members). SMEs account for the vast majority of the members of Lithuanian cluster organisations (74%), followed by research organisations/universities/technology centres (11%). Large companies account for 9% of cluster members in Lithuania. Overall, these numbers are in line with cluster organisations in the EU-27 where SMEs stand for 71%, the research sector for 8% and large companies for 10% of the cluster members. Moreover, many Lithuanian cluster organisations seek collaboration in areas such as digitalisation, internationalisation, partnering for projects & technology scouting. According to Lithuanian officials around 65% of the Lithuanian cluster organisations are members of international networks or contribute to international networks.

Figure 11: Overview of organization, structure, and thematic orientation of cluster organisations in Lithuania

Organisation

- Majority of cluster organisations rather small with 1-5 employees (23 cluster organisations)

Member structure

- Majority of cluster organisations have less than 30 members
- 3 larger cluster organisations (over 80 members)
- SMEs (74%; ØEU:71%) most prevalent followed by the research sector (11%; ØEU: 8%) & large companies (9%; ØEU: 10%)

Thematic orientation

- Cluster organisations in Lithuania can be related to 12 different EU industrial ecosystems
- Collaboration often sought in digitalisation, internationalisation, partnering for projects & technology scouting

Source: ECCP (2022).

[17] see European industrial strategy. Available under: https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_en (last accessed 08.02.2022)
[18] see https://klaster.lt/en/zemelapis/ (last accessed 23.03.2022)
[19] see ECCP (2021): European Cluster Panorama Report 2021. Available under: https://clustercollaboration.eu/sites/default/files/2021-12/European_Cluster_Panorama_Report_0.pdf (last accessed 08.02.2022)

Moreover, eight of the cluster organisations from Lithuania have obtained the bronze Label from the Cluster Excellence Label, while others have received national or regional labels and rewards, such as a certificate for the European Strategic Cluster Partnership Going International or Best National Tourism Business Project 2014.

As mentioned in the introductory section, the general sectors that make up the larger share of economic activity and growth in Lithuania can be subcategorised under the "Services" and "Industrial" sector. Taking this into consideration, the clusters pertaining to the respective businesses focus on a myriad of different sectors, for example with the Laser technology playing a focal role in Lithuania's economy. The two stand-out clusters for Laser technologies are LITE (Laser and Engineering Technologies) and TOOLAS (Laser Micromachining). The former provides a multitude of services from supporting the internationalisation of SMEs, to conducting innovation potential audits for SMEs and building wide-ranging links between industry players and R&D centres[20]. As a network that operates as its own training and research space, whilst setting the foundation for businesses to form and grow, LITEK now encompasses 50 companies. The latter cluster (TOOLAS) complements the former by further focusing on applied photonics and semiconductors. In regard to novel technologies, it is also relevant to mention LAuGEA (Lithuanian Automative Export Association), that is dedicated to developing, testing and employing scientific potential in the field of automotive products. Here they seek wide-ranging cooperative within EU project frameworks to make use of automotive "aftermarket" business expansion and branch out into different markets.

Another group of clusters of great importance to Lithuania are those focusing on agri-tech as well as agri-food sector. Hereby, clusters such as SMART Food Cluster, AgriFood Lithuania DIH (Digital Innovation Hub), FTD LT (Food Technologies Digitalisation LT) and NaMUK (National Food Cluster Lithuania) play a vital role to the regional development of said sectors.

The SMART Food Cluster is one of the most significant clusters of Lithuania that represents the food & beverages sector on an international level. as it coordinates global directives of SMEs. Most of the COSME (Competitiveness of Enterprises and Small and Medium Enterprises) projects are implemented by this cluster, whilst it also fosters cross-sectoral cluster innovations for example with its novel B2B and B2R&D matchmaking activities. Encompassing 20 members and ca. 6000 employees, having access to ca. 60 export markets, and yielding a €750 million turnover annually, SMART Food Cluster is a big player in the development and production of innovative agri-food products.

AgriFood Lithuania DIH fuses digital transformation with the agriculture and food sector, by bringing together a range of actors from research to business and public stakeholders.[21] One of their standout characteristics is the cutting-edge digital capacity, with competences encompassing AI, Distributed systems and blockchain, Big data and data analytics and many more[22]. By also applying an international-oriented approach, especially within European technological infrastructure, AgriFood Lithuania

[20] Agency for Science, Innovation and Technology (2022): Project 'Promotion and Development Innovation Networking' (InoLink). Available under: MITA_Brosiura-ENG_interactive_3.pdf (lrv.lt) (last accessed 18. 03. 2022)

[21] AgriFood Lithuania DIH (2021): We are AgriFood Lithuania DIH!. Available under: About Us - AgriFood Lithuania DIH (last accessed 31. 03. 2022)

[22] AgriFood Lithuania DIH (2021): The Future of Smart Agriculture is Now. Available under: Home - AgriFood Lithuania DIH (last accessed 31. 03. 2022)

FTD LT is dedicated to aiding the "food technology development on all fronts, as it has a wide scope of actors ranging from businesses, scientific institutions, to service providers in one interconnected network. This not only improves the creation process of nutritional products (milk processing, apple juice, vegetable oils, pasta, proteins, etc.), but also facilitates the scaling of the respective businesses through R&D activities and logistics management. Meanwhile NaMUK aim to specifically replace low added-value chains with high added-value chains, by focusing on Lithuanian niche markets. This is further underpinned by coordinating the engagement of network participants by facilitation the acquisition of skills, knowledge, and information, whilst enabling them to earn places as competitive players in the market.

On a further note, one can mention FETEK (Photovoltaic Technologies Cluster) of Lithuania, which is responsible for developing and facilitating the production and distribution process of photovoltaics. As a cluster that encompasses a total of 37 businesses and research entities (in linkage with 5 universities), FETEK primarily focusses on smart products and niche markets. The services are fundamentally firstly geared toward the process of manufacturing, development, and implementation of photovoltaics technology. Hereby, R&D activities are executed to improve energy efficiency, energy generation in buildings, reduce costs for photovoltaics systems and power electronics for green energy efficiency[23].

Finally, there is the Lithuanian Plastic Cluster which is responsible for more than 20% of Lithuania's plastic industry, as it boasts one of the largest businesses that interconnects with interests across Western Europe and Russia. With a skilled workforce in engineering and solid R&D foundations, Lithuanian Plastic Cluster employs over 900 employees and has an annual turnover of €107 million.

As the automotive sector, photovoltaics and laser production utilise semiconductors, Lithuanian clusters LAuGEA, LITEK, TOOLAS, and FETEK, respectively, consider further investment in said technologies, to facilitate the development in profitable and sustainability-oriented Innovations. This is potentially the reason behind Lithuania seeking to foster a close relationship with Taiwan, home to the most valuable semiconductor company of the world (TSMC). Hereby, Lithuania and Taiwan have reportedly negotiated an initial $200 million investment, which could enable the former to become "an inroad to the rest of the European semiconductor market"[24]. This development, in parallel with growing diplomatic ties between Lithuania and Taiwan, has however triggered an embargo against Lithuania by China, boycotting exports and goods from the Baltic nation. Taking this into consideration, FETEK plays a focal role in redefining Lithuania's future economic and trade infrastructure.

The importance of clusters for regional economic competitiveness

Against the backdrop of already established clusters and their respective organisations, intergovernmental R&D initiatives such as EUREKA, Eurostars or the Baltic Sea Region (2007-2013) have initiated more international-oriented projects for Lithuania. Drawing on Jurksiene & Pundziene (2014), developing clusters on an international level is a significant stepping-stone in fostering areas

[23] Agency for Science, Innovation and Technology (2021): Most Promising Lithuanian Cluster. Available under: Most Promising Lithaunian Clusters.pptx (live.com) (last accessed 18. 03. 2022)

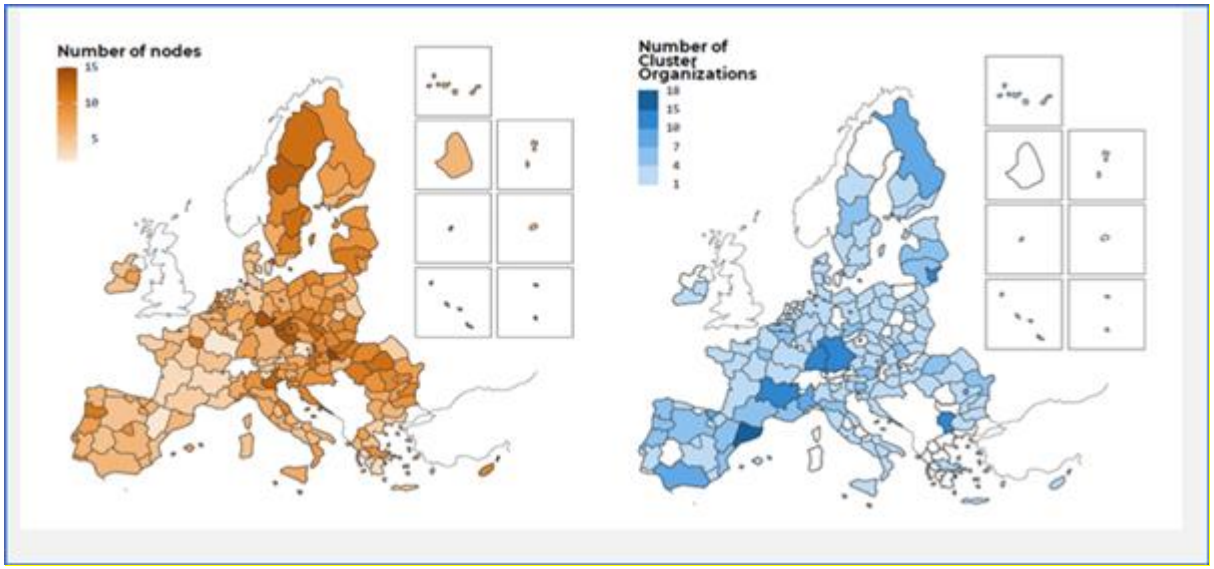
[24] Lau, S. & Cerulus, L. of Politico.eu (2022): Lithuania wins microchip windfall from Taiwan in China clash. Available under: Lithuania wins microchip windfall from Taiwan in China clash – POLITICO (last accessed on 18. 03. 2022).

for knowledge flows, innovation transfers and the expansion of business output[25]. The European Cluster Alliance for Lithuanian Clusters Network is a telling example of how a variety of actors ranging from SMEs, enterprises, research institutes, universities and knowledge transfer centres were successfully united within one grouping. This "alliance" functioned on national as well as European levels[26]. On a specific note, the Lithuanian Clusters Network focused on promoting local short value chains, increasing the value added created, integrating cluster members into international value-added chains and finally, encouraging the participation in R&D initiatives with an international scope.

The European Cluster Panorama Report (2021) examines the relationship between clusters and regional competitiveness. The stand-out findings of this report showcase how the presence of cluster organisations is positively correlated with economic indicators such as GDP per capita, labour productivity, as well as Business R&D expenditure. While public R&D expenditure is merely positively correlated with industry-relevant nodes[27], it does indicate how specific regions could earn greater public support, when specific industries pertain to a local significance. Particularly indicators pertaining to R&D expenditures are key in measuring economic performance concerning innovation.

In Figure 12 seen below, one can see how a high number of region-relevant specialisation nodes[28] and higher number of Cluster organisations (namely in the Vilnius County region) are prevalent in Lithuania.

Figure 12: Distribution of region-relevant sector specialization nodes and cluster organisations in EU-27



Source: European Cluster Panorama (2021).

[25] Jurksiene, L. Pundziene, A. (2014): Strengthening Business Performance Management. The need for the professionalisation of cluster management. Available under: https://www.researchgate.net/publication/261364180_Towards_greater_economic_competitiveness_Business_clusters_and_cluster_policy_in_Lithuania_and_Poland (last accessed on 18. 03. 2022)

[26] KlasterLT (Date unknown): Lithuanian Clusters Network. Available under: Lithuanian Clusters Network – European Clusters Alliance (last accessed on 18. 03. 2022).

[27] From the European Cluster Panorama Report (2021): Industry-relevant specialisation nodes: When the region is specialised in the sector (or industrial ecosystem) and regional employment in the sector is relevant in the EU context (industry employment share > 1%).

[28] From the European Cluster Panorama Report (2021): Region-relevant specialisation nodes: When the region is specialised in the sector and the employment share of that sector is relevant for the region (regional employment share > 1%).

Next to clusters having an enabling and facilitating effect on economic performance and growth, other studies have provided complementary information on the impact clusters can have. For example, Ketels & Protsiv (2021)[29] provide a thorough account of the positive relationship between cluster presence and industry-level wages across European regions. Key takeaways emphasise how particular clusters relate to sector-specific industries, as opposed to the mere "concentration of economic activity in a specific field" (pp. 217). On top of that, the data showcases how the influence and strength of clusters has an independent relationship with economic outcomes. Their findings suggest how the degree and nature of competitiveness within clusters must be understood on a location-to-location basis. This further reflects on what they refer to as the "business environment quality" that can have striking knock-on effects on wage levels. Most importantly, Ketels & Protsiv delineate how "cluster strength" has a unique impact on "wages and prosperity". A visual depiction that highlights this trend can be seen in the map of Ketels in the Annex.

In the context of Lithuania, the statistical data and analysis of Ketels & Protsiv (2021) suggest how the wealth of cluster organisation establishments (mainly in Vilnius County) are more developed than in other regions. The results are presented visually in the Annex.

In the context of Lithuania, clusters are particularly effective in yielding success for a variety of reasons. According to Jurksiene & Pundziene (2014), Lithuania boasts a relatively inexpensive labour force, potent geographical location and an already well-established logistics infrastructure. This, in-turn with direct innovation policies and cluster policies has enabled Lithuania to take full advantage of said structures, whilst streamlining efforts effectively.

In conclusion, one can make the case for Lithuania and its respective regions, as it has captured the attention of governances, civil society, stakeholders, and businesses alike. The EU Cluster Panorama Report (2021) in connection with Ketels & Protsiv (2021) further makes the case for cluster organisations as a proven method to stimulate long-term growth and innovative activity on a regional level as well as national level.

[29] Ketels, C. & Protsiv, S. (2021): Cluster presence and economic performance: a new look based on European data, Regional Studies, 55:2, 208-220, DOI: 10.1080/00343404.2020.1792435. Available at: https://www.tandfonline.com/doi/full/10.1080/00343404.2020.1792435 (last accessed 08.02.2022)

03

Cross-border cooperation and the involvement of Lithuanian clusters in European networks and support initiatives

EUROPEAN CLUSTER COLLABORATION PLATFORM

Strengthening the European economy through collaboration

3. Cross-border cooperation and the involvement of Lithuanian clusters in European networks and support initiatives

To boost sustainable growth and resilience building, cross-border cooperation is perceived as an important instrument for innovation stakeholders such as clusters to support their SME members.[30] To gain an overview of the existing cross-border cooperation of Lithuanian clusters, a closer look will be taken in this chapter on the involvement of Lithuanian clusters in European support initiatives with a focus on the 2014-2020 funding period (Figure 13).

Figure 13: Overview of EU support initiatives in the funding period 2014-2020

Source: ECCP (2022)

Involvement of Lithuanian cluster organisations in the European Strategic Cluster Partnerships (ESCP)

In the 2014-2020 funding period, one relevant EU support initiative to increase cross-border cooperation of EU cluster organisations and other intermediary organisations was the European Strategic Cluster Partnership (ESCP) initiative funded under the EU Programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME). The ESCP initiative established partnerships of European clusters and intermediary organisations from the different EU Member States or associated countries. Those partnerships focused on three different thematic areas which were internationalisation (ESCP for Going International), cluster excellence (ESCP for Excellence) and smart specialisation (ESCP for Smart Specialisation).[31]

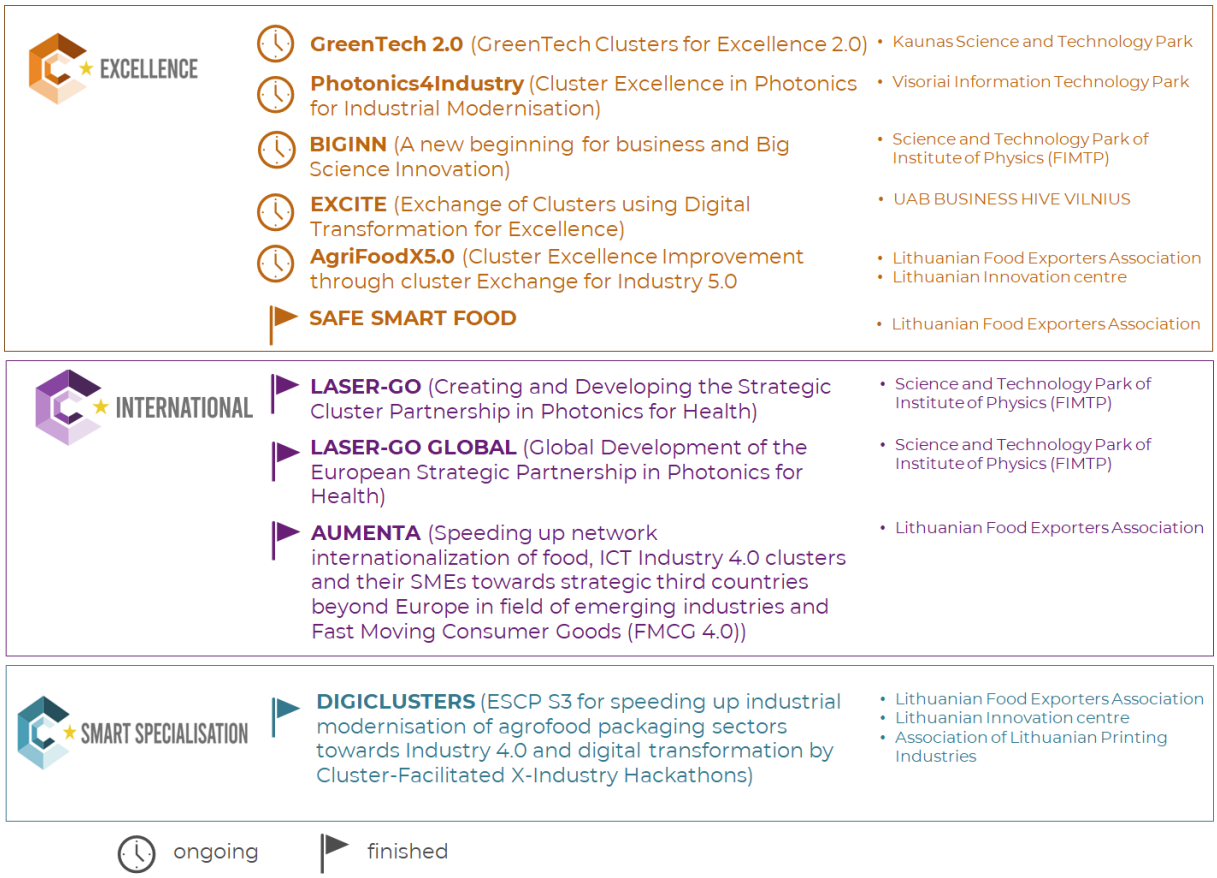
Figure 14 gives an overview of ESCP projects in which Lithuanian clusters have or are participating. In April 2022, three ESCP projects were still ongoing with an ending date in 2024, while seven projects have already been finished in the last years. Four Lithuanian clusters have participated or are participating in three ESCPs for Going International (ESCP-4i), three Lithuanian clusters are

[30] Prognos et al. (2021): Evaluation Study of & Potential Follow-Up to Cluster Initiatives under COSME, H2020 & FPI (DG GROW, Unit D2 - Industrial Forum, alliances, clusters). Study on behalf of the European Commission. Available under: https://op.europa.eu/en/publication-detail/-/publication/a2c3e9e1-3deb-11ec-89db-01aa75ed71a1/language-en/format-PDF/source-241039860 (last access on 31.01.2022).

[31] For more information on the European Cluster Partnerships see: https://clustercollaboration.eu/eu-cluster-partnerships (last access 07.02.2022).

participating in one ESCP for Smart Specialisation (ESCP-S3) and seven Lithuanian clusters are participating in six ESCPs for Excellence (ESCP-4x). Findings show that Lithuanian clusters such as the Lithuanian Food Exporters Association have been successful in participating in different types of partnerships like ESCP-4i and ESCP-4x with different European partners. The thematic focus of the Cluster Partnerships with Lithuanian cluster organisations was reflecting the strengthens of the Lithuanian innovation ecosystem. Participating Lithuanian cluster organisations are focusing on topics of the agri-food and packaging sector, industry 4.0/5.0, big science and the green tech industry.

Figure 14: Overview of the ten ESCP projects with participation of Lithuanian clusters



Source: ECCP (2022), own elaboration based on information from the COSME data hub (last access on 22.03.2022).

The EU contribution per project consortium varied between EUR 180.000 for the project consortium of the ESCP-4i strand 1 project LASER-GO and EUR 500.000 for the ESCP-4x projects GreenTech 2.0 and BIGINN. In total, the EU contribution to all ESCP projects with Lithuanian involvement reached EUR 4.1 million.[32]

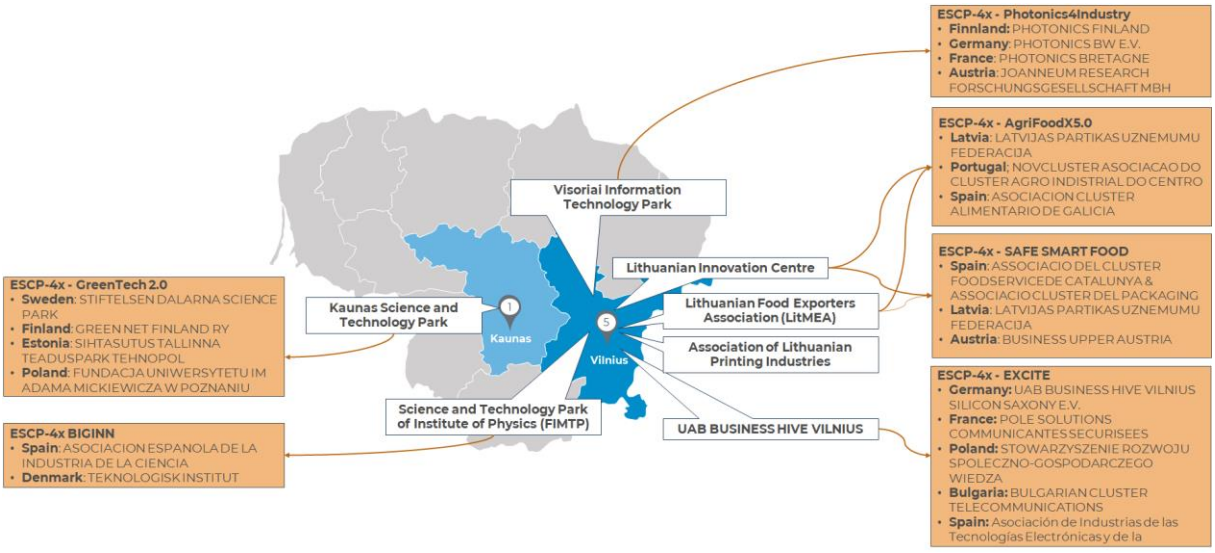
Compared with the other two Baltic countries Estonia and Latvia, Lithuania had a higher success rate with regards to the number of ESCPs with cluster partnerships. In total, Lithuanian clusters have been involved in ten ESCPs with eight different Lithuanian clusters. In comparison to the other Baltic States, Estonian clusters have participated in eight ESCP[33] and Latvian clusters have been involved in six

[32] Please see Figure 28 in the Annex for the EU contribution per ESCP with involvement of Lithuanian clusters.
[33] Latvian clusters have been involved in the following six ESCPs: GIVE, NE4HEALTH, FOODNET, AUMENTA (all ESCP-4i), 5FOREXCELLENCE (ESCP-4x) and DIGICLUSTERS (ESCP-S3).

ESCP[34] in the 2014-2020 funding period. While the total EU contribution of ESCP with the involvement of Lithuanian cluster organisations reached EUR 4,1 million, the EU contributions to ESCP with Estonian and Latvian clusters have been significantly below with EUR 2,7 million and EUR 3,2 million. The closer cooperation between the Baltic States becomes visible as Lithuanian, Latvian, and Estonian clusters participated in three ESCPs together.[35]

Figure 15f gives an overview of the countries of origin of project partners of the ESCP-4x projects with Lithuanian cluster organisations.[36] The most common countries of origin of the ESCP consortium partners were Spain with eight cluster organisations as consortia partners, followed by six Latvian and five French and Austrian cluster organisations. Other countries of origin of consortium partners were from Sweden (1), Finland (1), Estonia (1), Poland (4), Denmark (1), Germany (3), Bulgaria (1) and Portugal (1). In addition to the Intra-European cooperation of the Cluster Partnerships, the ESCP-4i has also targeted cluster organisations and SMEs based in third markets. The target markets of ESCP-4i projects with Lithuanian cluster organisations were diverse with 13 different third countries. The targeted countries of the three ESCP-4i projects have been or are Canada, Malaysia, Singapore, South Africa, United States (project "LASER GO"), Australia, Canada, Israel, Japan, New Zealand, South Korea, Singapore, United States (project "LASER GO GLOBAL") and Georgia, Morocco, Uruguay (Project "Aumenta").

Figure 15: Overview of consortium partners of ESCP-4x projects with participating Lithuanian clusters



Source: ECCP (2022), own elaboration based on information from the COSME data hub (last access on 22.03.2022).

Finished projects give evidence that European cluster partnerships have been successful in supporting cluster members to define business opportunities, to match with business partners and to enhance the integration of new businesses. As an example, the project summary of the partnership Laser-Go Global points out that the partnership performed during its project implementation six

[34] Estonian clusters have been involved in the following eight ESCPs: GEN; ERA, EUKETS4DualUse (all ESCP-4i), CELIS, BRIGHT, 5FOREXCELLENCE, GreenTech 2.0 (all ESCP-4x) and AI4DIAG (ESCP-S3).
[35] Projects with Estonian or Latvian participation were AUMENTA (ESCP-4i), DIGICLUSTERS (ESCP-S3) and GreenTech 2.0 (ESCP-4x).
[36] For an overview of European partners of ESCP-4i and ESCP-S3 projects with Lithuanian cluster, please see Figure 29 in the annex.

missions to its target countries and organized in total 220 events during which 662 clusters and SMEs met.[37] All in all, Laser-Go Global indicates to have successfully established a European cluster partnership including 1000 cluster members from sectors like photonics and health and supported the interregional cooperation of clusters and SMEs. The ESCP-4x partnership SAFE SMART FOOD expected that its project will help to boost interregional cooperation among clusters and SMEs with the focus on the smart specialisation priorities in the food and packaging sector.[38]

Involvement of Lithuanian cluster organisations in the INNOSUP-1 initiative

The INNOSUP-1 initiative "Cluster facilitated projects for new value chains" funded under the EU programme Horizon 2020 has also been a relevant EU support initiative addressing the challenge of developing new cross-sectoral industrial value chains in Europe through European cooperation of cluster organisations and other relevant intermediaries. [39] In this context, the INNOSUP-1 initiative aimed at boosting the cross-sectoral and cross-border cooperation in consortia of European cluster organisations and other relevant innovation intermediaries.[40] Different to other EU funding programmes, the INNOSUP-1 initiative consisted of the so-called cascade funding approach, meaning that cluster organisations served as intermediaries to support their SME members through different support instruments like direct financial support or capacity-building training. Findings from the Evaluation Study of and Potential Follow-Up to Cluster Initiatives under COSME, H2020 and FPI of the European Commission (2021) confirm that the transnational component of the cluster initiatives was perceived by beneficiaries as an EU added value with high mutual learning effects for cluster organisations and the supported SMEs.

[37] ECCP (2019): Publishable summary – Laser-Go Global. Available under: https://clustercollaboration.eu/sites/default/files/2021-02/strand-2-laser-go-global.pdf (last access on 22.03.2022).
[38] For more information see: https://clustercollaboration.eu/eu-cluster-partnerships/escp4x/safe-smart-food#section-3 (last access 22.03.2022).
[39] For more information on the ESCPs and the INNOSUP-1 initiative see: https://clustercollaboration.eu/eu-cluster-partnerships (last access 22.03.2022).
[40] European Commission (2020): Study on the effectiveness of public innovation support for SMEs in Europe . Annex E, INNOSUP evaluations. Available under: https://op.europa.eu/en/publication-detail/-/publication/888d351a-9d97-11eb-b85c-01aa75ed71a1/language-en (last access 03.02.2022).

Figure 16: Overview of Lithuanian clusters in INNOSUP-1 projects

PARSEC (Promoting the internAtional competitiveness of European Remote Sensing companies through Cross-cluster collaboration) - *finished*
- GEOMATRIX UAB

Block.IS (Blockchain Innovation Spaces) - *finished*
- UAB CIVITTA

SecurIT (New industrial value chain for Safe, sECure and Resilient cIties and Territories) - *ongoing*
- LIETUVOS KIBERNETINIU NUSIKALTIMU KOMPETENCIJU IR TYRIMU CENTRAS

Urban Tech (Value chain innovations in emerging Health Tech, Smart City and Greentech industries addressing the challenges of smart urban environment) - *ongoing*
- VIESOJI ISTAIGA KAUNO MOKSLO IR TECHNOLOGIJU PARKAS

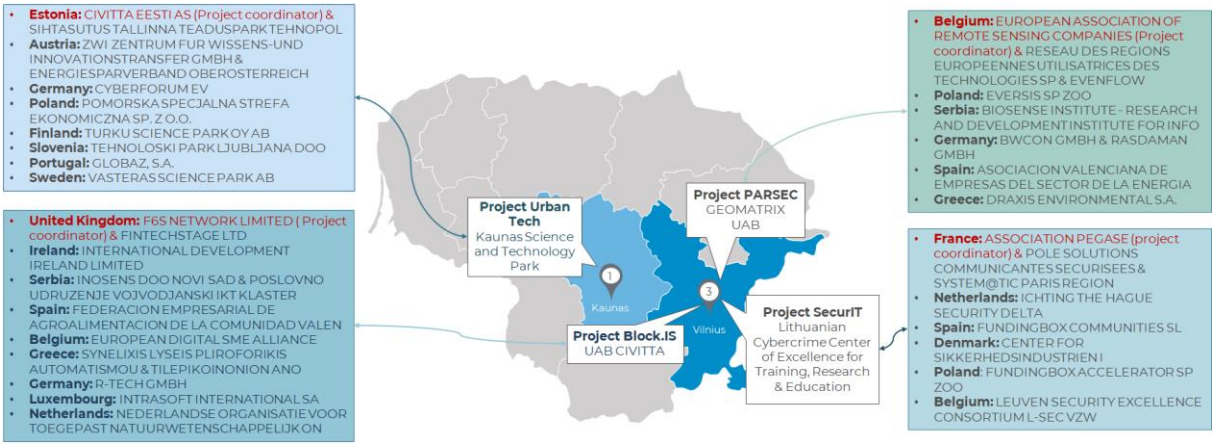
Source: ECCP (2022), own elaboration based on information from Cordis (last access on 11.03.2022).[41] [42] [43] [44]

The INNOSUP-1 initiative was a highly competitive funding initiative, and the overall success rate was only 8%. In total, 18 project consortia were selected with 204 partners. In total, four Lithuanian cluster organisations were or are still part of the INNOSUP-1 project consortia. Figure 16 gives an overview of the four different projects in which Lithuanian cluster organisations have been involved. Compared with Latvia and Estonia, Lithuanian cluster organisations were strongly represented on the EU level as only one Latvian cluster organisation and two Estonian cluster organisations participated in the INNOSUP-1 initiative.

One central component of the INNOSUP-1 initiative was the cross-border cooperation of beneficiaries. When looking at the origin of project partners of the four INNOSUP-1 projects with Lithuanian participation, cluster organisations from 18 other EU- or associated Horizon 2020 countries were or are part of the project consortia. Cluster organisations from different geographical areas were or are part proofing intense cross-regional cooperation of involved Lithuanian cluster organisations (see Figure 17). The TOP 3 countries of origin of consortium partners have been Belgium, Germany and France. Other countries of origin have been Estonia, Austria, Poland, Finland, Slovenia, Portugal, Sweden, United Kingdom, Ireland, Serbia, Spain, Greece, Luxembourg, Netherlands and Denmark.

[41] For more information on the INNOSUP-1 project "PARSEC" see: Promoting the internAtional competitiveness of European Remote Sensing companies through Cross-cluster collaboration | PARSEC Project | Fact Sheet | H2020 | CORDIS | European Commission (europa.eu) (last access on 11.03.2022).
[42] For more information on the INNOSUP-1 project "SecurIT" see: New industrial value chain for Safe, sECure and Resilient cIties and Territories | SecurIT Project | Fact Sheet | H2020 | CORDIS | European Commission (europa.eu) (last access on 11.03.2022).
[43] For more information on the INNOSUP-1 project "Block.IS" see: (last access on 11.03.2022).
[44] For more information on the INNOSUP-1 project "Urban Tech" see: Value chain innovations in emerging Health Tech, Smart City and Greentech industries addressing the challenges of smart urban environment | URBAN TECH Project | Fact Sheet | H2020 | CORDIS | European Commission (europa.eu) (last access on 11.03.2022).

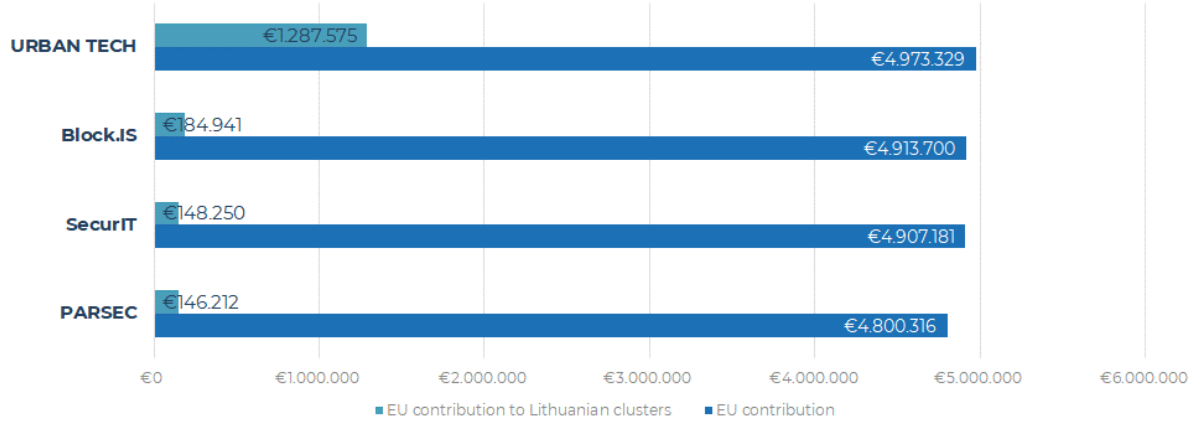
Figure 17: Overview of consortium partners of INNOSUP-1 projects with participating Lithuanian clusters



Source: ECCP (2022), own elaboration based on information from Horizon 2020 – INNOSUP data hub (last access on 11.03.2022).

Out of the four projects, two projects have already been finished. The projects PARSEC and Block.IS have finished in 2021, while the projects Urban Tech and SecurIT are still running until 2024. The total budget for the four INNOSUP-1 projects with Lithuanian participation was up to 21,2 million. with an EU contribution of EUR 19,5 million. The total budget for the six calls of the INNOSUP-1 initiative was EUR 132,4 million.[45] The EU contribution to the Lithuanian cluster differs by project. While three cluster organisations have received between 145.000 and 185.000 for their activities, the cluster VIESOJI ISTAIGA KAUNO MOKSLO IR TECHNOLOGIJU PARKAS receives up to EUR 1,3 million. for their activities (see Figure 18

Figure 18: Overview of EU contributions to INNOSUP-1 projects with participation of Lithuanian clusters



Source: ECCP (2022), own elaboration based on information from Horizon 2020 – INNOSUP data hub (last access on 11.03.2022).

[45]Prognos et al. (2021): Evaluation Study of & Potential Follow-Up to Cluster Initiatives under COSME, H2020 & FPI (DG GROW, Unit D2 - Industrial Forum, alliances, clusters). Study on behalf of the European Commission. Available under: https://op.europa.eu/en/publication-detail/-/publication/a2c3e9e1-3deb-11ec-89db-01aa75ed71a1/language-en/format-PDF/source-241039860 (last access on 31.01.2022).

The two finished INNOSUP-1 projects PARSEC and Block.IS have been proven to be successful in reaching out to European SMEs to boost the creation of new cross-sectoral value chains through cascade funding.

The INNOSUP-1 project PARSEC offered interested SMEs support through the PARSEC accelerator that supported SMEs applying earth observation technologies that address challenges in sectors such as the food, energy or environment industries. To reach out to interested SMEs, the PARSEC consortium organised 59 third party events out of which seven events took place in Lithuania. [46] According to the consortium, third party events have been a powerful way of engaging interested audiences. The funding budget of the accelerator programme reached EUR 2.5 million. In total, 100 projects received funding in the 1st call and 60 new EO-based solutions were funded in the context of the 2nd call. Supported SMEs came from 29 EU- and associated-Horizon 2020 countries.[47] Out of the 100 supported SMEs of the 1st call, three SMEs came from Lithuania, two from Latvia and two from Estonia. The supported Lithuanian clusters have been Baltic Freya[48], Indre Ruskyte and art21[49].

The INNOSUP-1 project Block.IS aimed at supporting cross-border and cross-sectoral innovation ecosystems using blockchain technologies in the fields of agri-food, logistics and finance. Around EUR 418.000 direct funding was provided to 53 SMEs from 12 EU- and associated-Horizon 2020 countries.[50] In addition, Block.IS also offered business and technical services as part of its acceleration programme. Out of the 53 supported SMEs, the SME *art 21* came from Lithuania. Another other SME came from Estonia.

[46] Following events took place in Lithuania: Agribusiness Forum 2019 (Vilnius), NASA Space App Challenge (Vilnius), Smart digital agriculture B2B conference (Vilnius), Agribusiness Forum 2019 (Vilnius), Agri-renaissance interreg Europe workshop (Vilnius), Digital Lithuania Meetup (Vilnius) and Agro-tech exhibition "Inno Panorama" (Kaunas).
[47] The PARSEC project funded SMEs from Latvia, Turkey, Estonia, Slovenia, Belgium, Slovenia, Ukraine, Switzerland, Denmark, Romania, Czechia, Greece, North Macedonia, Serbia, Netherlands, Hungary, France, Germany, Island, Malta, Italy, Cyprus, United Kingdom, Norway, Ireland, Lithuania, Austria, Tunisia and Bulgaria.
[48] For more information on Baltic Freya see: Growing food in fog - Balticfreya (last access on 14.03.2022).
[49] For more information on art21 see: Art21 (last access on 14.03.2022).
[50] The Block.IS project funded SMEs from Estonia, Serbia, Slovenia, Italy, United Kingdom, North Macedonia, Bulgaria, Greece, Spain, Germany, Lithuania and Belgium.

04

From the S3 Strategy 2014-2020 to the S3 Strategy of Lithuania 2021-2027

4. From the S3 Strategy 2014-2020 to the S3 Strategy of Lithuania 2021-2027

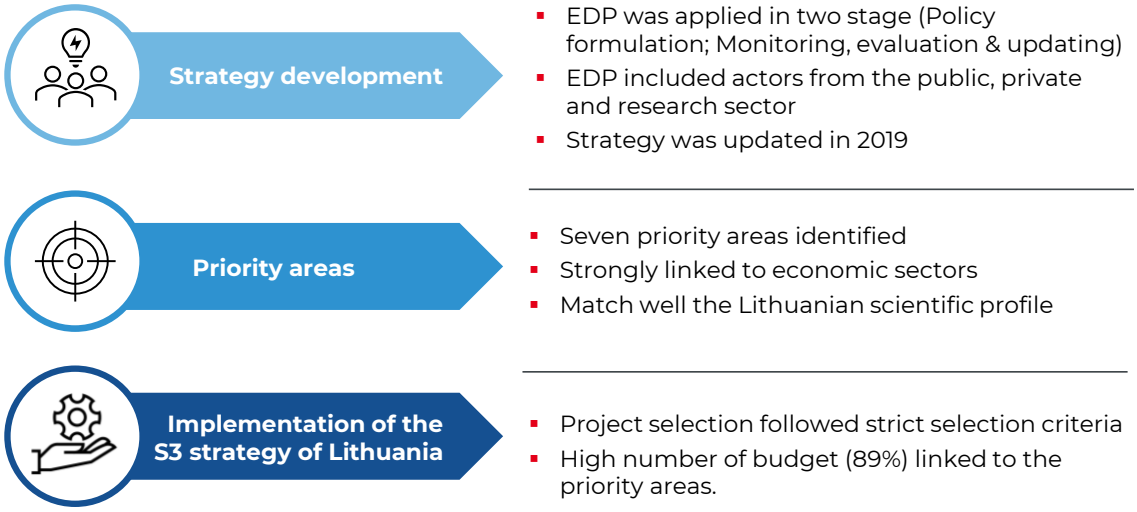
Cluster organisations (can) play an important role in the design and implementation of smart specialisation strategies since in both concepts, the facilitation of economic growth and competitiveness through regional proximity, are key elements. Hence, this chapter focuses on the Lithuanian S3 Strategy 2014-2020 and as well as on the S4 Strategy.

S3 Strategy 2014-2020 of Lithuania

The Lithuanian S3 Strategy 2014-2020 was published in 2014 and set the framework for the concentration of resources to dedicated research and development as well as innovation priority areas. Figure 19 provides a quick overview of the key facts about the Lithuanian S3 Strategy 2014-2020 and will be presented in more detail in the following.

A key starting point for the analysis of the Lithuanian S3 Strategy 2014-2020[51] is the data collected in the Study on prioritisation in Smart Specialisation Strategies in the EU.[52] This study systematically screened and assessed all available S3 strategies across the EU to discover the respective approaches to prioritisation, to analyse if priorities set within the strategies correspond to innovation capabilities and if these were translated into concrete projects. The following analyses will follow the logic of an 'ideal' S3 process (from strategy development to implementation of projects).

Figure 19: Factsheet - Lithuanian S3 Strategy 2014-2020



Source: ECCP (2022)

[51] see also https://strata.gov.lt/en/smart-specialisation (last access on 08.03..2022)
[52] Prognos /CSIL (2021): Study on prioritisation in Smart Specialisation Strategies in the EU. Study on behalf of the European Commission. Available under: https://ec.europa.eu/regional_policy/en/information/publications/studies/2021/study-on-prioritisation-in-smart-specialisation-strategies-in-the-eu (last access on 31.01.2022)

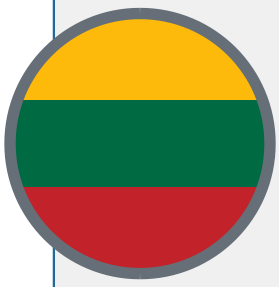
Strategy development

Regarding the Entrepreneurial Discovery Process[53] (EDP) it can be stated that in Lithuania the EDP was applied in the stages of policy formulation as well as Monitoring, evaluation and updating. In the other stage of decision-making and implementation the EDP was not applied in the Lithuanian S3 Strategy 2014-2020. The EDP included actors from the public, private, and research sectors. The civil society was not included in this process. Box 1 shows some good practices of cluster involvement in S3 strategies from other European regions and especially in the EDP.

Priority areas

The seven priority areas that were identified in the updated Lithuanian S3 Strategy 2014-2020 are presented below. During the update of the initial Lithuanian S3 Strategy 2014-2020 in 2019 several priority areas were thematically new aligned, and a new priority area (Information and communication technologies) was added.

Figure 20: Priority areas of Lithuania in the S3 Strategy 2014-2020



Priority areas of Lithuania

1. Agricultural innovation and food technologies
2. Energy and sustainable environment
3. Health technologies and biotechnologies
4. Inclusive and creative society
5. Information and communication technologies
6. Intelligent, green and integrated transport
7. New production processes, materials and technologies

Source: ECCP (2022). Note: the priority areas shown above correspond to the updated Lithuanian S3 Strategy

The Lithuanian Strategy 2014-2020 is strongly linked to economic sectors (79%) as well as to scientific fields (61%) and a lesser extent to technology fields (51%).[54] This means that similar to many other S3 strategies the priorities of the Lithuanian S3 Strategy 2014-2020 are not solely economically, scientifically, or technologically driven but rather reflect a combined approach. In addition, when it comes to its thematic focus (measured with a Bandwidth Index[55]) the Lithuanian S3 Strategy 2014-2020 is characterised by a medium thematic bandwidth (43%; EU average: 36%).

Regarding the correspondence of the Lithuanian S3 Strategy 2014-2020 with its regional profile and regional innovation capabilities, it can be stated that the Lithuanian strategy matches best the scientific profile. This means that there is a relatively strong and positive correspondence between the S3 priority areas mentioned above and the average publication share in the three years before the strategy implementation.

[53] The entrepreneurial discovery is an interactive and inclusive process in which the relevant actors identify new and potential activities and inform the government. The government assess this information and empowers those actors most capable of realising the potential. See https://s3platform.jrc.ec.europa.eu/edp (last access on 31.01.2022)

[54] The respective share indicates the extent to which priority areas can be explained through NACE sectors or scientific / technology fields. This has been based on a matching approach between priority fields and their description with NACE sectors or scientific / technology fields.

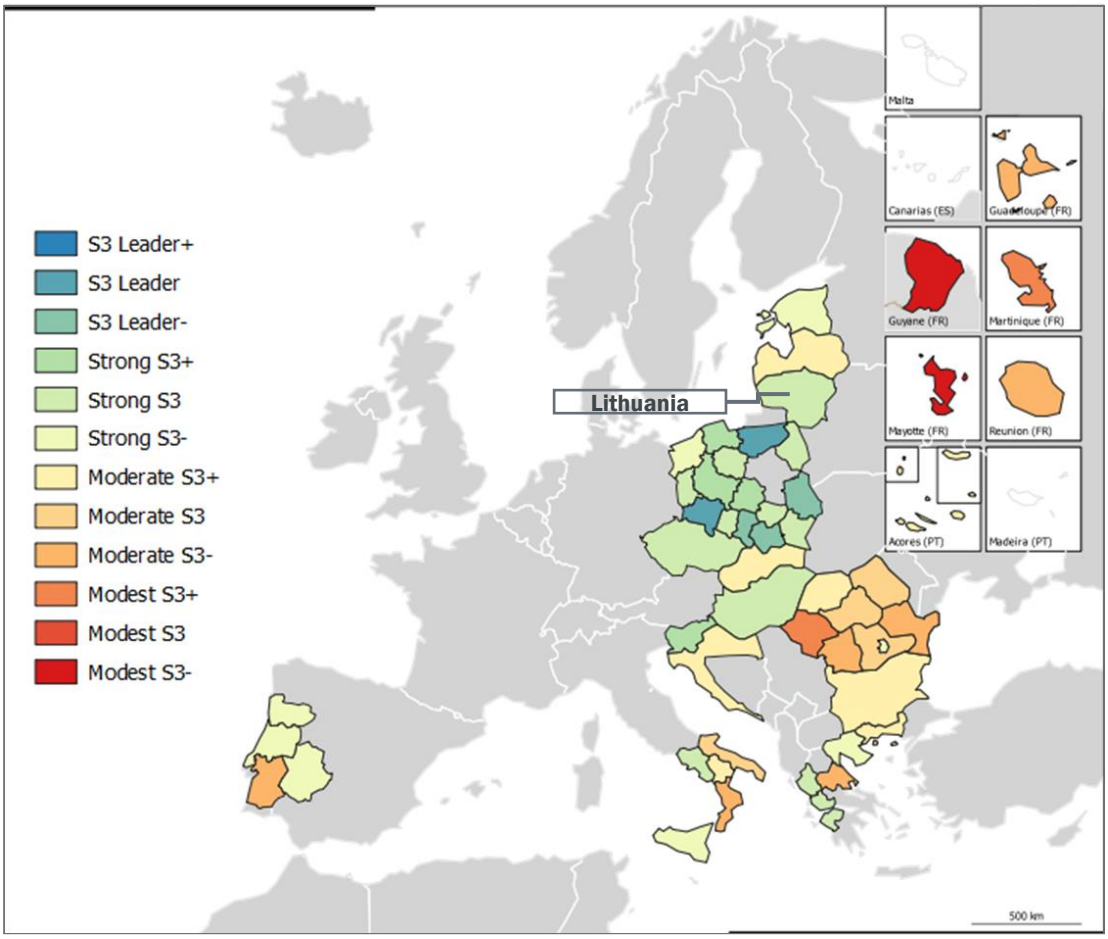
[55] The index of bandwidth indicates the thematic broadness that a S3 strategy covers. It is measured by the degree to which the strategy targets all the possible economic sectors, scientific and technological fields. If a strategy is "narrowly" defined (lower index) it means that it picked only a few economic sectors, scientific and technological fields. A "broadly" defined strategy (higher index) indicates that it focuses on many economic sectors, scientific and technological fields.

Implementation of the S3 strategy of Lithuania

Considering the implementation of the Lithuanian S3 Strategy 2014-2020 it is found that overall, the project selection followed strict selection criteria as many projects needed an alignment to the S3 priority areas mentioned above. These rather strict selection criteria are also reflected in the high budget that is linked to the priority areas of the Lithuanian S3 Strategy 2014-2020. Overall, around 89 % of the Lithuanian ERDF-TO1 project budget between 2014-2020 are connected to the S3 priorities. Correspondingly, 65 % of the ERDF-TO1 projects are connected to the S3 priorities. Among all 185 S3 strategies on average 57% of the projects are connected to the priority areas and 62% of the budget.

As a concluding remark on the Lithuanian S3 Strategy 2014-2020, an S3 Scoreboard for Transition Regions is presented (Figure 21). This Scoreboard serves as a comparative assessment of all 185 smart specialisation strategies in EU Member States and regions. This reflects many of the analytical steps shown before and ranks the regional S3 strategies based on their performance relative to their group average. These groups follow the Cohesion Region classification from the European Commission and are based on economic development.[56] In this Scoreboard Lithuania is classified as a 'Strong S3', meaning that it performs above the group average.

Figure 21: Lithuania in the S3 Scoreboard 2021 (Less Developed Regions)



Source: ECCP (2022), own elaboration based on Prognos / CSIL (2021).

[56] For more information on the Cohesion Regions see: https://ec.europa.eu/eurostat/web/cohesion-policy-indicators/context/cohesion-regions (last accessed 03.02.2022)

Box 1: Good practices of cluster involvement in S3 strategies

Good practices of cluster involvement in S3 strategies

Berlin/Brandenburg – Cluster 'Master Plans':
In Berlin/Brandenburg cluster organisations developed 'Master Plans' for priority areas in which specific objectives and actions for implementation were laid out. Thereby, an important element of these 'Master Plans' is the highly participatory and consultative process in which the various stakeholders are involved and can postulate their opinions on the priorities.

Lombardy - Technology clusters and biannual work programmes:
While priority areas are defined in a rather generic manner in the strategy, Lombardy has foreseen biannual Work Programmes that structure priorities into macro-themes and macro-themes into development themes. The establishment of these biannual work programmes is the result of a continuous Entrepreneurial Discovery Process (EDP) to identify more specific domains of the priorities. Thereby especially technology cluster organisations played a crucial role in the S3 process and were involved in identifying areas for further development and the further definition of the priority areas in biannual Work Programmes.

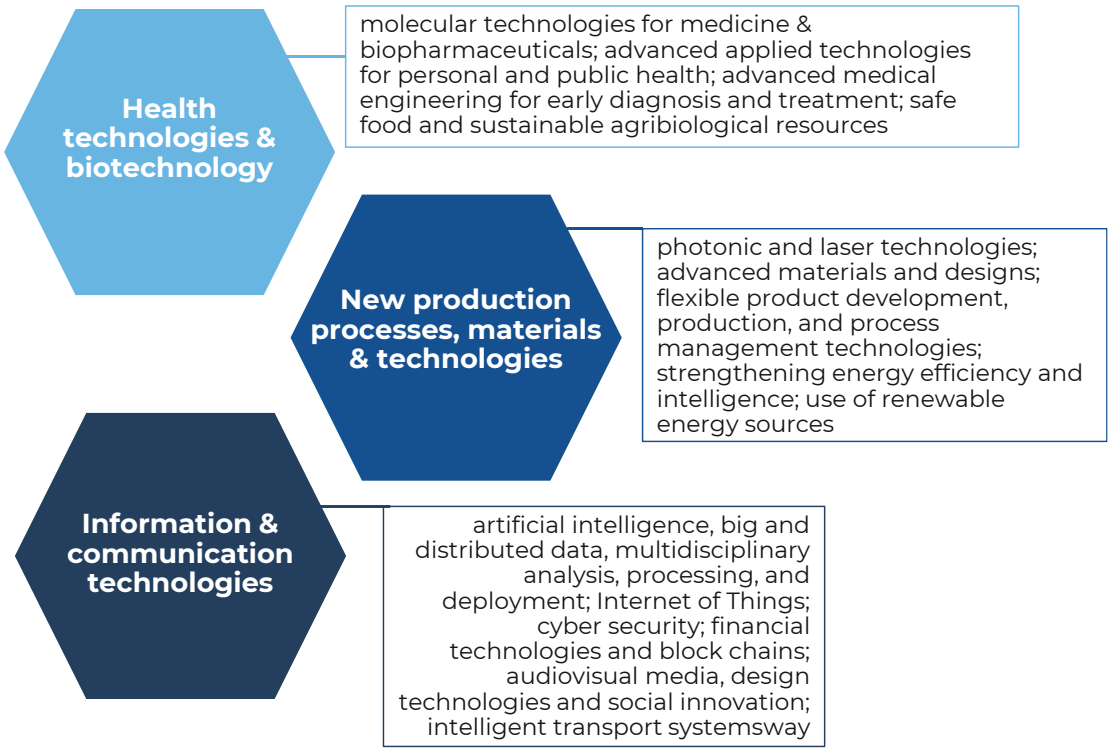
Slovenia - Strategic Research and Innovation Partnerships and the role of clusters (SRIPs):
In Slovenia, lasting partnerships between different types of stakeholders were created to implement the S3 through action plans. Cluster organisations can get involved in this process and these Strategic Research and Innovation Partnerships (SRIPs). There, priority areas are implemented through one SRIP per priority area and constitute long-term partnerships between different actors such as the business communities, research organisations, and the state.

Source: ECCP (2022), based on Case Studies conducted in the context of the Study on prioritisation in Smart Specialisation Strategies in the EU (Prognos / CSIL, 2021).

S3 Strategy 2021-2027 of Lithuania

The Lithuanian Smart Specialisation Strategy (S3) for the period 2021-2027 is currently being developed and has not yet been officially approved. Figure 22 shows the preliminary priority areas for the Lithuanian S3 Strategy for 2021-2027. Currently this strategy covers the three priority areas presented below which also include broad sub-priorities:

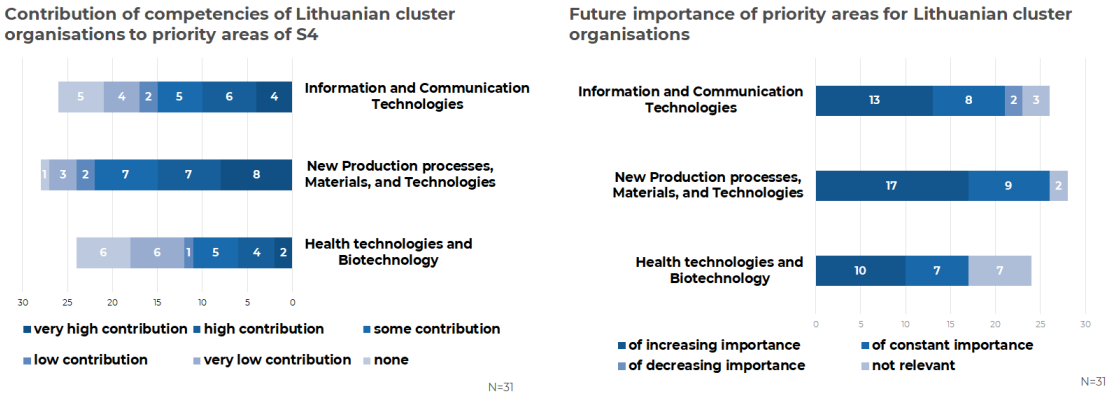
Figure 22: Overview of (preliminary) priority areas of Lithuania for the S3 Strategy 2021-2027



Source: ECCP (2022).

Results of the survey conducted with the cluster organisations in Lithuania show that a majority of 28 cluster organisations are contributing to the priority area of new production processes, materials, and technologies. Around 15 cluster organisations indicate that their involvement is very high or high in this priority area. 18 clusters confirm to contribute to the priority area of health technologies and biotechnology followed by 21 clusters that are contributing to the field of ICT.

Figure 23: Results of survey - Priority areas of the upcoming Lithuanian Strategy (S4)



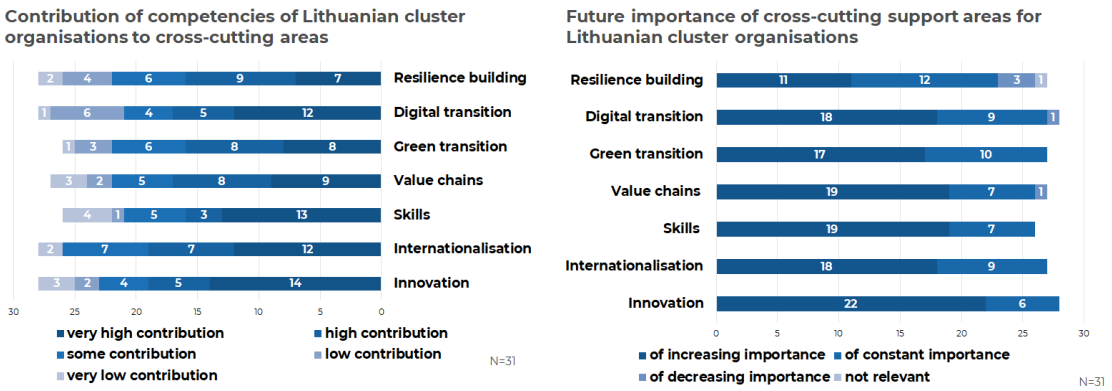
Source: ECCP (2022). Results are based on the self-assessment of Lithuanian cluster organisations.

When looking at the future importance of priority areas, 17 cluster organisation indicated an increase of importance in the priority area linked to new production processes, materials and technologies. However, also the other two priority areas are of increasing importance for 10 to 13 cluster organisations (see Figure 23).

Cross-cutting support areas and strategic challenges

Figure 24 shows the results of the survey with regards to the cross-cutting support areas and strategic challenges of the Lithuanian cluster organisations. Most cluster organisations are very highly contributing to the areas of innovation (14 clusters), skill (13 clusters), internationalisation (12 clusters) and digital transition (12 clusters). However, Lithuanian clusters confirm that cross-cutting support areas such as digital transition (18 clusters), and the green transition (17 clusters) will be also of increasing importance. The cross-cutting support area with the most important increase is the field of innovation with 22 clusters confirming the increasing importance followed by value chains and skills (both 19 clusters).

Figure 24: Survey results - Cross-cutting support areas and strategic challenges

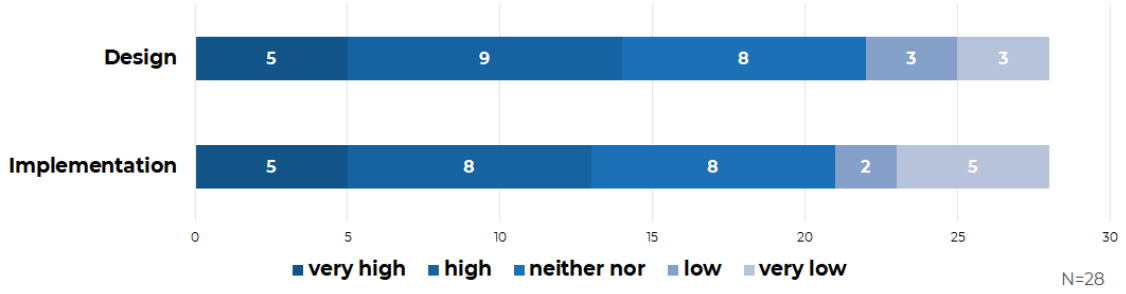


Source: ECCP (2022). Results are based on the self-assessment of Lithuanian cluster organisations.

Involvement of Lithuanian clusters in regional initiatives

Cluster organisations can be involved in regional initiatives such as regional economic governance, policy design and implementation at the regional level. Survey results show that around half of the Lithuanian cluster have been involved to a very high or high extent in the implementation and design of regional initiatives (see Figure 25). Respondents indicated that Lithuanian cluster organisation are very proactive in policy design and that some clusters are involved in working groups of the Ministry of Economy and Innovation, the Ministry of Energy and the Ministry of Environment of the Republic of Lithuania. Other clusters confirm that they have been involved in the development of strategies such as the smart specialisation strategy or the Lithuanian export strategy for the automotive sector. Other clusters have participated in initiatives such as the “Green Lithuania strategy”.

Figure 25: Results of survey - Level of involvement in regional initiatives of Lithuanian clusters in the 2014-2020 funding period



Source: ECCP (2022). Results are based on self-assessment of Lithuanian cluster organisations

Annex

Regional Innovation Scoreboard

Table 2: Key socio-economic and sectoral indicators of Lithuania and the EU

	LT01*	LT02**	Lithuania (LT)	EU
GDP per capita (PPS)	**37,800**	**21,200**	**26,000**	**31,200**
GDP per capita growth (PPS)	**5.77**	**5.52**	**5.86**	**3.21**
Population density	**87**	**37**	**45**	**109**
Urbanisation	**76**	**53.9**	**60.7**	**75.3**
Population size (000s)	**820**	**1,970**	**2,790**	**446,450**
Share of employment in:				
Agriculture & Mining (A-B)	**1.9**	**8.7**	**6.5**	**4.6**
Manufacturing (C)	**11.5**	**18**	**15.9**	**16.4**
Utilities & Construction (D-F)	**8.6**	**10**	**9.6**	**8.2**
Services (G-N)	**70.7**	**57.8**	**62**	**62.9**
Public administration (O-U)	**7.3**	**5.4**	**6**	**7.1**
Average number of employed persons per enterprise	**5.2**	**4.1**	**4.5**	**5.2**

*LT01: Vilnius County
**LT02: Central and Western Lithuania regions

Source: ECCP (2022), own elaboration based on Regional Innovation Scoreboard 2021.

Table 3: Regional Innovation Scoreboard - Vilnius County, Lithuania (LT01)

	Data	Normalised Score	Relative to Lithuania	Relative to EU
Tertiary education	67	1.000	105	174
Lifelong learning	8.1	0.302	116	75
International scientific co-publications	1,832	0.694	145	124
Most-cited-scientific publications	4.8	0.225	87	41
Above average digital skills	32.8	0.567	103	108
R&D expenditures public sector	0.66	0.442	121	91
R&D expenditures business sector	0.64	0.230	164	44
Non-R&D innovation expenditures	+/-	0.617	+/-	+/-
Innovation expenditures per person employed	+/-	0.650	+/-	+/-
Employed ICT specialists	6.4	0.859	224	172
Product innovators	+/-	0.782	+/-	+/-
Business process innovators	+/-	0.835	+/-	+/-
Innovative SMEs collaborating	+/-	0.765	+/-	+/-
Public-private co-publications	209.6	0.514	154	104
PCT patent applications	0.42	0.218	100	35
Trademark applications	10.74	0.792	166	173
Design applications	2.54	0.458	139	80
Employment knowledge-intensive activities	16.6	0.651	174	109
Employment innovative enterprises	+/-	0.776	+/-	+/-
Sales of innovative products	+/-	0.735	+/-	+/-
Air emissions by fine particulates	12.9	0.531	99	108
Average score	--	0.602	--	--
Country EIS-RIS correction factor	--	0.917	--	--
Regional Innovation Index 2021	--	0.552	--	--
RII 2021 (same year)	--	--	125.6	102.7

RII (cf. to EU 2014)	**--**	**--**	**--**	**117.9**
Regional Innovation Index 2014	**--**	**0.328**	**--**	**--**
RII 2014 (same year)	**--**	**--**	**115.9**	**70.1**
RII – change between 2014 and 2021	**--**	**47.8**	**--**	**--**

Source: ECCP (2022), own elaboration based on Regional Innovation Scoreboard 2021.

Table 4: Regional Innovation Scoreboard
Central and Western Lithuania regions, Lithuania (LT02)

	Data	Normalised Score	Relative to Lithuania	Relative to EU
Tertiary education	**49**	**0.801**	**84**	**140**
Lifelong learning	**6.5**	**0.242**	**93**	**60**
International scientific co-publications	**517**	**0.368**	**77**	**66**
Most-cited-scientific publications	**46**	**0.215**	**83**	**40**
Above average digital skills	**32**	**0.549**	**100**	**104**
R&D expenditures public sector	**0.47**	**0.311**	**85**	**64**
R&D expenditures business sector	**0.22**	**0.079**	**56**	**15**
Non-R&D innovation expenditures	**+/-**	**0.615**	**+/-**	**+/-**
Innovation expenditures per person employed	**+/-**	**0.485**	**+/-**	**+/-**
Employed ICT specialists	**1.5**	**0.153**	**40**	**31**
Product innovators	**+/-**	**0.578**	**+/-**	**+/-**
Business process innovators	**+/-**	**0.634**	**+/-**	**+/-**
Innovative SMEs collaborating	**+/-**	**0.463**	**+/-**	**+/-**
Public-private co-publications	**43.6**	**0.234**	**70**	**47**
PCT patent applications	**0.42**	**0.218**	**100**	**35**
Trademark applications	**3.4**	**0.249**	**52**	**54**
Design applications	**0.43**	**0.188**	**57**	**33**

Employment knowledge-intensive activities	**8.1**	**0.223**	**63**	**38**
Employment innovative enterprises	**+/-**	**0.578**	**+/-**	**+/-**
Sales of innovative products	**+/-**	**0.578**	**+/-**	**+/-**
Air emissions by fine particulates	**12.7**	**0.541**	**101**	**110**
Average score	**--**	**0.398**	**--**	**--**
Country EIS-RIS correction factor	**--**	**0.398**	**--**	**--**
Regional Innovation Index 2021	**--**	**0.365**	**--**	**--**
RII 2021 (same year)	**--**	**--**	**83.0**	**67.8**
RII (cf. to EU 2014)	**--**	**--**	**--**	**77.9**
Regional Innovation Index 2014	**--**	**0.218**	**--**	**--**
RII 2014 (same year)	**--**	**--**	**77**	**46.6**
RII – change between 2014 and 2021	**--**	**31.3**	**--**	**--**

Source: ECCP (2022), own elaboration based on Regional Innovation Scoreboard 2021.

Table 5: European Innovation Scoreboard: Lithuania in comparison to Baltic Nations

	Lithuania (LT)	Estonia (ET)	Latvia (LV)
SUMMARY INNOVATION INDEX	**92.1**	**128.3**	**55.9**
Human resources	**112.7**	**136.4**	**76**
Doctorate graduates	42.6	77	19.6
Population with tertiary education	259.5	157	165.3
Lifelong learning	67.8	214.4	72.2
Attractive research system	**59.9**	**117.8**	**59.7**
International scientific co-publications	105	172.8	90.4
Most cited publications	40.8	88.3	39.4
Foreign doctorate students	42.4	109.5	63.2
Digitalisation	**158.7**	**141.8**	**109.1**
Broadband penetration	184.4	130.4	130.4

People with above basic overall digital skills	127.8	155.6	83.3
Finance and support	**73.6**	**109.7**	**29.7**
R&D expenditure in the public sector	66.7	98.2	50.9
Venture capital expenditures	165.1	253.9	22.7
Government support for business R&D	119	24.1	5.8
Firm investments	**85.1**	**115.3**	**32.9**
R&D expenditure in the business sector	29.9	63.8	9.4
Non-R&D innovation expenditures	162.9	220.7	65.1
Innovation expenditures per employee	60.8	109.5	13.8
Use of information technologies	**76.4**	**8.2**	**87.1**
Enterprises providing ICT training	60	80	80
Employed ICT specialists	95.2	233.3	95.2
Innovators	**151.1**	**217.7**	**56.6**
Product innovators (SMEs)	152.4	238.8	59.7
Business process innovators (SMEs)	149.8	199.2	53.8
Linkages	**162.9**	**241.7**	**78.6**
Innovative SMEs collaborating with others	162.4	347.8	66.9
Public-private co-publications	87.4	172.7	88.4
Jon-to-job mobility of HRST	220.5	217.9	79.5
Intellectual assets	**56.5**	**114**	**58.4**
PCT patent applications	14.9	45.6	22.5
Trademark applications	121.4	196.9	109.5
Design applications	29.5	92.8	39.9
Employment Impacts	**91.6**	**150.4**	**53.4**
Employment in knowledge-intensive activities	70.7	113.3	70.7
Employment in innovative enterprises	106.5	176.6	41.2
Sales Impacts	**45.1**	**78.3**	**59.4**

Medium and high-tech goods exports	63.5	66.4	45.3
Knowledge-intensive services exports	4.6	73.1	74.8
Sales of innovative products	68.9	100.3	59.4
Public administration (O-U)	**108.9**	**68.8**	**23.2**
Resource productivity	70.8	25.5	87.4
Air emissions by fine particulate matter	120.2	35.4	0
Environment-related technologies	117	137.3	14.8

Source: ECCP (2022), own elaboration based on Regional Innovation Scoreboard 2021.

Table 6: European Innovation Scoreboard 2021: Lithuania (LT)

	Lithuania (LT)	EU
Performance and structure of the economy		
GDP per capita (PPS)	25,100	30,800
Average annual GDP growth (%)	1.8	-2.5
Employment share Manufacturing (NACE C) (%)	15.9	16.5
of which High and Medium high-tech (%)	15.2	47.9
Employment share Services (NACE G-N) (%)	40.6	41.2
of which Knowledge-intensive services (%)	27.1	35.1
Turnover share SMEs (%)	49.1	36.5
Turnover share large enterprises (%)	32.2	45.7
Foreign-controlled enterprises – share of value added (%)	12.6	11.8
Business and entrepreneurship		
Enterprise births (10+ employees) (%)	1.4	1.0
Total Entrepreneurial Activity (TEA) (%)	11.3	6.7
FDI net inflows (% GDP)	2.6	2.0
Top R&D spending enterprises per 10 million population	0.0	16.2
Buyer sophistication (1 to 7 best)	3.3	3.7
Innovation profiles		

In-house product innovator with market novelties	14.7	10.7
In-house product innovators without market novelties	10.1	12.3
In-house business process innovators	11.2	11.0
Innovators that do not develop innovations themselves	12.4	11.6
Innovation active non-innovators	2.1	3.3
Non-innovators with potential to innovate	15.0	19.9
Non-innovators without disposition to innovate	34.5	31.3
Governance and policy framework		
Ease of starting a business (0 to 100 best)	81.1	76.5
Basic school entrepreneurial education and training	n/a	2.0
Govt procurement of advanced tech. products	3.0	3.5
Rule of law (-2.5 to 2.5 best)	1.0	1.1
Climate change indicators		
Circular material use rate	4.3	11.7
Greenhouse gas emissions intensity of energy consumption	103.4	86.6
Eco-innovation Index	82.0	100.0
Demography		
Population size	2.8	446.7
Average annual population growth (%)	-0.3	0.1
Population density	44.8	108.8

Source: ECCP (2022), own elaboration based on Regional Innovation Scoreboard 2021.

List of cluster organisations in Lithuania

Table 7: Overview of cluster organisations in Lithuania, their sectoral industries and addressed EU industrial ecosystems

N°	Cluster organisation	Industrial Ecosystem
1	SMART food cluster	Agri-food
2	Laser & Engineering Technologies Cluster	Aerospace & Defence
3	Lithuanian Photovoltaic Technology Cluster	Renewable Energy
4	Food Technologies Digitalization LT	Agri-food
5	National Food Cluster Lithuania	Agri-food
6	Lithuanian Social Innovation Cluster (LSIC)	Creative & Cultural Industries
7	Smart Digital Solutions cluster	Digital
8	BCCS (Blockchain Cybersecurity and Compliance Solutions) Cluster	Digital
9	Digital Rocket LT	Digital
10	Maritime cluster	Energy Intensive Industries
11	Health technology cluster iVita	Health
12	Information Technologies in Medicine (MedIT)	Digital
13	Baltic Automotive Components Cluster (BACC)	Mobility-Transport-Automotive
14	Cleantech Cluster Lithuania	Renewable Energy
15	Laser Micromachining Cluster	Electronics
16	Life Sciences Digital Innovation Hub	Health
17	Lithuanian Prefabricated Wooden House Cluster - PrefabLT	Construction
18	Association of Lithuanian Printing Industries	Creative & Cultural Industries
19	LAuGEA cluster (Lithuanian Automotive Export Association)	Mobility-Transport-Automotive

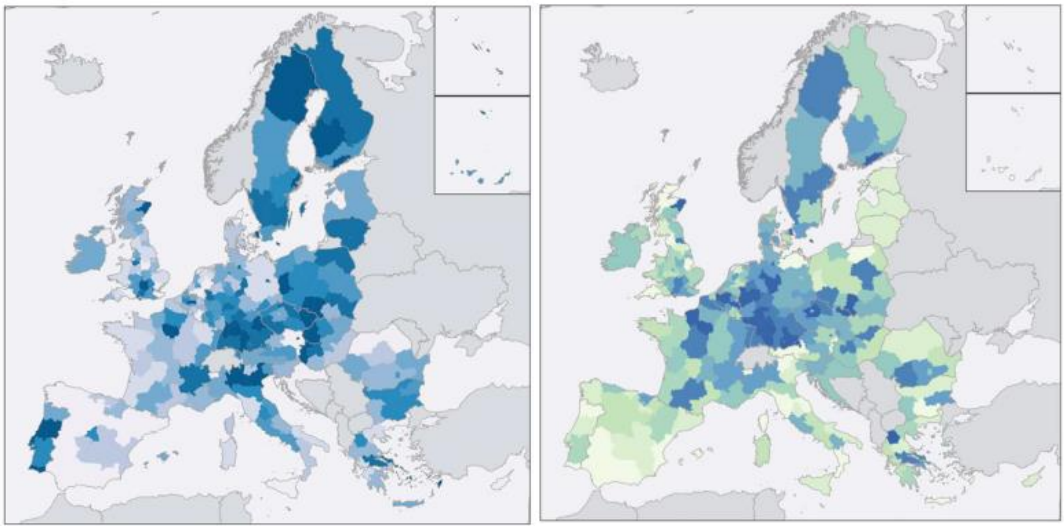
20	Lithuanian Apparel and Textile Industry Association	Textiles
21	Lithuanian Medical Tourism Cluster	Tourism
22	AgriFood Lithuania DIH	Agri-food
23	Baltic Film & Creative Tech Cluster	Creative & Cultural Industries
24	Lithuanian Plastics Cluster	Energy Intensive Industries
25	Lithuanian Laser Association	Electronics
26	Lithuanian Space Association (LSA)	Aerospace & Defence
27	Vilnius Film Cluster	Creative & Cultural Industries
28	Anyksciai Tourism Cluster	Tourism
29	Baltic Furniture Cluster	Construction
30	Biopower Plants Development Cluster	Renewable energy
31	Birzai Tourism Cluster	Tourism
32	DIGITAL LITHUANIA – Lithuanian IT company cluster	Digital
33	EcoIndustria LT	Energy Intensive Industries
34	Cluster of Manufacturing Innovators – CoMI	Digital
35	IT cluster BLASTER	Digital
36	Stem Cell & Regenerative Medicine Innovation Cluster	Health
37	We Are Baltic Cluster	Creative & Cultural Industries
38	National creative industries association	Creative & Cultural Industries
39	Nebula Film & Visual Arts	Creative & Cultural Industries
40	Odontology Innovation Cluster	Health
41	Pamario Tourism Cluster	Tourism
42	Advanced Orthopedics and Rehabilitation Cluster	Health
43	Smart Construction and Real Estate Cluster	Construction
44	International Energy Cluster	Renewable energy

45	**Waynord**	**Digital**
46	**Žemaitija Tourism Cluster**	**Tourism**

Source: ECCP (2022) and own adaptations.

Indicators of cluster strength

Figure 26: Indicators of cluster strength: cluster portfolio strength (share of payroll accounted for by strong clusters) (left) and cluster mix (right)



Source: Ketels & Protsiv (2021): Cluster presence and economic performance: a new look based on European data. Note: Colours refer to deciles of the corresponding variables such that darker colours indicate higher values.

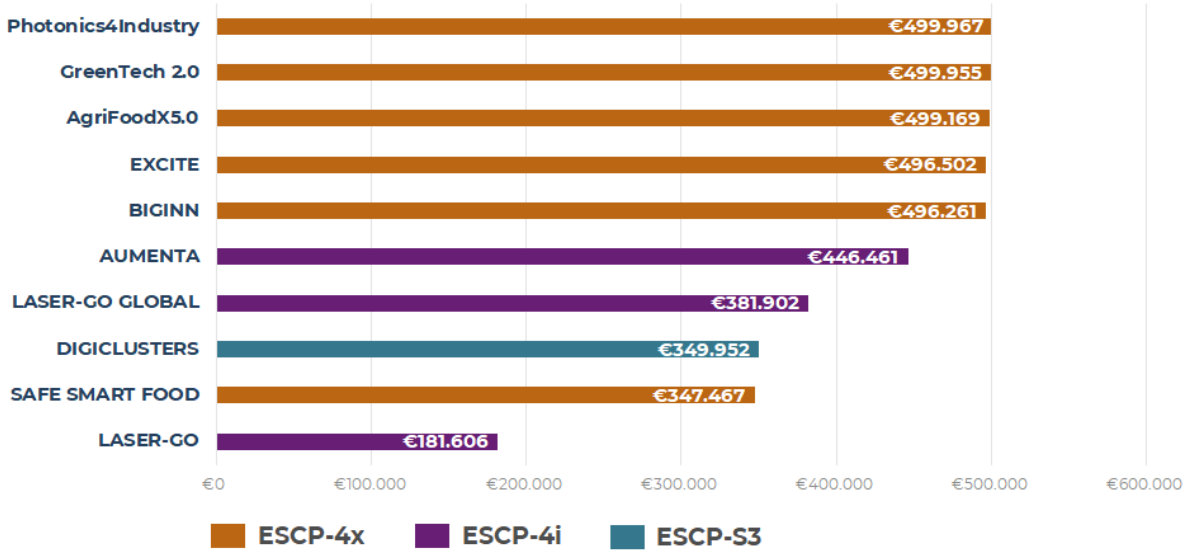
Overview of industrial ecosystems

Figure 27: EU industrial ecosystems based on the European industrial strategy

14 industrial ecosystems are: aerospace and defence, agri-food, construction, cultural and creative industries, digital, electronics, energy intensive industries, energy-renewables, health, mobility – transport – automotive, proximity, social economy and civil security, retail, textile and tourism

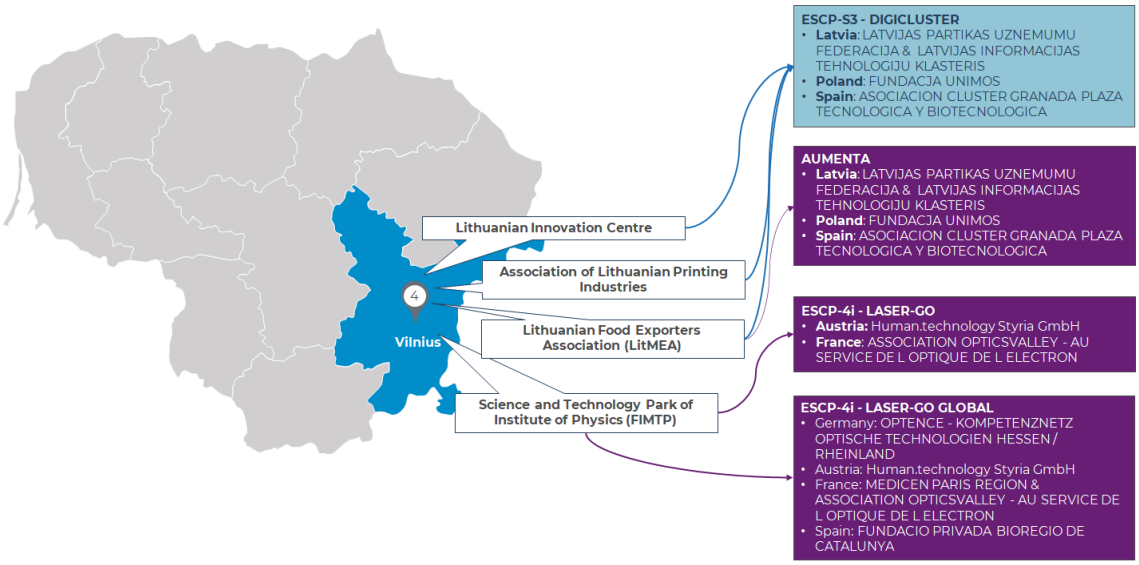
Source: European Commission: https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-industrial-strategy_en

Figure 28: Overview of EU contributions to ESCP projects with participation of Lithuanian clusters



Source: ECCP (2022), own elaboration based on information from COSME data hub (last access on 22.03.2022).

Figure 29: Overview of consortium partners of ESCP-4i and ESCP-S3 projects with participating Lithuanian clusters



Source: ECCP (2022), own elaboration based on information from COSME data hub (last access on 22.03.2022).

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