4 The present and future provision of education in Estonia

Education is the most important service provided by municipalities, comprising half of the expenditures. This chapter discusses the current and future provision of education in Estonia in face of shrinkage, as an example of service network reform. After describing the main features, reforms and trends of the school system, this chapter evaluates whether actual differences in school sizes, resources and expenditure across municipalities align with differences explained by geographic and demographic characteristics. The chapter then offers insights into future policy scenarios of school network adaptation and discusses opportunities and challenges of digital education in rural areas. Finally, the chapter offers a series of recommendations to prepare the education sector for shrinkage, along with policy insights for other service areas stemming from the analyses.

Introduction

Demographic change and depopulation present a challenge for municipalities to adapt their service networks to be more efficient while still providing quality services for all. Across OECD countries, education constitutes one of the largest expenditure items for national and subnational governments (OECD, 2021[1]). Indeed, in Estonia, the education sector represented over 49% of all municipal expenditures in 2019, even greater than economic affairs, culture, social protection and housing services combined (Statistics Estonia, 2021[2]). Furthermore, this share is continuing to increase at a steady pace. As such, municipalities must adapt education services to demographic change as shrinking results in lower municipal revenues.

Today practically all counties of Estonia and most municipalities face the need to re-organise their school networks. The complex decision-making system around school consolidation involving municipalities, the central government and schools to different degrees across educational levels had stalled school consolidation in the past (Santiago et al., 2016[3]). While the need for rationalisation of schools has come to be more accepted by all education stakeholders in the last decade, current difficulties include involving local communities in the restructuring of the school network, finding qualified teachers and ensuring their full workload, and ensuring reorganisation leads to the modernisation of the learning environment.

Available population projections also show that the need for adapting the school network will become more pressing in the next decades. Internationally comparable estimations for 27 EU countries and the United Kingdom (UK) from the European Commission (EC)/OECD report *Access and Cost of Education and Health Services* (2021[4]) showed that already in 2011, Estonia had one of the largest additional costs per student in sparse rural areas in Europe and the largest percentage of students far from schools in sparse rural areas in Europe. By 2035, the number of students in cities is expected to increase, while the number of students in sparse rural areas, villages, towns and suburbs is expected to decrease. These changes mean that Estonia is projected to see the fourth largest increase in annual costs per primary student and the third-largest increase in annual costs per secondary student (OECD/EC-JRC, 2021[4]).

This chapter offers a series of recommendations to align all actors in Estonia around adapting the school network to demographic change while striving to ensure access to high-quality education for all students. Based on the analyses conducted, it also presents insights into other service sectors that also must adapt in the face of shrinkage. The chapter draws mainly from the 2016 OECD School Resources Review of Estonia (Santiago et al., 2016[3]) and an OECD mission questionnaire to focus on the question of school network adaptation and digital transition, with a special focus on rural and suburban areas. The first section of the chapter sets the scene by describing the most relevant elements for adaptation on governance, funding and access. The second describes geographical patterns and trends of the school network, resources (teachers), quality and expenditure, focusing on changes in the last decade and rural-urban differences. The third benchmarks actual data to estimations based on an efficient allocation of schools and teachers to identify areas with potential for policy interventions. The fourth presents more detail on the future projections based on simulated data, including a comparison between policy scenarios for adaptation. The fifth discusses current opportunities and challenges for digital education provision. Finally, the last section presents six policy recommendations for Estonia's consideration.

School network governance, reforms and trends

The basic school network in Estonia is composed of all schools formally licensed by the government and thus entitled to public funding. Estonia makes a distinction between basic schools offering ISCED levels 1 and 2 (Stages I, II and III/Grades 1-9) and higher-level schools offering ISCED level 3 (Grades 10-12), which can be either general or vocational.

Three acts regulate the Estonian school network: i) the Basic Schools and Upper Secondary Schools Act; ii) the Vocational Education Institutions Act; and iii) the Private Schools Act. The Basic Schools and Upper

Secondary Schools Act[1] of 2010 (henceforth the “Schools Act”) provides the legal basis for the formation, functioning and development of the education system. Key educational policies, including school consolidation and digitalisation, are contained in the “Education Strategy 2021–2035”, a follow-up of the Estonian Lifelong Learning Strategy 2020. In relation to education adaptation to demographic change, the most relevant goals in the strategy include:

- “to define more clearly the distribution of responsibilities at the level of upper secondary education by giving more responsibilities to the government and continuing the consolidation of the network of upper secondary schools”
- “to mandate local authorities to ensure the provision of basic education close to home at least at the first and second stage of basic school. In regions with declining populations, concentrate the provision of lower secondary education to larger centres, providing, where appropriate, services to support participation, such as transport”
- “to support regional development and offer special solutions for regions that need a boost to development, including collaboration between educational institutions and local companies”.

The central government has taken concrete steps to achieve these goals in the past years, including ensuring there is a state gymnasium offering high-quality general secondary education and at least one optimised basic school in each county. The central government is also in the process of defining and implementing regional education centres to better co-ordinate higher education actors in counties. Moreover, the central government has been encouraging the cross-use of basic public education infrastructure, including infrastructure for digital learning. The reminder of this section discusses institutional aspects related to education responsibilities and provisions on access to schools.

Governance and funding

The current governance scheme of the educational system comprises three levels: the national government (represented by the Ministry of Education and Research), municipal governments and educational institutions (schools/school principals). Among their main responsibilities, schools have a high degree of autonomy in school-related decisions including hiring and firing of teachers and are in charge of managing the school budget. In turn, the main responsibilities of municipalities include providing and managing all pre-primary education and most of the basic education, and establishing, re-arranging and closing general education schools. Finally, the national government is in charge of funding education and providing it at the upper secondary level (Table 4.1) (Santiago et al., 2016[3]).

Associations of local authorities created after the disappearance of county governments are another actor in education provision with co-ordination responsibilities. Currently, 15 associations of local authorities (1 national and 14 regional) that represent their members’ interests in relations with central authorities are in charge of promoting co-operation between municipalities. These associations also have the role of co-ordinating discussions and actions towards the improvement of education provision, including co-ordinating discussions about school network reorganisation strategies at the county level.

On funding, the Schools Act stipulates that school managers are responsible for covering school’s running costs, which in practice means this responsibility lies with municipalities using funding received from the central government and other sources. Municipalities receive funding based on the number of students they serve in municipal schools, so funds depend on students’ place of study and not their place of residency. The Private Schools Act ensures similar subsidies for current expenditure are made available to private general education schools. In 2018, 62% of current expenditure on basic education from private institutions (30.1 million out of 48.5 million) was covered by government funding sources, 61% of which went to cover staff compensation and 7.5% to capital expenditure. Importantly, to preserve the autonomy of municipalities’ decisions, the allocation cannot include conditionality provisions on how the municipality spends the funds.

Table 4.1. Distribution of education responsibilities in Estonia

Level	Responsibilities
Education institutions (schools/school principals)	• Hire and dismiss staff • Manage the school budget • Adapt the national curriculum to the local context
National government	• Fund primary and secondary education • Manage an information system on local and school-level processes • Oversee inspection services • Define student learning objectives • License education providers • Provide education (at the upper secondary level)
Municipalities	• Manage all public provision of pre-primary education, most general education provision and a small share of vocational education provision • Fund municipal schools • Establish, re-arrange and close general education schools • Keep account of the number of compulsory attending children • Ensure school attendance control • Make arrangements for school transport and the provision of school meals • Ensure the quality of their education services, including the planning of services, provision of support to schools, quality assurance, maintenance and development of infrastructure • Manage human resources (including wage-setting and hiring and firing of teachers) • Invest in municipal school buildings

Source: Author's elaboration based on Santiago, P. et al. (2016[3]), *OECD Reviews of School Resources: Estonia 2016*, https://dx.doi.org/10.1787/9789264251731-en.

Funding formulas have historically included coefficients to account for geographical differences in class sizes attached to the size and remoteness of municipalities. Between 2008 and 2014, the per capita formula was calculated based on efficiency criteria. Since 2014, municipalities with a small number of students receive a funding supplement on top of the per student funding through a fixed coefficient applied to teachers' salaries to ensure small municipalities can pay wages close to the national average. The state budget support for teachers' salaries at the basic school level amounted to more than EUR 20 million in the last school year.

The decentralised setting of responsibilities in Estonia means the central government does not have direct decision power over school closures. Instead, the Ministry of Education and Research can resort to funding incentives promote concentration if it aligns with its objectives. Since 2014, any savings derived from school consolidation remain within the municipality and should be used to pay teachers' wages. Additionally, as provisioned in the Schools Act, since 2018, the beginner's allowance for teachers has been mainstreamed and extended to all municipalities.[2] Municipalities facing teacher shortages may offer other incentives such as financial incentives or accommodation.

Provisions on access to school

According to the Schools Act, rural municipalities are mandated to provide all students with educational opportunities and arrange transport or compensate for the student's travel expenses if these are not already covered as per the public transport act (e.g. by the use of public buses).

Since 2018, travelling by bus in Estonia is free within most countries and is partly financed from the state budget. According to the 2015 Public Transport Act, public transport planning in Estonia requires a certain level of multi-level governance co-operation as transport is managed by rural municipalities and city councils, rural municipalities and city governments, the Estonian Road Administration and the national government. The co-ordination of rural public transport services is, however, the responsibility of local authority bodies.

The Schools Act also establishes 60-minute maximum travel times for at least 80% of basic school students. According to the Schools Act, municipalities are in charge of organising school transport to ensure access to basic schools as needed. To ensure accessibility of the youngest students, consolidation efforts in basic education have focused mostly on lower secondary education and is manifested in many cases in a lower grade offer per school instead of a school closure.

While the Schools Act stipulates that the number of upper secondary schools must align with student numbers to adapt to demographic change, it also includes a provision for the central government to maintain at least one upper secondary school per county. Accordingly, the government's strategy has been focused on investing in high-quality basic schools and gymnasia (upper secondary schools) using European Union (EU) Structural Funds (which amounted to EUR 332 million in the last funding round) together with local funds.

Basic and upper secondary education trends

In 2020, the school network in Estonia encompassed 512 schools, including 354 basic schools and 158 general education schools offering upper secondary education. The large majority of schools are owned by municipalities (420 out of 512) and a small percentage are private (59 schools) or owned by the state (33 schools). The school network served about 150 000 pupils in 2020/21, 75% of which reside in urban areas according to the national classification of settlements.[3]

This section discusses school network trends with a focus on geographical differences. It first focuses on student, teacher and school trends and evaluates the pace of consolidation in basic and upper secondary across degrees of urbanisation. It then discusses geographical differences in quality outcomes and school resources across administrative units and by degree of urbanisation (see Box 4.1). Finally, the section focuses on expenditure trends, including levels and changes in wages across municipalities.

School network geographical distribution and trends

In aggregate terms, the number of students declined steadily in the 2000s and started to grow again in 2013 (Figure 4.2). According to the national classification of settlements, pupil-to-teacher ratios are higher in cities and small towns (13.3 and 13.1) than in rural areas (9.1). Across countries, pupil-to-teacher ratios varied from 8.5 in Hiiu County to 12.1 in Tartu in 2019/20. Available internationally comparable data for 2018 shows that student-to-teacher ratios in Estonia are smaller in rural schools compared to city schools by about 4 students per teacher, the fifth-largest difference across 30 OECD countries (OECD, 2021[1]; OECD, 2020[7]). Similarly, class sizes were around 10 students per class smaller in rural schools compared to city schools, the fourth largest difference among 30 OECD countries.

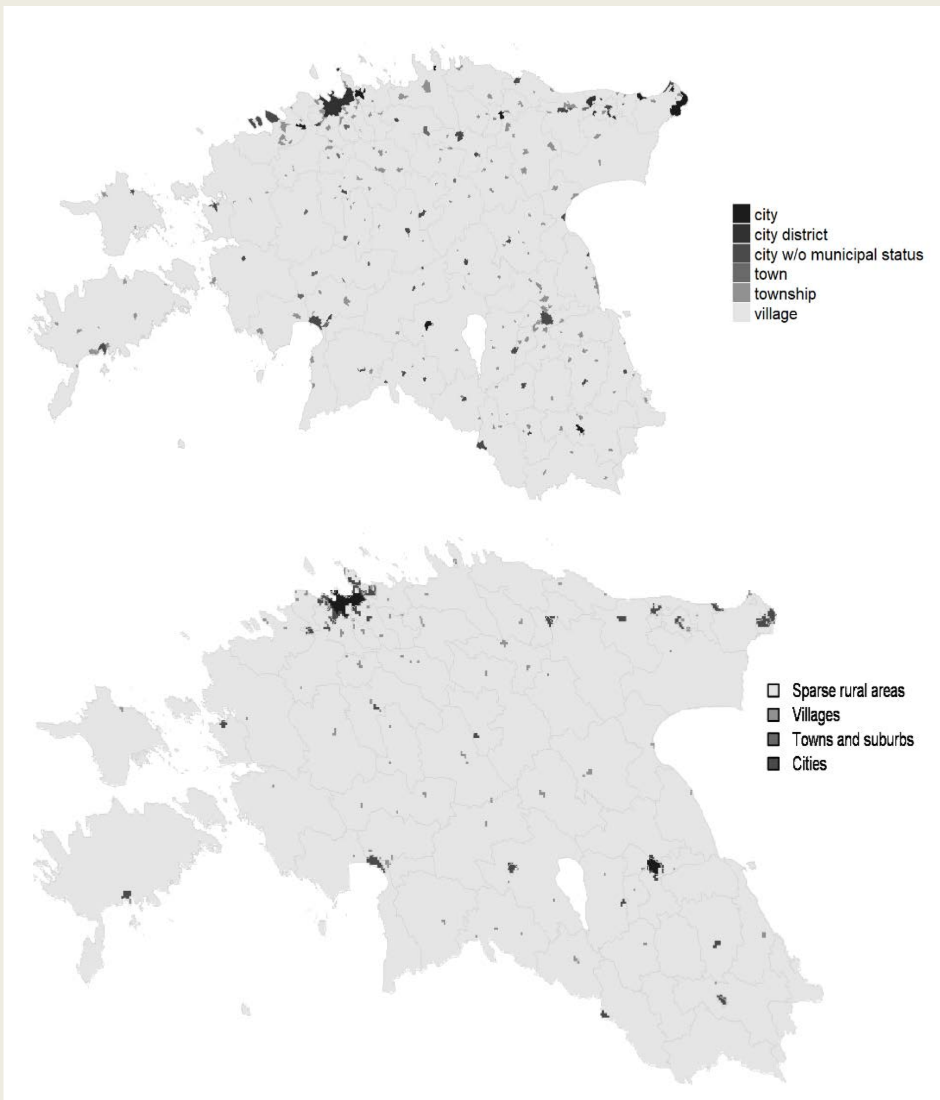
Still, in 2020 the network served 57 080 fewer students compared to 2000. Before 2012, the rate of decline in the number of teachers was slower than the rate of decline in student numbers. After 2012 when student numbers started to increase, the number of teachers tended to increase at a similar pace. In contrast, the decline in the number of schools has been fast even in periods of expansion in the number of students. However, these aggregated figures are not per full-time equivalent (FTE) and consequently also include part-time teachers.

While the consolidation of schools picked up pace in 2013, it recently slowed down in line with higher demand, especially in urban areas. Already between 2005 and 2013, 9% of schools – including 78 general education municipal schools – were closed, while a number of other schools were restructured or merged (Santiago et al., 2016[3]). By 2020, there were 173 fewer schools compared to 2000. Meanwhile, the number of teachers has not changed as fast: available data shows there were only 530 fewer teachers in 2020 compared to 2005, even though the number of students decreased by 18 718 students in the period. This means there has on average 1 teacher less for every 35 fewer students in the network.

Box 4.1. Classifying settlements based on their degree of urbanisation

The analysis in this chapter makes use of the degree of urbanisation classification, as it is particularly useful to disentangle different types of settlements in rural areas. This classification, based on 2015 population data, is also compatible across the globe and is suitable for international comparisons, as it does not rely on administrative borders and uses the same criteria for all countries (see Annex 4.A for details). For instance, according to the national classification illustrated in Figure 4.1, the largest part of the territory of Estonia is classified as a "village". The degree of urbanisation classification also has a "village" category but distinguishes this type of small clustered settlement from sparse rural areas that have the lowest density levels (less than 50 persons per km^2).

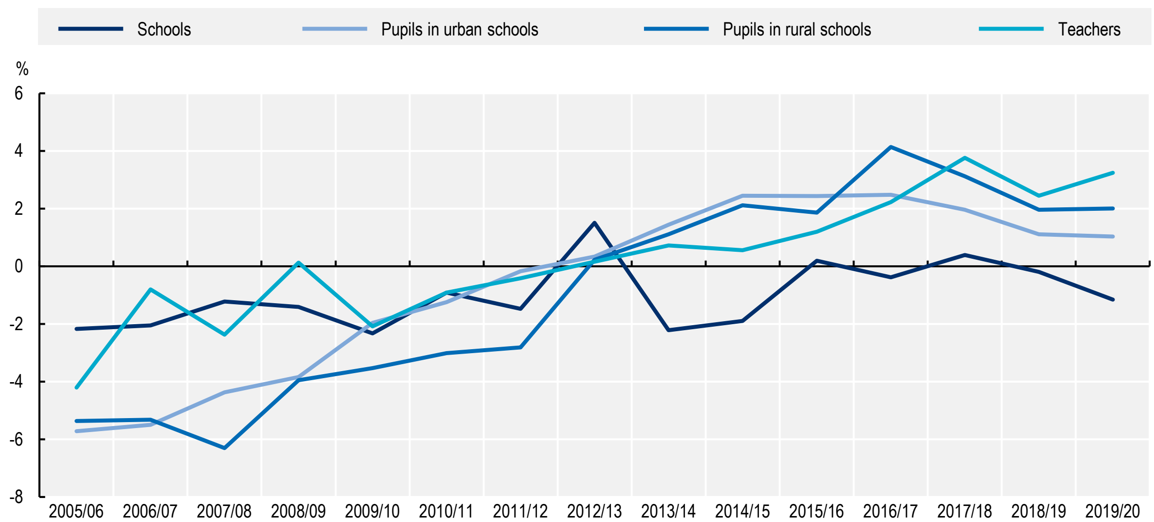
Figure 4.1. Classification of settlements according to their degree of urbanisation, Estonia



Note: See Annex 4.A for a definition of the degree of urbanisation areas. Municipal borders in light grey.
Source: Geoportal (2021[5]), *Administrative and Settlement Division*, https://geoportaal.maaamet.ee/eng/Spatial-Data/Administrative-and-Settlement-Division-p312.html (accessed on 1 February 2021) and authors' elaboration based on the GHSL database.

According to the national classification of settlements, pupil-to-teacher ratios are higher in cities and small towns (13.3 and 13.1) than in rural areas (9.1). Across countries, pupil-to-teacher ratios varied from 8.5 in Hiiu County to 12.1 in Tartu in 2019/20. Available internationally comparable data for 2018 shows that student-to-teacher ratios in Estonia are smaller in rural schools compared to city schools by about 4 students per teacher, the fifth-largest difference across 30 OECD countries (OECD, 2021[1]; OECD, 2020[6]). Similarly, class sizes were around 10 students per class smaller in rural schools compared to city schools, the fourth largest difference among 30 OECD countries.

Figure 4.2. Change in schools, pupils in rural and urban schools, and teachers, 2005-20



Note: Year-on-year growth rates. Rural-urban split between pupils based on national settlements classification.
Source: Author's elaboration based on data from Statistics Estonia (2021[7]), *General Education*, https://www.stat.ee/en/find-statistics/statistics-theme/education/general-education (accessed on 20 August 2021).

Across degrees of urbanisation, sparse rural areas concentrate slightly more than one-third of all students (34%), about three-quarters of all schools (73%) and 4 out of 10 teachers in basic education. In comparison to schools in towns and suburbs and cities, schools in sparse rural areas have about six students less per class and about three students less per teacher. Both smaller average school sizes and a smaller proportion of students to teachers in these areas reflect the presence of a higher share of small schools. At the same time, the share of teachers with qualifications is 4 percentage points below in sparse rural areas (82%) compared to towns and suburbs (86%) (Table 4.2). It is worth noting that the sparse rural classification of some schools located at the fringes of urban areas may not accurately reflect the situation in 2020, as the degree of urbanisation classification used 2015 population data and suburbanisation has advanced rapidly in the past years.

In contrast, schools in sparse rural areas concentrate less than one-quarter of students in general schools offering all educational levels and upper secondary schools (21%), while the largest share of students in this level attends schools located in cities (42%) and towns and suburbs (31%). Unlike basic schools, the proportion of students to teachers in upper secondary schools is similar across types outside cities. Still, class sizes are smaller in sparse rural areas compared to other areas, with a gap of 15 students per class with respect to towns and suburbs.

School-level figures for 2011 and 2020 by the degree of urbanisation show that most school closures accrued upper secondary schools outside sparse rural areas, in line with decreased demand and the ongoing upper secondary consolidation. In sparse rural areas, where demand for upper secondary education increased (by 1 808 additional students), there was in fact 1 school less for every 904 additional students. At the same time, the number of teachers expanded so in these areas there was 1 additional teacher for every 29 additional students. Meanwhile in villages, where the number of upper secondary students dropped (by 1 559 fewer students), the change in teachers was more aligned with the decline in students.

Table 4.2. Distribution of schools, teachers and schools by degree of urbanisation, 2020

Degree of urbanisation	Schools	Share (%)	Students	Share (%)	Teachers	Share (%)	Students/ teachers	Average number of students in classes	Share of teachers with qualification (%)
	Basic education (ISCED 1 and 2)								
Sparse rural areas	260	73	44 793	34	4 627	40	9.7	11.0	82
Villages	12	3	8 744	7	744	6	11.8	14.5	85
Towns and suburbs	42	12	35 543	27	2 818	25	12.6	17.1	86
Cities	40	11	41 824	32	3 275	29	12.8	17.2	84
Total	**354**		**130 904**		**11 464**				
	Upper secondary education (ISCED 3)								
Sparse rural areas	50	32	4 972	21	423	23	11.8	18.6	89
Villages	17	11	1 415	6	131	7	10.8	20.7	89
Towns and suburbs	37	23	7 387	31	559	31	13.2	33.7	90
Cities	54	34	9 814	42	689	38	14.2	25.7	92
Total	**158**		**23 588**		**1 803**				

Note: Degree of urbanisation classification based on 2015 data. Teachers refer to FTE equivalent teachers. ISCED 3 schools include schools offering ISCED level 3 education and possibly other levels.
Source: Author's elaboration based on data from Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*, and EC (2021[9]), *GHSL - Global Human Settlement Layer – GHS-SMOD*, https://ghsl.jrc.ec.europa.eu/download.php?ds=smod (accessed on 1 February 2021).

Table 4.3. Change in school, students and teachers by educational level and degree of urbanisation, 2011-20

Degree of urbanisation	Change in schools	Change in students	Change in teachers	Change in student-to-pupil ratio
	Basic education (ISCED 1 and 2)			
Sparse rural areas	15	18 930	1 620	1.1
Villages	**-3**	**-3768**	-301	-0.2
Towns and suburbs	8	1 462	167	-0.2
Cities	13	3 350	543	-1.3
Total	33	19 974	2029	-0.3
	Upper secondary education (ISCED 3)			
Sparse rural areas	**-3**	1 808	59	3.0
Villages	**-19**	**-1559**	**-170**	0.9
Towns and suburbs	**-23**	**-583**	**-177**	2.3
Cities	**-20**	**-1252**	**-211**	1.6
Total	**-65**	**-1586**	**-499**	2.0

Note: Degree of urbanisation classification based on 2015 data. Negative values are indicated in bold. Teachers refer to FTE equivalent teachers. ISCED 3 schools include schools offering ISCED level 3 education and possibly other levels.
Source: Author's elaboration based on data from Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*, and EC (2021[9]), *GHSL - Global Human Settlement Layer – GHS-SMOD*, https://ghsl.jrc.ec.europa.eu/download.php?ds=smod (accessed on 1 February 2021).

Basic schools – particularly those in sparse rural areas – concentrated most of the increase in students in the last decade. In sparse rural areas, the increase of 18 930 more students in 2011-20 was met with previous schools and 15 new schools (on average 1 new school for every 1 262 additional students). In contrast, cities added 3 350 students in the period and there was on average one new school for every 66 additional students in cities. Most of the 33 basic schools added to the school network between 2011 and 2020 were located in sparse rural areas (15 schools) and cities (13 schools). Out of 33 additional basic schools, 18 were private schools (including all 8 new schools in Tallinn).

Geographical differences in school resources and quality

While pupil-to-teacher ratios have remained stable at the national level in the last decade, they have decreased in some rural municipalities and generally increased in upper secondary education. Nationally, the pupil-to-teacher ratio in general schools changed from 12.2 in 2010/11 to 12.0 in 2019/2020, with the largest reductions in Hiiu (10.1 to 8.5) and Jõgeva (10.8 to 9.4) Counties. The concentration of upper secondary schools resulted in around 3 more students per teacher in sparse rural areas and 2.2 more students per teacher in cities. Currently, pupil-to-teacher ratios range from 8.5 pupils-per-teacher in Hiiu County to 12.1 pupils-per-teacher in Tartu. Internationally comparable data for 2017 shows that Estonia has pupil-to-teacher ratios in lower secondary education below the OECD average, slightly higher ratios for upper secondary education and similar ratios for primary education (OECD, 2021[1]).

Table 4.4. Population density, pupil-to-teacher ratios and education quality indicators by county, 2018

	Population density	Pupil-to-teacher ratio	PISA average test results	Share of repeaters in general education (%)	Share of discontinuers in general education (%)
Hiiu	9.09	8.5	523	1.2	1.0
Lääne	11.30	9.1	549	2.9	2.1
Järva	11.33	9.4	505	1.9	2.4
Pärnu	15.86	9.6	518	1.8	1.6
Jõgeva	11.29	9.8	507	1.4	1.8
Võru	12.90	9.9	527	1.5	1.7
Valga	14.80	10.2	506	2.5	1.7
Lääne-Viru	16.05	10.4	507	1.5	2.0
Viljandi	13.56	10.7	522	2.6	1.6
Saare	11.27	10.8	547	1.4	2.2
Rapla	12.045	11.0	512	1.9	1.5
Ida-Viru	45.85	11.5	493	0.6	1.5
Põlva	13.71	12.1	518	1.6	1.1
Tartu	45.67	12.1	531	1.4	1.3
Harju	138.23	13.4	534	1.0	1.4

Note: Students over FTE number of teachers in 2019/20 based on teachers' workload. Data of teachers and pupils are as of 10 November 2018. All general education schools plus teachers and pupils in general education classes of two vocational educational schools considered. All teachers and pupils regardless of the forms and methods of study. Includes only teachers with valid contracts except for teachers whose contract has been temporarily suspended (e.g. teachers on maternity leave). Pupil-to-teacher ratios include all teachers and class teachers plus school heads, head teachers and support specialists who are involved in teaching, and all teachers and pupils regardless of the forms and methods of study.

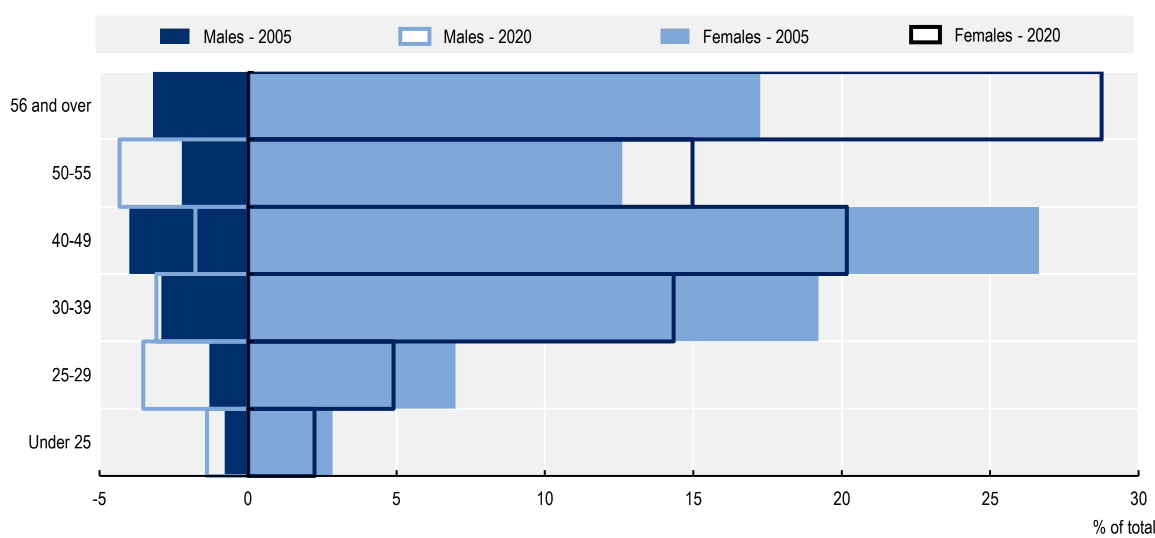
Source: Author's elaboration based on data from Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*, OECD (2020[6]), *PISA 2018 Results (Volume V): Effective Policies, Successful Schools*, https://dx.doi.org/10.1787/ca768d40-en, Statistics Estonia (2021[10]), *Main Demographic Indicators*, http://andmebaas.stat.ee/ (accessed on 8 February 2021) and Statistics Estonia (2021[7]), *General Education*, https://www.stat.ee/en/find-statistics/statistics-theme/education/general-education (accessed on 20 August 2021).

Available data on education quality by county as measured by the OECD Programme for International Student Assessment (PISA) 2018 test scores reveals a low correlation between population density and pupil-to-teacher ratios at the county level on the one hand and PISA test scores on the other. In fact, counties with a significant share of the rural population such as Lääne on the west coast and the island of Saare had the highest average scores in the country, above the average scores of Harju and Tartu where density levels are much higher. The largest and most persistent difference in PISA across schools in Estonia is between schools in Ida-Viru County and the rest. According to the diagnosis of the Ministry of Education and Research, the lack of a sufficient number of teachers meeting Estonian language requirements has slowed down quality improvements in Ida-Viru.

On the other hand, with the exception of Hiiu, counties with lower pupil-to-teacher ratios and lower population density display higher than average shares of repeaters and dropouts in general education. Lääne and Saare, two counties with low population density, had higher shares of repeaters and discontinuers compared to the national average in 2018, although they had higher than average PISA scores in the same year. These results suggest a correlation between indicators of student motivation and a larger share of small/remote schools.

Despite the large volume of teachers, many municipalities face new teacher shortages. A much higher proportion of principals in Estonian schools reported facing teacher shortages compared to the OECD average (44% versus 27%) (OECD, 2020[6]). National data also shows that more rural counties have a smaller percentage of teachers aged 30 or younger in basic education: young teachers in counties with a population density of 12 inhabitants per km^2 represented only 5.7% of teaching staff, almost 10 percentage points less than in the more urbanised counties of Tartu (15.1) and Harju (13.8). The problem of teaching shortages is linked to ageing staff, as currently, over 50% of teachers are 50 years or older (Figure 4.3).

Figure 4.3. Age and gender distribution of teachers in Estonia, 2005 and 2020



Source: Author's elaboration based on Statistics Estonia (2021[7]) (2021), *General Education*, https://www.stat.ee/en/find-statistics/statistics-theme/education/general-education (accessed on 20 August 2021).

Geographical differences and trends in education expenditure

In Estonia, total school spending per pupil in general education, which includes running costs such as school staff salaries and information and communication technology (ICT) equipment, steadily increased in the last decades to reach USD PPP 7 462 in 2017. Available internationally comparable data for 2016 shows Estonia spends less on average than OECD countries at all levels of education (OECD, 2021[1]).

Data for 2011 showed Estonia spent more on capital and less on wages as a share of total expenditure than OECD countries, as a result of high pupil-to-teacher ratios, low wages and high levels of investment on modernising the upper secondary school network (Santiago et al., 2016[3]). In 2018, 66% of total expenditure in basic education accrued to staff compensation.

More recent data for 2014-19 at the municipal level shows that nominal expenditure per capita grew in all municipalities, linked to an increase in wages across all areas and work categories (Table 4.5). Nominal expenditure per capita and wages grew by 9.1% and 8.3% in cities, faster than in towns and suburbs (8.2%) and rural areas (8.6% and 8.7%). Small geographical differences in wages may be linked to similar levels of satisfaction with wages between teachers in rural and urban schools. Internationally comparable data for 2018 showed that the level of satisfaction with wages among teachers in rural schools was not significantly different to the level of satisfaction of teachers in cities (OECD, 2021[1]).

Table 4.5. Municipal expenditure in education per capita and average wages of teachers, support staff and school heads by degree of urbanisation, 2014-19

Degree of urbanisation (LAU2)	Expenditure per capita 2019	Standard deviation	Change 2014-19 (%)	Wages teachers 2019	Standard deviation	Change 2014-19 (%)	Wages support staff 2019	Standard deviation	Change 2014-19 (%)	Wages school principals 2019	Standard deviation	Change 2014-19 (%)
Cities	384	95	9.1	1 647	51	8.3	1 472	98	11.9	2031	265	6.9
Towns and suburbs	465	78	8.2	1 508	118	8.2	1 313	566	9.8	1 851	226	6.4
Rural areas	537	125	8.6	1 513	132	8.7	1 173	542	8.6	1 699	306	7.2

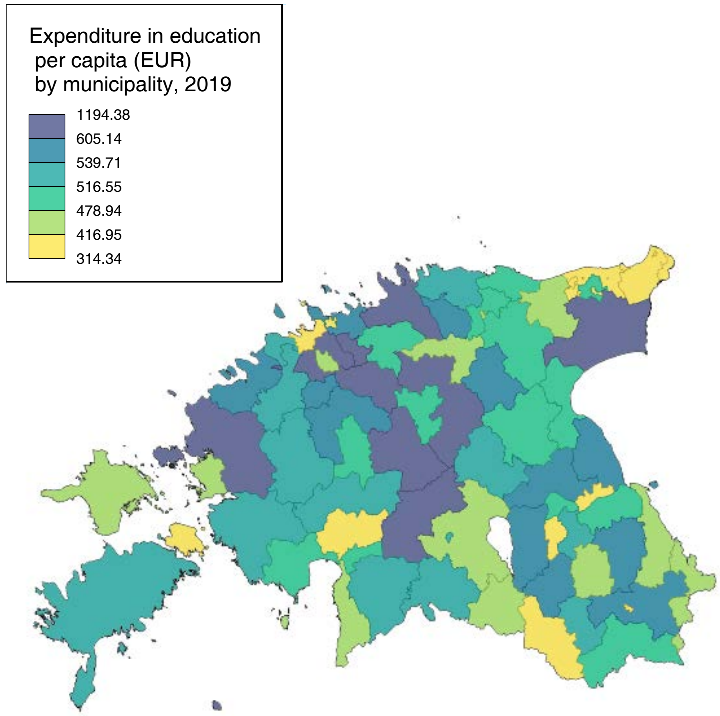
Note: Teachers include all class teachers and teacher and support specialists (special educator, social pedagogue, speech therapists, school psychologist) and school management staff (school principal, head of studies) who are involved in teaching. The degree of urbanisation classification at the municipality level relies on 2011 population grid and 2016 local administrative unit (LAU) boundaries.
Source: Author's elaboration based on Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)* and Eurostat (2021[11]), *Degree of Urbanisation (DEGURBA)*, https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/population-distribution-demography/degurba (accessed on 1 February 2021).

While the wage gap between rural and city municipalities is small, wage levels vary more widely across rural municipalities than in other municipality types. Nominal wages in cities – that do not take into account geographical differences in the cost of living – are on average only EUR 134 higher in cities compared to rural areas. Current transfer policies may be behind this alignment. On the other hand, rural municipalities have a much higher variation in average wages, especially for support staff that can have wages as low as EUR 700 below and as high as EUR 145 above compared to support staff in cities.

Across municipalities, expenditure per capita in 2019 varied from EUR 314 in Tallinn to over EUR 1 000 in central and border rural municipalities with sparse populations (Figure 4.4). Nevertheless, the rate of increase of per capita expenditure between 2014 and 2019 has a regional component, with a large proportion of municipalities in Northern and Central Estonia experiencing the largest average increases and municipalities in Northern, West and Southern Estonia experiencing the lowest increases (Figure 4.5).

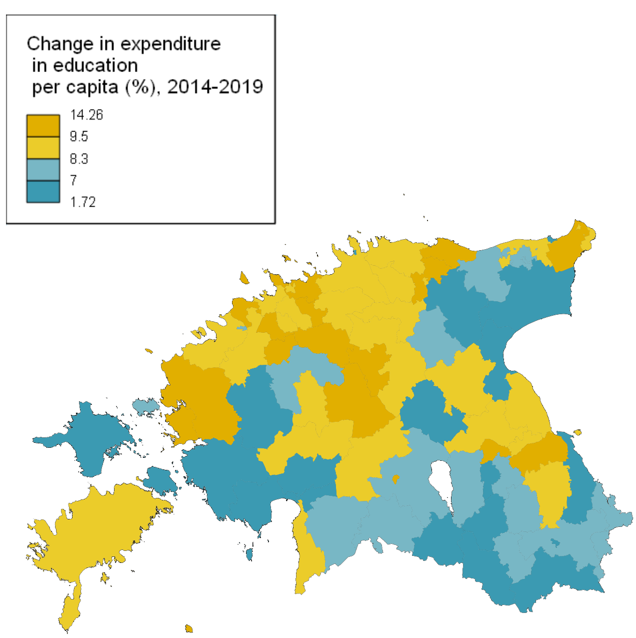
In summary, the education system in Estonia has achieved high quality and equity in provision combined with efforts to increase efficiency. The biggest challenge in maintaining this balance in the future is the strong generational inertia on teaching staff that has at the same time prevented downsizing teaching staff and created shortages of new teachers, especially in rural areas. The redistribution mechanisms in place seem to accomplish the goal of ensuring wages in rural areas remain aligned with national averages, although the incentives for school consolidation through funding for teaching staff may have led to over-dispersion in compensation across municipalities.

Figure 4.4. Expenditure in education per capita by municipality, 2019



Note: Expenditure in nominal values. Values binned by quantiles.
Source: Author's elaboration based on Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*.

Figure 4.5. Change in expenditure in education per capita by municipality, 2014-19



Note: Change calculated as compound annual growth rate.
Source: Author's elaboration based on Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*.

Benchmarking school sizes, resources and expenditure

Are actual differences in school sizes, resources and expenditure across municipalities aligned with what can be expected based on geographic and demographic differences? This section benchmarks 2011 actual school sizes, school resources (teachers) and expenditure to estimates based on the allocation model used in (OECD/EC-JRC, 2021[4]). For comparative purposes, the analysis in this section focuses on basic schools for the school sizes and resources parts and all general schools (primary and secondary in the estimations) for the expenditure part. Annex 4.B describes the data processing and estimation approach in more detail.

For the purpose of the comparative analysis in this section, schools are grouped into two categories: primary encompassing ISCED level 1 schools (Stages I and II/Grades 1-12) and secondary schools encompassing schools offering ISCED levels 2 and 3 (Grades 7-12).

Benchmarking school sizes and resources

The comparison of actual versus estimated resources (teachers per 100 students) and school sizes (students per school) across municipalities reveals that most municipalities classified as towns and suburbs have schools that are larger and less staffed than expected. On average, towns and suburbs municipalities have 0.7 fewer teachers per 100 students and 30 students per school more than what the estimations suggest (Table **4.6**).

Table 4.6. Differences between actual and simulated values on teachers per student, students per school and share of students coming from another municipality

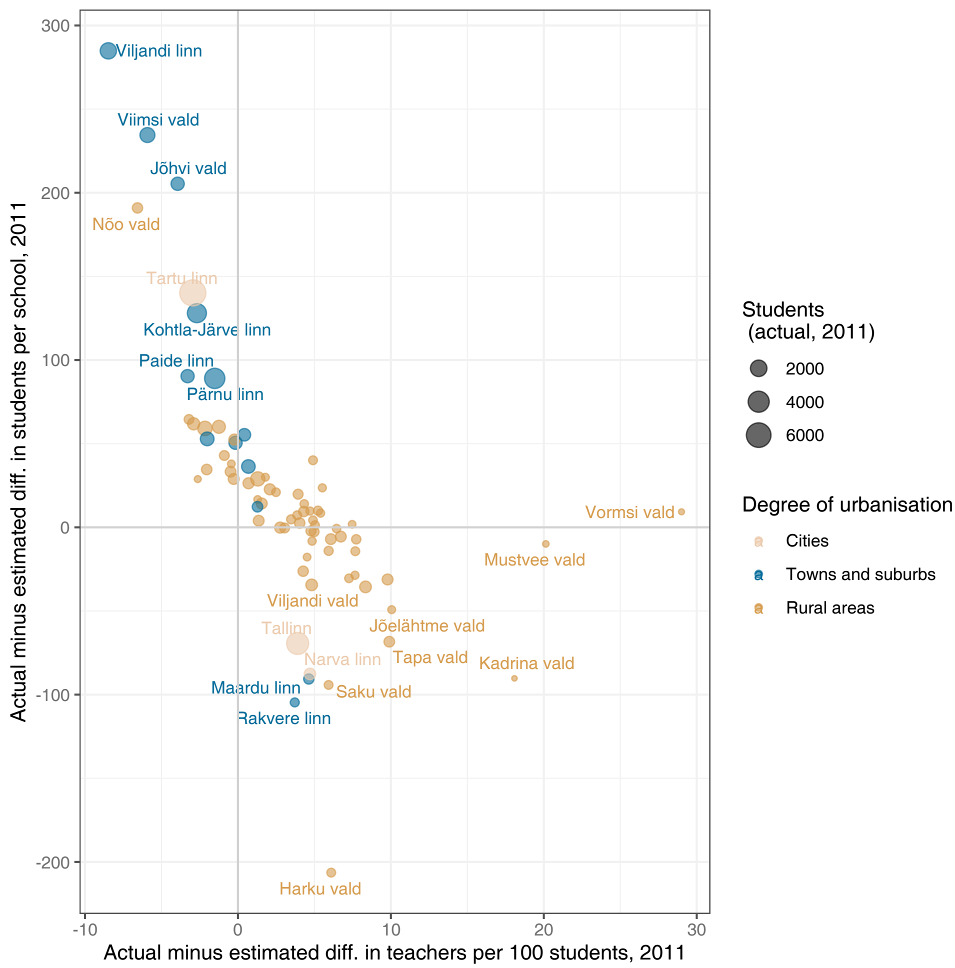
Degree of urbanisation (LAU2)	Actual minus estimated difference in teachers per 100 students	Actual minus estimated difference in students per school, 2011	Actual minus estimated % of students coming from outside the municipality
Cities	1.9	-5.6	0.8
Towns and suburbs	-0.7	30.2	-17.0
Rural areas	5.5	3.7	-3.5

Note: Based on 2011 data. Basic schools only. Degree of urbanisation classification based on 2011 data. Degree of urbanisation based on classification at the municipality level.
Source: Author's elaboration based on Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*, OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*, and Eurostat (2021[11]), *Degree of Urbanisation (DEGURBA)*, https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/population-distribution-demography/degurba (accessed on 1 February 2021).

Within the group of towns and suburbs municipalities, some seem to have shortages of both schools and teachers, while others seem to be operating under a smaller scale compared to their potential. Towns and suburbs municipalities serving a relatively large number of students including Nõo, Pärnu and Viimsi show more rationing in terms of teachers per student and larger scale in terms of students per school compared to the estimation. On the contrary, a number of non-urban municipalities close to cities – especially those in North Estonia close to Tallinn (Harku, Keila and to a lower extent Saku) have a smaller size compared to the estimations.

On the other hand, rural municipalities have on average 5.5 more teachers per every 100 students and around 4 students more per school than expected. The picture for municipalities is split between rural municipalities operating schools at a larger size and with a smaller teaching staff than expected (top left corner) and small rural municipalities with a smaller scale and an excess of teachers for the size of their student population. This includes municipalities such as the island of Vormsi and Mustvee in Jõgeva County that have at least 20 more teachers per every 100 students compared to the estimations.

Figure 4.6. Comparison of actual versus estimated students per school and teacher per students in basic schools, 2011



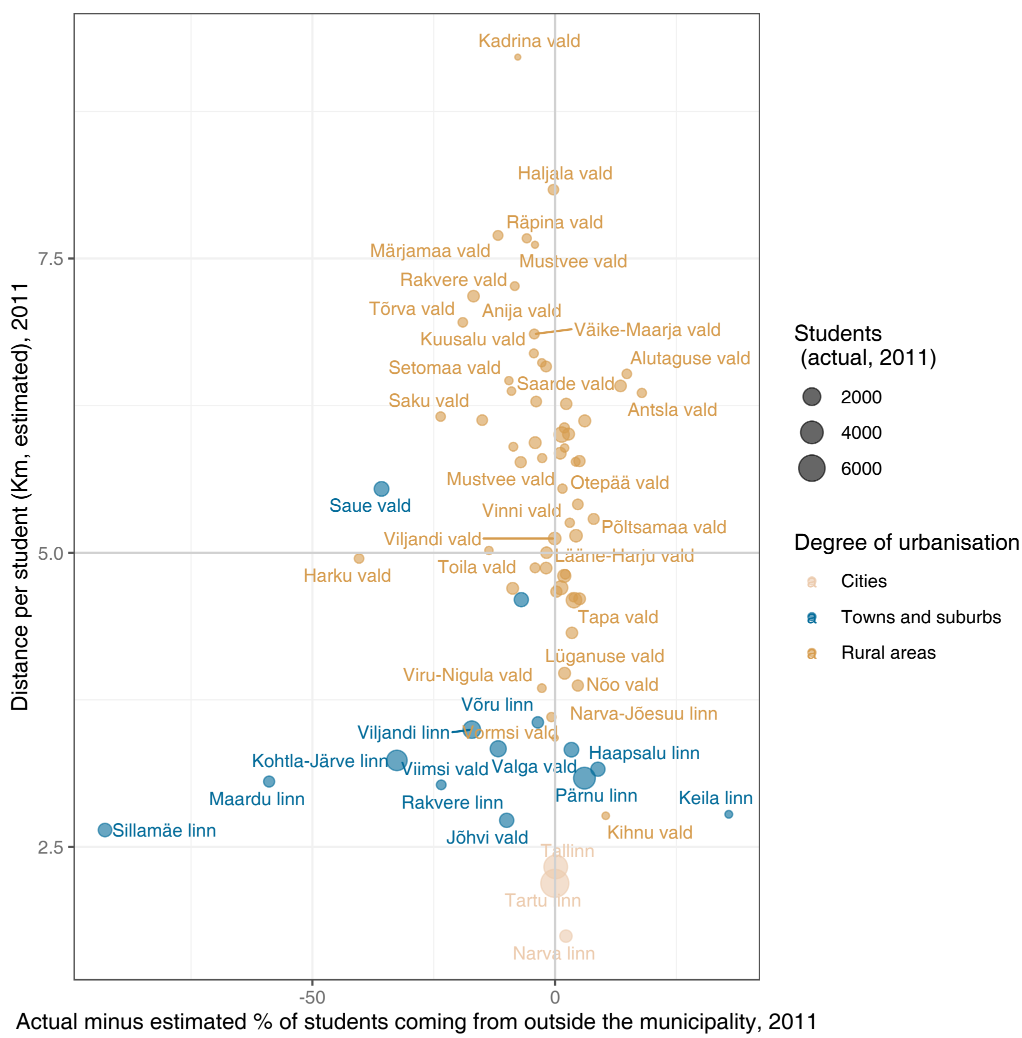
Note: Degree of urbanisation classification based on 2011 data. Basic schools are schools offering ISCED levels 1 and 2. See Annex 4.B for details. Excludes two observations for visual purposes (Ruhnu island, values -20 and 66 and Keila linn, values -621 and 8).

Source: Author's elaboration based on Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*, OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*, and Eurostat (2021[11]), *Degree of Urbanisation (DEGURBA)*, https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/population-distribution-demography/degurba (accessed on 1 February 2021).

Part of the issues with smaller than expected school sizes may have to do with a low level of mobility across municipalities. It may be possible that students who could cross a municipal border to attend a school closer to them than in their municipality are not doing so. As the simulations do not impose any geographical restrictions on school choice and also do not consider quality differences across schools, both issues may be behind the observed differences.

The comparison shows that a number of towns and suburbs municipalities have a much smaller share of students coming from another municipality than expected, even when the distances that students travel to get to schools in those places from other municipalities is relatively small (i.e. below 5 km) (Figure 4.7). The most extreme cases are the urban municipalities of Sillamäe in Ida-Viru and Maardu in Harju, where the difference between the actual and estimated share of students coming from another municipality is 50 percentage points or more. What is more, growing municipalities such as Harku and Saku – that were shown before to have fewer students than expected – may also have the potential to have more students from other municipalities.

Figure 4.7. Actual and estimated share of students coming from another municipality versus distance per student, 2011

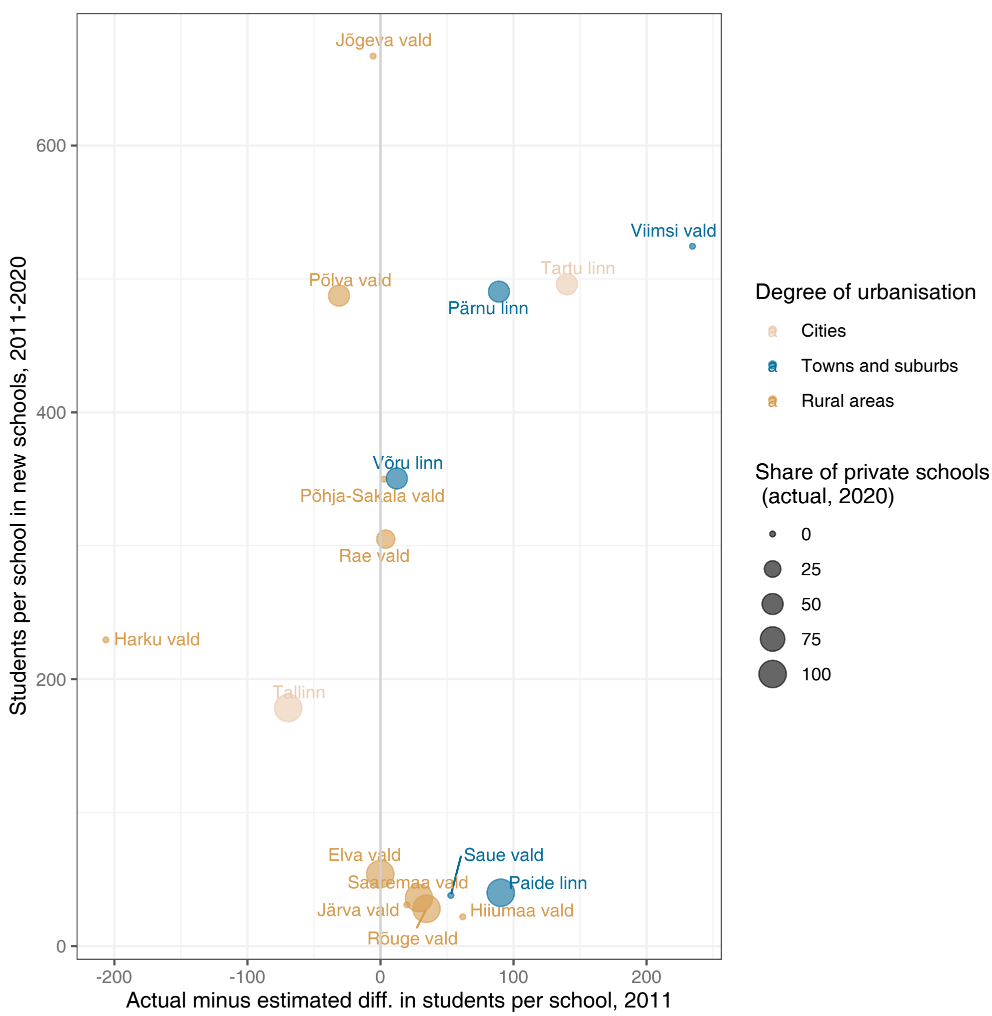


Note: Degree of urbanisation classification based on 2011 data. Basic schools are schools offering ISCED levels 1 and 2. See Annex 4.B for details. Excludes one observation for visual purposes (Ruhnu island, values -100 and 9.8).
Source: Author's elaboration based on Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*, OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*, and Eurostat (2021[11]), *Degree of Urbanisation (DEGURBA)*, https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/population-distribution-demography/degurba (accessed on 1 February 2021).

Benchmarking new schools

A relevant question at this point is whether additional schools have been built in areas with school deficits and/or where demand grew in the last decade. This is the case for Viimsi (two new public schools), Pärnu and Tartu (each with one new public school and one new private school), where new schools came to supply increased demand in the last decade (Figure 4.8). Additional schools appeared in other suburban municipalities including Rae (two new public schools and one new private school) and Harku (two new public schools) that did not show excess capacity in the 2011 benchmark but experienced sharp increases in demand in the last decade.

Figure 4.8. Actual minus estimated students per school versus students in additional schools, 2011-20

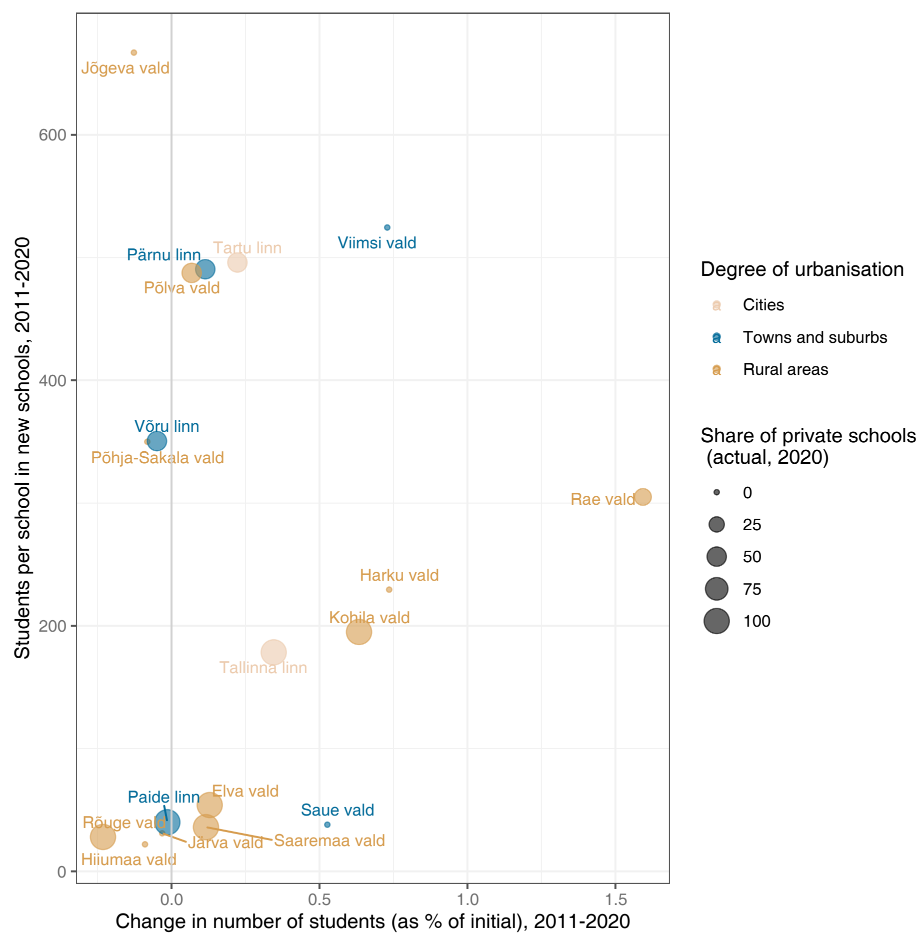


Note: Based on 35 additional schools in 2011-20. Students in basic schools only. Degree of urbanisation classification based on 2015 data. Basic schools are schools offering ISCED levels 1 and 2. See Annex 4.B for details.

Source: Author's elaboration based on Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*, OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*, and EC (2021[9]), *GHSL - Global Human Settlement Layer - GHS-SMOD*, https://ghsl.jrc.ec.europa.eu/download.php?ds=smod (accessed on 1 February 2021).

On the other hand, the supply of additional schools in some rural municipalities does not seem to align with increased demand in the past decade or differences identified in the benchmark to estimated values. This is the case of Jõgeva and Viljandi that had fewer students per school in 2011 than expected and also experienced a decline in student numbers in 2011-20. In both cases, the additional school was a public school (Figure 4.9). In some cases, however, the construction of a new school was accompanied by the closure of one or more schools, so the total number of schools did not grow.

Figure 4.9. Change in number of students versus students in additional schools, 2011-20



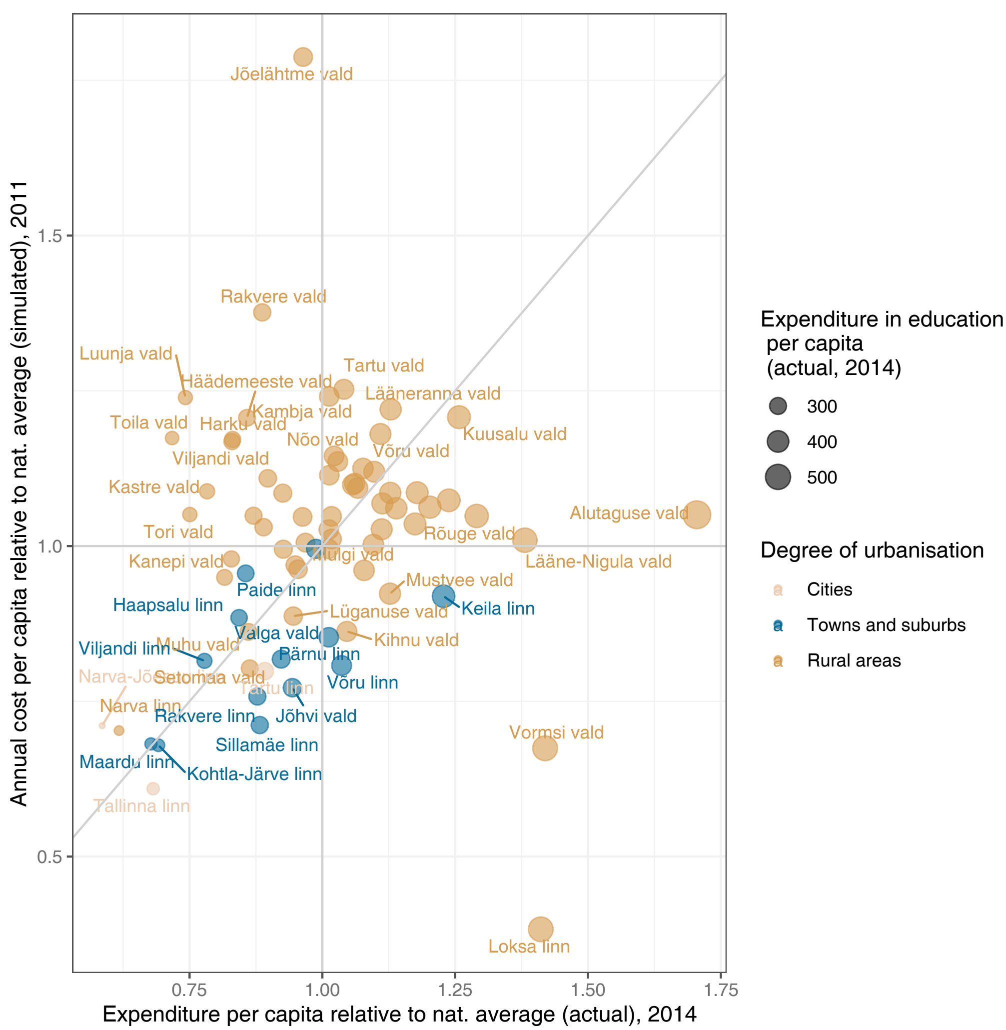
Note: Degree of urbanisation classification based on 2015 data. Basic schools are schools offering ISCED levels1 and 2. See Annex 4.B for details.
Source: Author's elaboration based on Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*, OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*, and EC (2021[9]), *GHSL - Global Human Settlement Layer - GHS-SMOD*, https://ghsl.jrc.ec.europa.eu/download.php?ds=smod (accessed on 1 February 2021).

Benchmarking expenditure

A final question that could be explored with the simulated data is whether the funding per municipality correspond to what could be expected if the allocation was guided by unavoidable costs arising from geographic and demographic factors.

Figure 4.10 compares differences with respect to the national average in expenditure per capita (X-axis) versus estimated annual cost per capita based on simulated school placements (Y-axis). Compared to the benchmark of being aligned with the national average, a number of municipalities mostly classified as cities, towns and suburbs (left bottom quadrant and close to the 45 degree line) have lower than average expenditure per capita according to both the actual data and the simulated data. Similarly, a number of rural municipalities such as Kuuslu (top right quadrant and close to the 45 degree line) have levels above the national average according to both the simulated and actual data.

Figure 4.10. Expenditure per capita (actual) versus annual costs per capita (estimated) relative to national average by municipality, 2011 and 2014



Note: Degree of urbanisation classification based on 2015 data. Annual cost includes the sum of estimated expenditure in all simulated schools (primary and secondary) based on 2011 population information. Expenditure in education includes expenditure for all educational levels in 2014.
Source: Author's elaboration based on Statistics Estonia (2021[10]), *Main Demographic Indicators*, http://andmebaas.stat.ee/ (accessed on 8 February 2021), Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*, OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*, and EC (2021[9]), *GHSL - Global Human Settlement Layer - GHS-SMOD*, https://ghsl.jrc.ec.europa.eu/download.php?ds=smod (accessed on 1 February 2021).

Nevertheless, the majority of municipalities (42 out of 79) (left top quadrant) have higher than average annual costs per capita according to the simulated data but lower than average expenditure per capita according to the actual data. The most extreme case is Jõelähtme in Harju County, which has annual costs per capita 78% above the national average but actual expenditure per capita 4% below the national average. Opposite to these cases are 32 municipalities that have larger expenditure per capita than what would be predicted based only on unavoidable costs of smallness and remoteness, with significant deviations (more than 10 percentage points) in only 18 cases. These include some small and remote rural municipalities (including some small islands) to which funding may have been allocated based on remoteness criteria.

The analysis in terms of total expenditure shares shows that expenditure allocation across municipalities largely corresponds to what could be expected from an allocation based on unavoidable costs driven by geography and demography. As Figure 4.11 shows, the shares of total expenditure in towns and suburbs and rural municipalities largely correspond to the shares of total costs (i.e. most observations lie close to the 45 degree line). By this measure, most rural municipalities seem to have a smaller share of total expenditure than what would be predicted by their unavoidable costs of smallness and remoteness, while a small group of municipalities including Rae and Viimsi seem to have higher shares than expected.

In summary, current spatial differences in demand patterns in Estonia may require three different strategies: i) focus on improving efficacy and efficiency in the use of school resources in remote areas with low access; ii) increasing the scale of provision of schools in suburban municipalities with underutilised potential to alleviate congestion in areas with fast-growing demand; and iii) increase provision in growing urban and suburban municipalities with a strategic and common planning vision. At the same time, current expenditure in education shares generally reflects the needs of municipalities facing unavoidable costs of smallness and remoteness. The next section discusses how this assessment holds when considering future population projections.

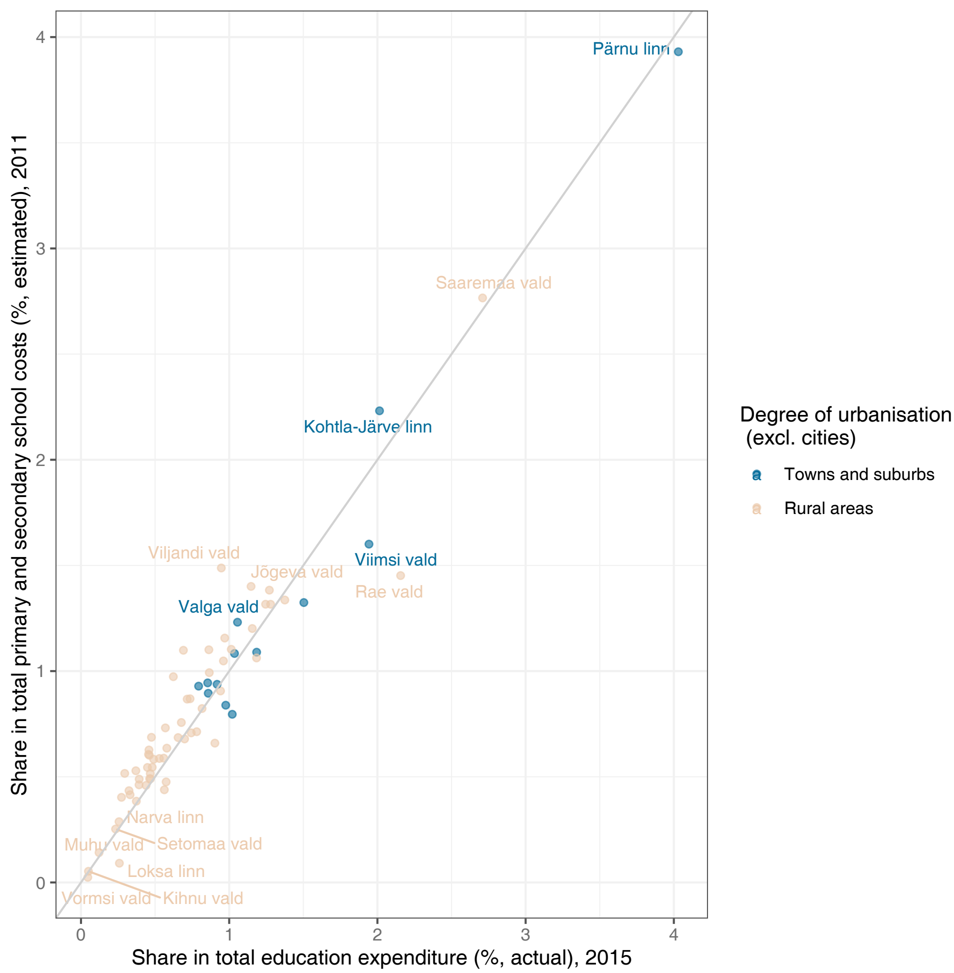
Future policy scenarios

Available population projections for Estonia show that, by 2035, the number of primary and secondary students is projected to decrease by 13% (-0.6% annually) and 2% (-0.07% annually). These changes will happen unevenly across degrees of urbanisation. Student numbers will increase in cities and decrease in sparse rural areas and villages and to a lesser extent in towns and suburbs. This section reviews how the number of schools, school resources (teachers), costs and distance would change following these trends under three policy scenarios:

1. What if the school network in 2035 responded efficiently to new demand levels? (i.e. the school network to 2035 is set up according to 2035 student numbers or the "2035 students/2035 schools" scenario).
2. What if the present school network is kept intact in the future? (i.e. keeping the same 2011 school network in 2035 or the "2035 students/2011 schools" scenario).
3. What if the 2011 school network remains the same in 2035 but student-to-teacher ratios increase by three more students everywhere (the "larger pupil-to-teacher ratio" scenario)?

The results of this section are based on simulated school placements for 2011 and 2035 following the method outlined in the OECD/EC-JRC report (2021[4]). While the 2021 network would have been much preferred as a baseline, the available simulated data only includes data for 2011 and 2035. Unlike the previous sections, results are aggregated by primary (ISCED level 1, ages 5-11) and secondary education (ISCED levels 2 and 3, ages 12-18).

Figure 4.11. Share in annual costs (estimated) versus share in total education expenditure (actual) by municipality, 2011 and 2014



Note: Degree of urbanisation classification based on 2015 data. Excludes municipalities classified as cities for visual purposes. Annual cost includes the sum of estimated expenditure in all simulated schools (primary and secondary) based on 2011 population information. Expenditure in education includes expenditure for all educational levels in 2014.

Source: Author's elaboration based on Estonian Ministry of Education and Research (2021[8]), *Estonian Education Information System (EHIS) (database)*, , Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*, and EC (2021[9]), *GHSL - Global Human Settlement Layer - GHS-SMOD*, https://ghsl.jrc.ec.europa.eu/download.php?ds=smod (accessed on 1 February 2021).

By degree of urbanisation and schools

By 2035, Estonia is projected to have a lower absolute number of students and also a different distribution of the remaining students. Compared to a policy that adapts the 2035 school network to serve the new demand, a policy that preserves the 2011 school network leads to higher increases in annual costs outside cities and smaller increases in distances in sparse rural areas. The effect of decreased demand is nevertheless felt even if the school network adapts, especially in sparse rural areas where small schools will have to remain open to ensure adequate access. This is also reflected in smaller annual changes in schools compared to annual changes in students. On the other hand, the spatial changes in future demand imply the need for a simultaneous fall in the number of teachers outside cities and an increase in the number of teachers in cities to match the pace of changes in the number of students.

An alternative to adapting the school network is to increase school efficiency. The results show that increasing student-to-teacher ratios by three more students per teacher reduces annual costs per student in all types of areas but more strongly in more urbanised areas. In this way, annual costs in sparse rural areas would increase by 0.49% annually until 2035 if the 2011 school network remains the same but they would decrease by 0.03% annually if the number of students per teacher increases everywhere.

Table 4.7. Changes in students, schools, teachers, distance and annual costs per student by degree of urbanisation and educational level, 2011-35

	Change in students (%)	Change in schools (%, annual)	Change in teachers (annual, %)		Change in distance per student (km)		Change in annual costs per student (%, annual)		
Scenario		2035 schools/ 2035 students	2035 schools/ 2035 students	2011 schools/ 2035 students	2035 schools/ 2035 students	2011 schools/ 2035 students	2035 schools/ 2035 students	2011 schools/ 2035 students	Larger pupil-to-teacher ratio
	Primary education (ISCED 1)								
Sparse rural areas	-1.7	-0.9	-1.7	-1.5	0.20	0.39	7.3	12.6	-0.7
Villages	-1.0	-0.2	-0.9	-1.3	-0.07	0.23	3.3	5.3	-10.2
Towns and suburbs	-1.0	-0.7	-1.0	-0.9	-0.03	-0.04	1.2	2.1	-14.2
Cities	0.5	0.4	0.5	0.4	-0.04	-0.06	-0.1	-0.6	-16.6
	Secondary education (ISCED 2 and 3)								
Sparse rural areas	-2.0	-1.2	-2.0	-1.8	0.26	0.57	2.1	4.8	-14.1
Villages	-1.8	-0.8	-1.7	-1.4	-0.17	0.48	2.7	2.4	-16.3
Towns and suburbs	-0.3	0.3	-0.2	-0.7	-0.31	0.10	2.6	1.8	-16.9
Cities	1.3	0.9	1.3	1.3	-0.23	-0.44	-0.1	-1.8	-19.3

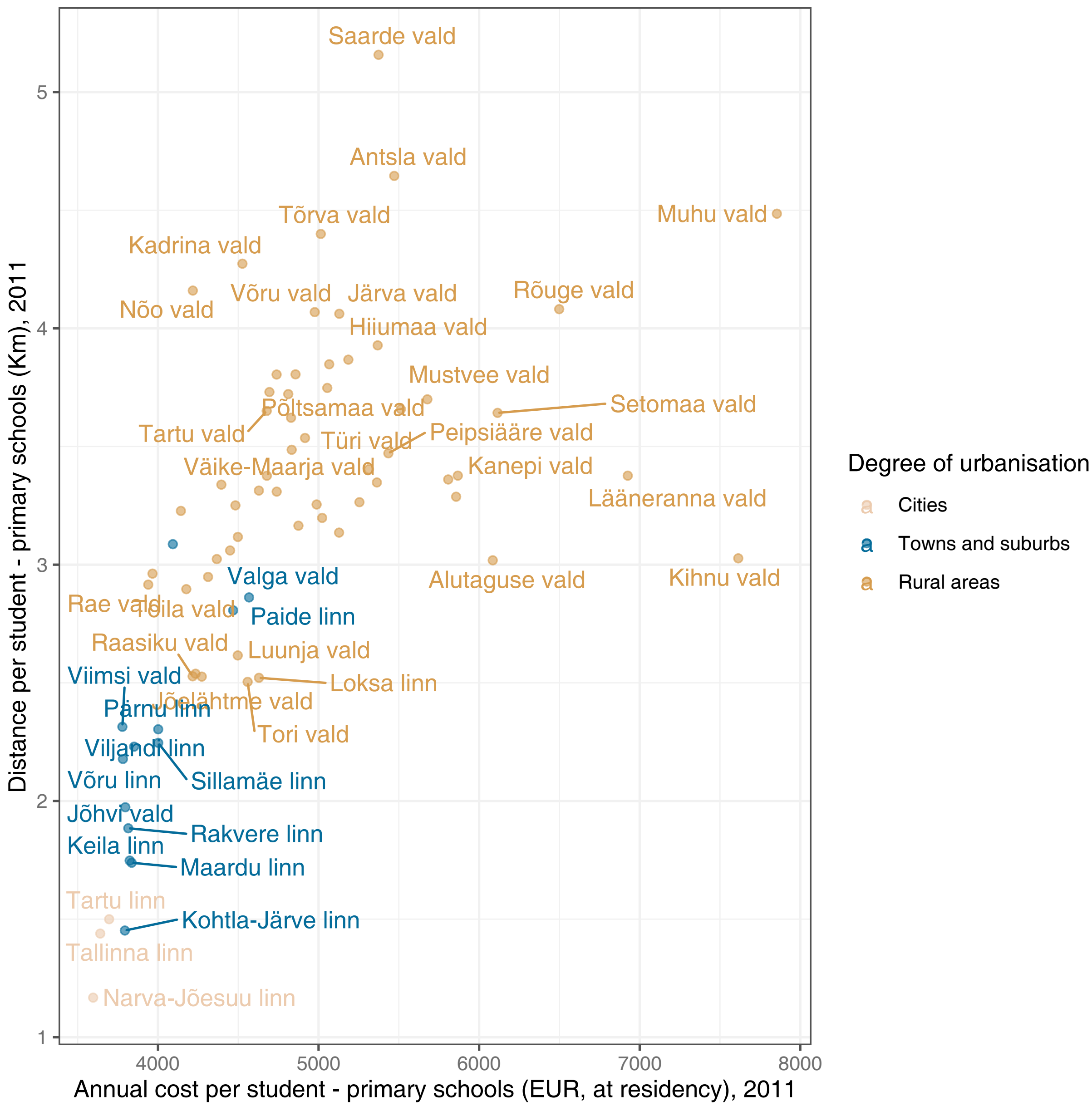
Note: Degree of urbanisation classification based on 2015 data. Change measured by compound annual growth rates.
Source: Author's elaboration based on OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*, and EC (2021[9]), *GHSL - Global Human Settlement Layer - GHS-SMOD*, https://ghsl.jrc.ec.europa.eu/download.php?ds=smod (accessed on 1 February 2021).

Importantly, not adapting the school network does not necessarily mean distances to schools remain the same in the future. In fact, under the no consolidation scenario, the most remote primary and secondary schools are further away compared to the present (2011) and school network adaptation scenarios (see Annex 4.C). This is because present schools do not necessarily have the best location in terms of access for future students, given the expected changes in the spatial distribution of students. Generally, when seen from the perspective of schools, the scenario of no school network adaptation leads to more dispersion in costs, with some schools reaching annual costs more than four times higher than the average.

By municipalities and counties

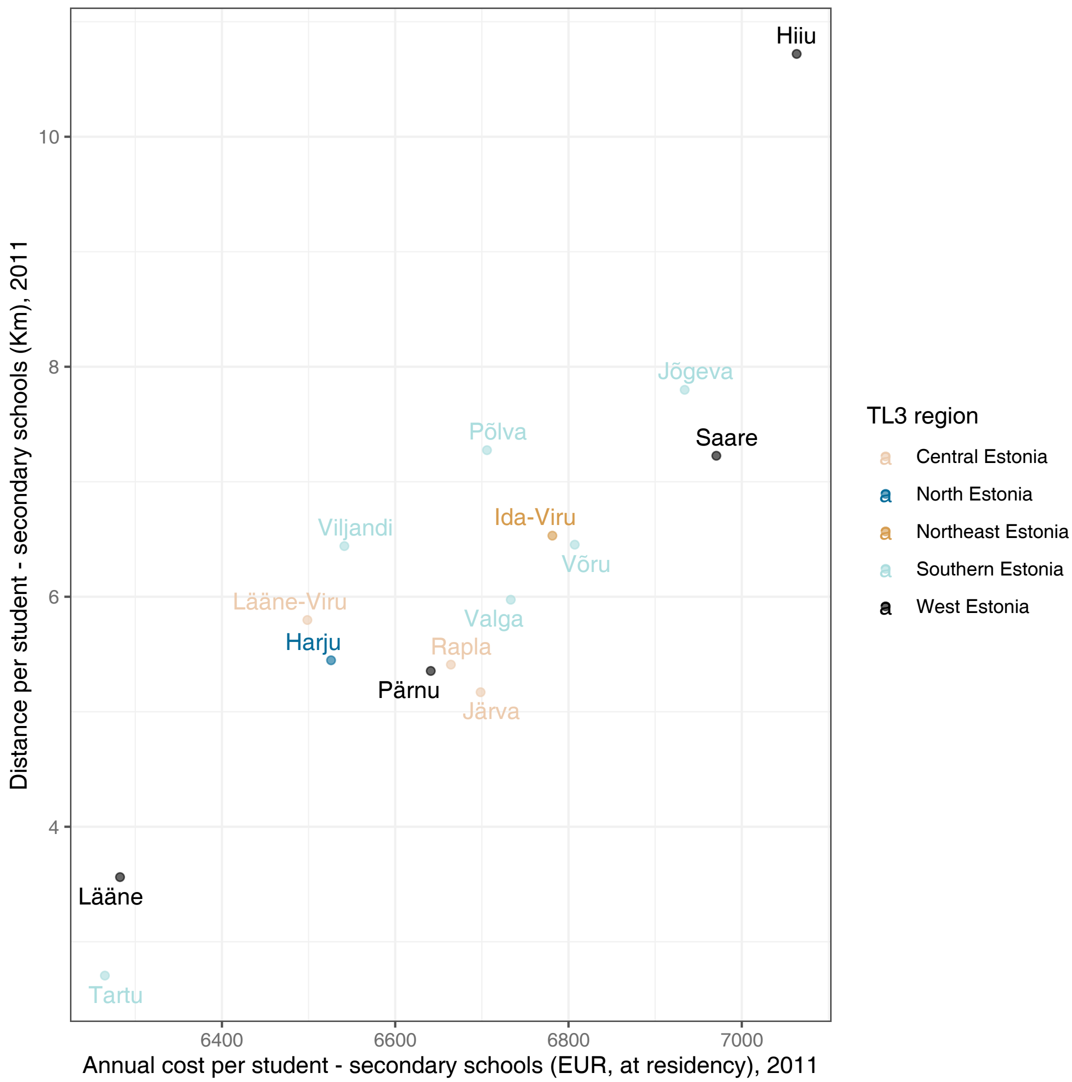
The present values of annual costs and distances per student illustrate how the trade-off between efficiency and access is faced by municipalities and counties to different degrees. While municipalities classified as towns, suburbs and cities have both the lowest annual costs and distances per primary school student, most rural municipalities have simultaneously larger values in both dimensions (Figure 4.12). At the county level, Lääne and Tartu have both lower annual costs and distances per secondary school students, while a county such as Hiiu faces distances per student around 9 km larger and annual costs almost EUR 1 000 above Tartu (Figure 4.13).

Figure 4.12. Annual costs and distances per primary school student by municipality, 2011



Note: Degree of urbanisation classification based on 2011 data. Primary school level excludes one municipality with higher values for visual purposes (Vormsi, EUR 11 989 and 2.03 Km).
Source: Author's elaboration based on OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*, and EC (2021[9]), *GHSL - Global Human Settlement Layer - GHS-SMOD*, https://ghsl.jrc.ec.europa.eu/download.php?ds=smod (accessed on 1 February 2021).

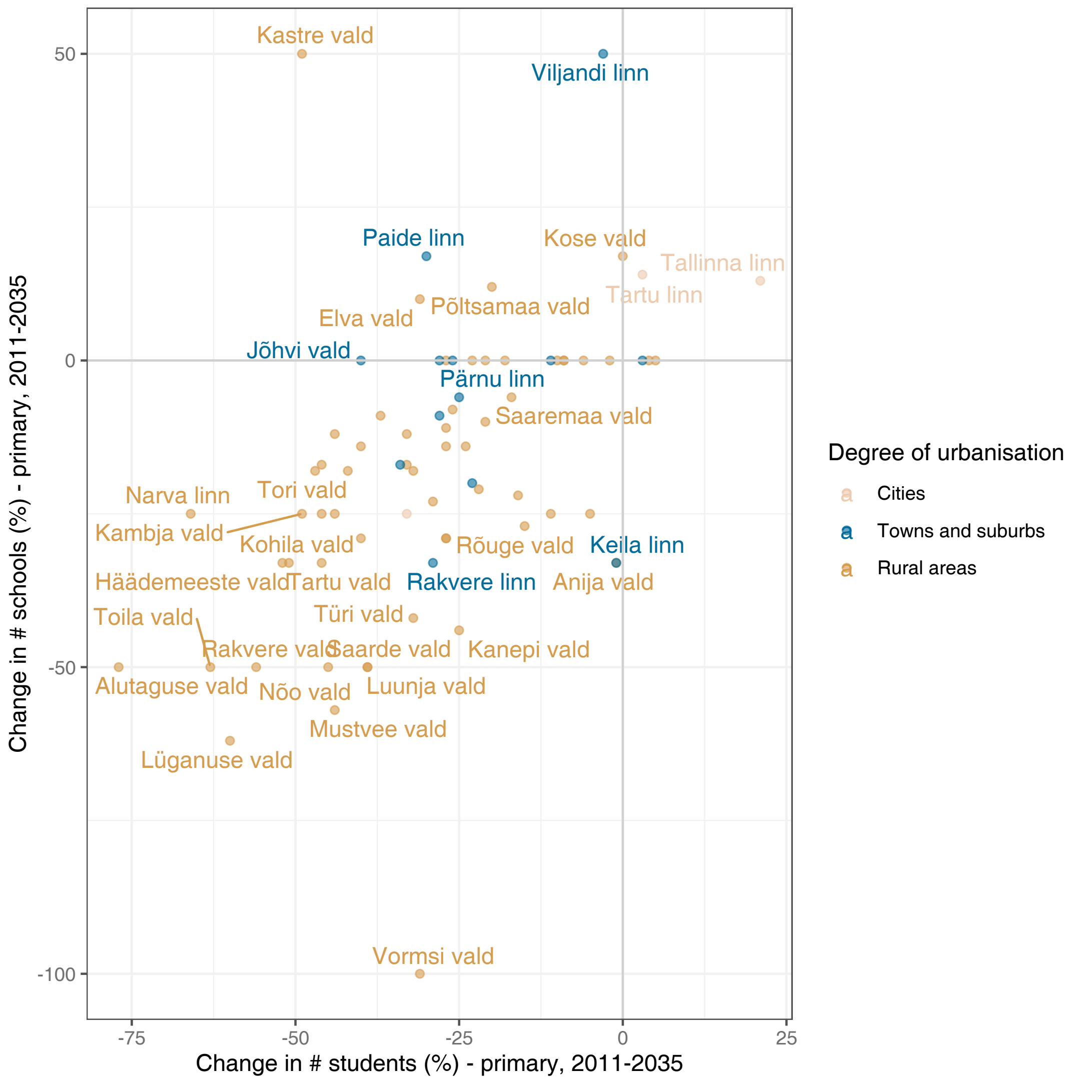
Figure 4.13. Annual costs and distances per secondary school student by county, 2011



Source: Author's elaboration based on OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, and Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*.

The projections for primary schools show that while the number of students is expected to increase in only a handful of urban municipalities including Tallinn and Tartu, the number of schools can increase in some rural municipalities close to cities such as Kastre near Tartu and Viljandi (Figure 4.14). Nevertheless, the large majority of rural municipalities is expected to see a decrease in both students and schools if the school network adapts to future demand. These changes are substantial in some remote municipalities such as Alutaguse.

Figure 4.14. Change in number of primary students and schools by municipality, 2011-35

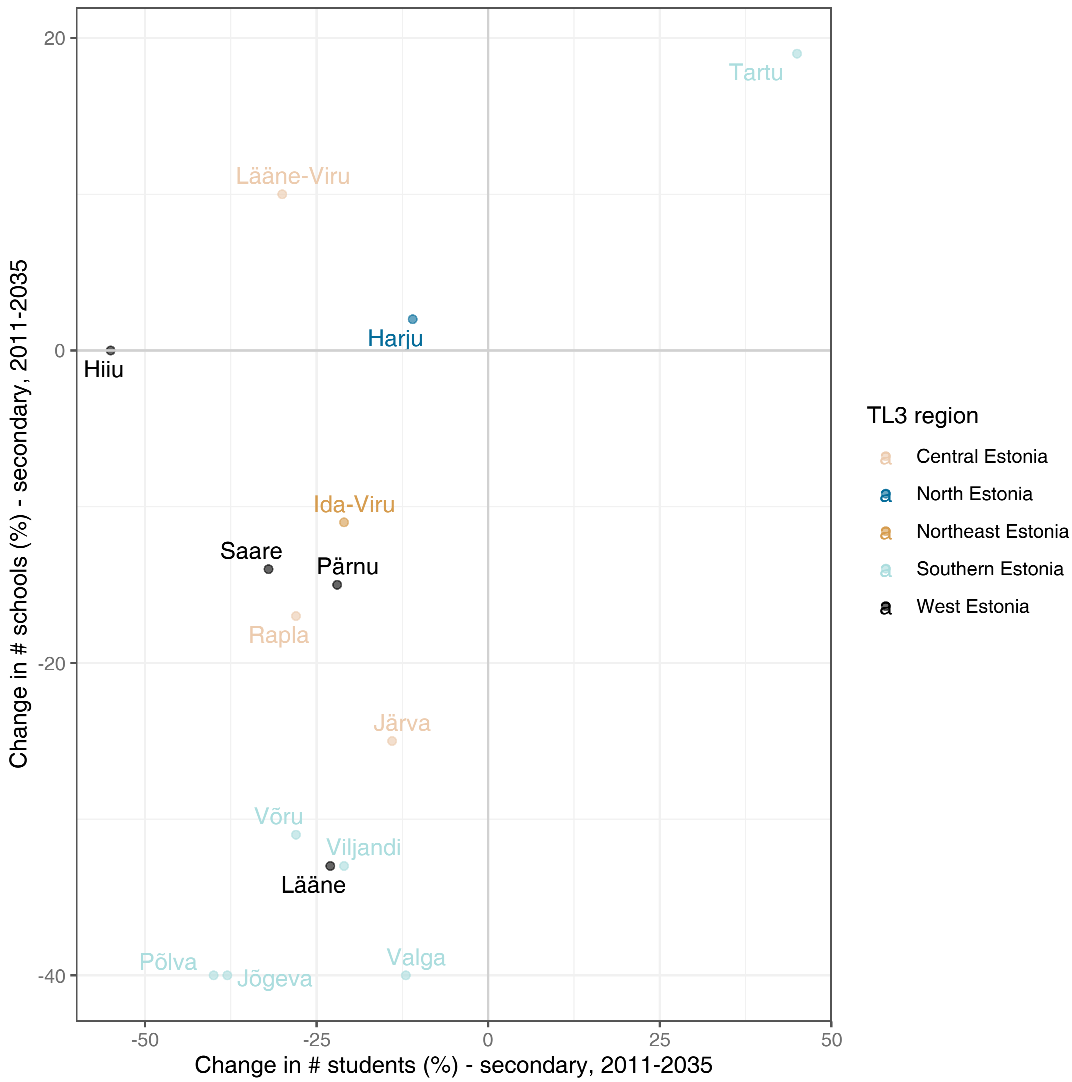


Note: Degree of urbanisation classification based on 2011 data. Annual costs calculated at schools.

Source: Author's elaboration based on OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*, and Eurostat (2021[11]), *Degree of Urbanisation (DEGURBA)*, https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/population-distribution-demography/degurba (accessed on 1 February 2021).

Regarding secondary education, only Harju, Lääne-Viru and Tartu are expected to have more schools in 2035 compared to 2011 (Figure 4.15). Unlike Tartu, both Harju and Lääne-Viru will themselves experience a decrease in students but will at the same time have new schools to serve the needs of growing surrounding areas. On the other hand, all counties of Southern Estonia including Jõgeva, Põlva and Valga and Lääne on the west coast will face the largest decreases in the number of secondary schools following strong projected decreases in the number of students.

Figure 4.15. Change in number of secondary students and schools by county, 2011-35

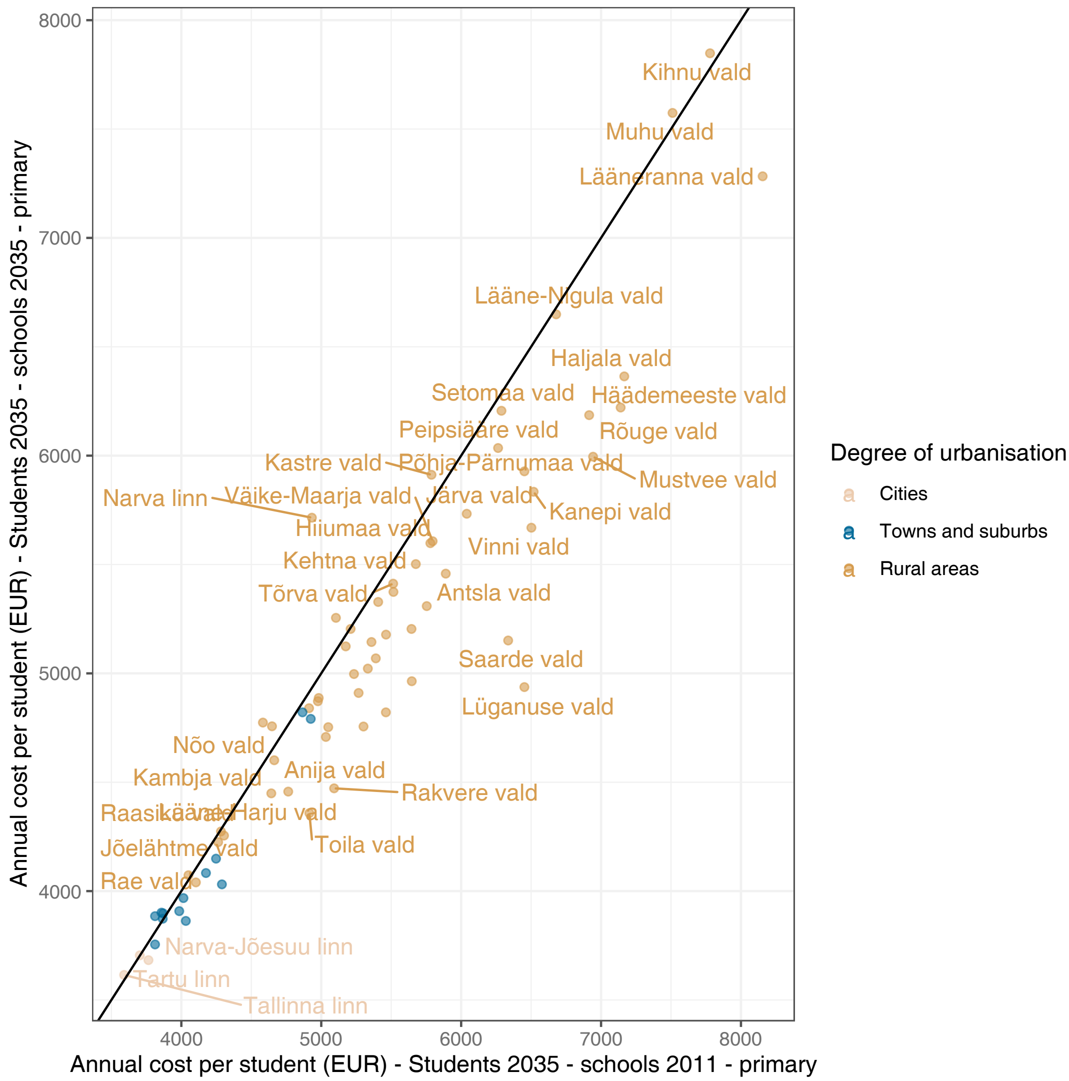


Note: Annual costs calculated at schools.

Source: Author's elaboration based on OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, and Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*.

Finally, as Figure 4.16 shows, the future costs differential from keeping the present school network versus adapting it vary across municipalities and counties. Small rural municipalities such as Saarde in Pärnu and Lüganuse in Ida-Viru (furthest away from the 45 degree line) face annual costs of at least EUR 1 000 per student above the annual costs they would experience if the school network was adapted to the future demand. On the other hand, for a significant share of municipalities, primary school annual costs would remain at similar levels even without school network adaptation. At the county level, only Jõgeva faces the most significant differences in cost from policies that maintain present secondary schools into the future.

Figure 4.16. Annual costs per primary school student by municipality under two school network adaptation scenarios, 2011-35

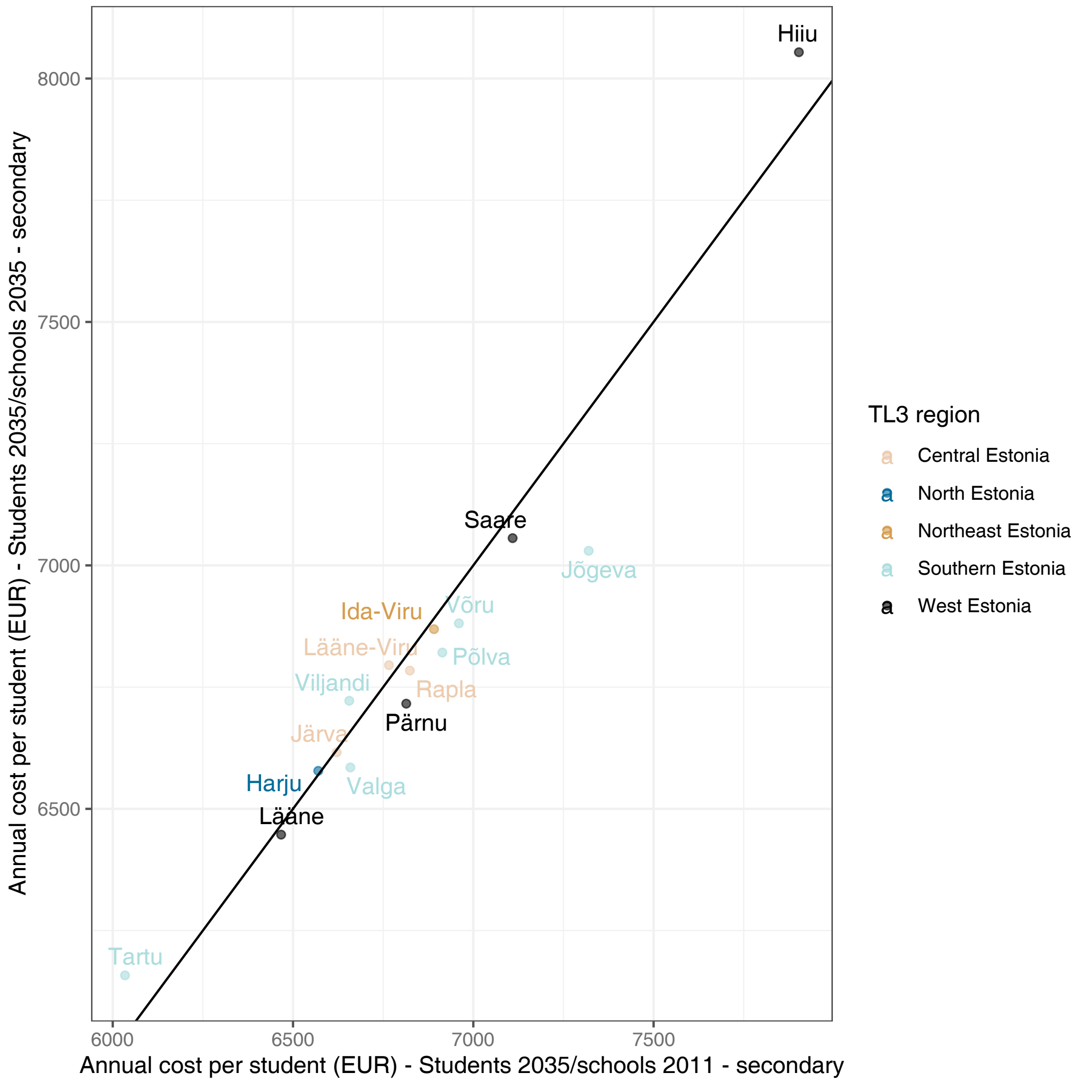


Note: Degree of urbanisation classification based on 2011 data. Excludes one observation for primary school level (Vormsi, EUR 13 425 and EUR 7 910) for visual purposes.

Source: Author's elaboration based on OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*, and EC (2021[9]), *GHSL - Global Human Settlement Layer - GHS-SMOD*, European Commission, https://ghsl.jrc.ec.europa.eu/download.php?ds=smod (accessed on 1 February 2021).

In summary, school consolidation will have to continue in the next decades in most municipalities. At the same time, a number of urban and suburban municipalities will have to deal with increasing capacity. The results show that school network adaptation to future demand can be achieved without increasing travelled distances. Still, a number of small schools in remote areas operating at high costs will have to remain open at relatively high costs for decades to ensure access. Comparatively, increasing within school efficiency can lead to major cost savings that can outpace the increase in costs associated with the decline in future demand for educational services. Before turning to the conclusions and recommendations of this chapter, the next section discusses digital provision for education services.

Figure 4.17. Annual costs per secondary school student by municipality under two school network adaptation scenarios, 2011-35



Source: Author's elaboration based on OECD/EC-JRC (2021[4]), *Access and Cost of Education and Health Services: Preparing Regions for Demographic Change*, https://dx.doi.org/10.1787/4ab69cf3-en, Goujon, A. et al. (eds.) (2021[12]), *The Demographic Landscape of EU Territories: Challenges and Opportunities in Diversely Ageing Regions*, EUR 30498 EN, Publications Office of the European Union, Luxembourg, and Jacobs-Crisioni, C. et al. (n.d.[13]), *Development of the LUISA Reference Scenario 2020 and Production of Fine-Resolution Population Projections by 5 Year Age Group*.

Digital education provision in Estonia: Opportunities and challenges

Estonia has recently increased its efforts to digitalise its education system, including vocational education and training (VET). Despite the progress made in recent years, Estonia still faces significant challenges from digital skills to broadband connectivity.

This section first discusses recent efforts to digitalise education, especially in the access to and use of technological devices. It then describes how Estonia is preparing vocational education for the challenges of tomorrow despite persistent high dropout rates and low transition from VET to higher education. Finally, the section sheds light on the Estonian shortcomings in the area of digitalisation, in particular with regard to the digital skills of teachers and urban-rural connectivity gaps.

Recent government strategies to digitalise education show encouraging results

In the framework of the Lifelong Learning Strategy, the Estonian government's education reference document for 2014-20, Estonia implemented a digital transformation programme to improve the digital skills of teachers and students and to digitalise learning tools across all of the territory, including small towns and rural areas.

At the end of 2021, the Estonian Ministry of Education and Research has adopted the Education Strategy 2021-2035[4] in parallel to Estonia's long-term reform plan Estonia 2035, which serves as the basis for planning the use of incoming EU funds (Estonian Ministry of Education and Research, 2019[14]). This educational comprehensive strategy has several objectives in the field of digitalisation, including:

- Develop and use digital solutions in order to foster educational innovation as well as the diversification and personalisation of education (e.g. assessment for learning, raising awareness of the opportunities and risks of the information society).
- Increase the acquisition of vocational and professional skills, including digital skills.
- Promote more efficient use of digital resources and improved working conditions (including through digital tools and solutions) for teachers.

Other initiatives such as the EDULAB project have aimed at increasing the use of new technologies and digital tools in the school system. This project enables schools and researchers to develop innovative educational technologies and to promote co-creation methods for connecting educational innovation and practice. The EDULAB project also offers an online platform where teachers help and consult each other on using technological resources (Burns and Gottschalk, 2020[15]).

Today, all Estonian schools use e-school solutions, such as the web applications eKool and Stuudium to improve organisation and collaboration between teachers, parents and students, or the e-Schoolbag portal (*e-koolikot*) for digital learning materials, among many others. In addition, 95% of the schools have participated in the ProgeTiger technology programme to introduce subjects such as engineering sciences, design and technology and ICT in the school curricula.

According to the Programme for the International Assessment of Adult Competencies (PIAAC), which provides internationally comparable data on adults' proficiency in key information-processing skills, 99% of Estonian teachers use computers at work more frequently than teachers in 16 countries included in the sample,[5] and most are satisfied with their computer skills (Valk, 2013[16]). On the students' side, according to PISA 2018, 97% of Estonian students have access to Internet at home. Estonian rural areas are also better equipped than city schools in terms of available computers per student at modal grade (OECD, 2021[1]). In addition, 90% of Estonian children feel satisfied with digital studying from home, 80% of them report good access to needed devices – a larger proportion than in other countries – and 70% have started to use new study methods and tools of communication when studying from home (Telia Company, 2020[17]).

Estonia plans to make VET future-ready despite remaining challenges

Government efforts in the field of digitalisation of education also include VET. In addition to the Vocational Educational Institution Act (*Kutseõppeasutuse seadus*) of 2013 which had among its objectives to modernise the infrastructure of VET, national programmes support the development of digital skills via a holistic approach and result-oriented use of learning technologies (Cedefop, 2017[18]). Vocational schools also use the above-mentioned e-Schoolbag portal as well as the Study Information System (*Õppeinfosüsteem*, ÕIS), a digital system containing information about study programmes and timetables, and allowing for examination registrations (OECD, 2020[19]).

On the matching of vocational students to labour market needs, since 2015, the OSKA labour market needs monitoring and forecasting system serves as a platform for employers, educational institutions and the public sector to discuss how to evaluate labour and skills needs of key sectors, including ICT. According to a 2016 sectoral report on ICT, Estonia needed a total of 37 000 ICT professionals by 2020 in order to ensure that the number of ICT professionals matches the development needs of the country in the ICT sector and other economic sectors. OSKA's forecasting results are used for career counselling, curriculum development and strategic planning at all education levels, including VET (Cedefop, 2017[18]).

Despite digitalisation efforts, vocational education in Estonia still faces significant challenges. In countries such as Austria, Sweden or the United States, more than 10% of post-secondary VET graduates entered higher education, while in Estonia this rate was 6.9% in 2019/20.[6] Recent data from 2020 suggests nevertheless that around a quarter (24%) of students who enter post-secondary VET in Estonia already have a higher education diploma. In 2020, 19.2% of all students who start vocational secondary education dropped out during their first year of studies and 9.4% did not continue studying either in VET or in general education the next year after they dropped out. In addition, few upper secondary VET graduates pursue the additional bridging year to access higher education as this means losing the public benefits and social guarantees they receive as students (Musset et al., 2019[20]).

The digital skills and urban-rural divides are still a challenge to overcome

While digital skills in Estonia are lower than those of its northern neighbours when looking at internationally comparable data (Nordic Co-operation, 2015[21]),[7] rural-urban gaps persist. In 2011/12, 29% of persons in Estonia did not have sufficient technical computer skills to undertake cognitive tests on the interviewer's computer, 5 percentage points above the international average and more than twice as high as countries such as Denmark, Norway or Sweden. In addition, in Estonia, 31% of individuals living in rural areas have basic digital skills, in contrast with 68% in cities. Regarding connectivity, in 2020, cable networks covered only 23.6% of rural households (76.7% of all households in Estonia) and fixed very high-capacity network (VHCN) only covered 20.5% of rural households (71% in Estonia) (EC, 2021[22]).

Furthermore, teachers' low digital skill levels have represented a major challenge for Estonia in the past, especially because of the high proportion of older staff among teachers. According to a PIAAC study published in 2013, only 27% of Estonian teachers had good skills in problem-solving in technology-rich environments (PS-TRE)[8] (scoring at the proficiency levels 2 or 3), significantly below the average of 16 countries (46%). Moreover, the proportion of high-skilled in PS-TRE (levels 2-3) was lower among teacher education graduates than among higher education graduates (Valk, 2013[16]). These gaps may be associated with a negative correlation between PS-TRE skills and age (Nordic Co-operation, 2015[21]) and may particularly affect rural areas where teaching staff is older (Echazarra and Radinger, 2019[23]).

According to a satisfaction survey conducted by the Estonian Ministry of Education and Research, 66% of teachers stated they have sufficient digital skills in 2018, with this share increasing to 70% in 2020. A 2018 teacher satisfaction survey conducted by the Estonian Ministry of Education and Research showed that teachers self-assess their own digital skills as insufficient and only 30% of teachers stated in the 2018 OECD Teaching And Learning International Survey (TALIS) that they felt sufficiently prepared to use ICT in teaching. Nevertheless, according to TALIS 2018, Estonia is one of the OECD countries where ICT skills for teaching were most included in teachers' professional development activities (EC, 2020[24]).

Policy recommendations

Based on the assessment developed in the previous sections, this section provides recommendations to help Estonia adapt its school network and achieve the goal of ensuring access to high-quality education for students, regardless of where they live. It also presents some common insights for policies across all service sectors that stem from the analyses of education networks conducted in this chapter.

Focus on training and career incentives to attract teachers to rural schools

The issue of shortages of newly qualified teachers that disproportionally affects rural areas could result in future rural-urban gaps in quality, even with the current mechanisms to ensure the alignment of wages in rural schools with national levels. Rural areas need to ensure clear incentives for new teachers, as well as mechanisms to compensate for the specificities of rural schools, including not only small and multi-grade classroom teaching but also possible feelings of isolation and long travel times. In this sense, the incentives to become a teacher in a small rural school need to go beyond lump-sum financial aid.

The current context requires a special emphasis on incentives to ensure a better assignment of human resource funds within rural schools, for instance by assuming more flexibility in roles and retirement plans for older staff and strong career and training incentives for newly qualified staff, including on digital skills. They could also evaluate the current attractiveness of part-time contracts as a significant share of teachers in rural areas work on a part-time basis. As the responsibility for the strategic planning of human resources in basic schools falls under the responsibilities of municipalities, the government should keep close track of performance indicators in small and shrinking municipalities and act to bridge capacity gaps, for instance by actively promoting managerial capacity sharing across neighbouring municipalities.

To bridge rural-urban gaps in teacher shortages, Estonia could consider additional benefits for new rural teachers – especially itinerant teachers – including flexible work hours, fewer contact hours per week and/or rotation systems. These policies should in any case be mindful of the needs of women in rural areas and their families, as the overwhelming majority of teachers in Estonia are women.

Use objective measures of unavoidable costs while allowing more flexibility in the use of funding

Small and sparsely populated municipalities will need to consolidate most of their schools while keeping some small schools open to ensure access to basic education. Because of the small scale of provision and already long travel distances to school, these municipalities will also have the largest unavoidable costs of providing primary education compared to cities, estimated to be on average over 30% in sparse rural areas. The additional cost of not adjusting the school network to future lower demand is largest in the smallest municipalities that also face the highest costs of maintaining old and under-utilised facilities. At the same time, these areas will need to downsize in the number of teachers while facing the most difficulties in attracting qualified, high-performing teachers.

While the inclusion of a fixed coefficient in the education grant system is a first step in the direction of ensuring small rural municipalities are appropriately funded, ideally, the criteria used in the transfer system should not include factors that are under the direct control of municipalities. The unavoidable cost estimates based purely on geographic and demographic factors presented in this chapter represent an example of such criteria. In the OECD context, Sweden uses a similar modelling approach to unavoidable additional costs in education in its territorial equalisation policies. Importantly, the cost and access estimates taken together can also help to signal the feasibility of further consolidation across municipalities.

Furthermore, while block grants have served the purpose of ensuring rural teachers in basic and upper secondary education are not paid significantly below national levels, they may lead to wage inflation in some municipalities and may not represent the best use of resources in the current context of teacher shortages. Meanwhile, rural municipalities may have other funding needs including funding for teacher skill upgrading and relocation support for new teachers. With more flexibility in the use of funds, municipalities could be better placed to focus on quality objectives such as reducing gaps in the shares of teachers with qualifications and digital training. An option towards increasing flexibility is to phase out earmarked block basic education grants and redirect funds to increase other revenues of local governments, for instance through an equalisation fund. This approach should be accompanied by transparency in the way municipalities allocate funding.

Develop incentives to boost co-operation in education provision across municipalities

Promoting co-operation among municipalities undergoing shrinkage with the aim of increasing the quality of basic education through increased scale and resource sharing will be key in the next decades. Because of a history of lack of quality-oriented co-operation across rural municipalities in Estonia, this may require additional policy actions on top of existing financial incentives for school closures. These could focus for instance on effective incentives to ensure access to dormitories and transportation solutions in co-operation with neighbouring municipalities.

In general, the merger of some of the functions of groups of rural schools could help in achieving the goal of increasing resource sharing across rural schools, ensuring accountability for school principals and increasing the incentives for specialised teachers while maintaining access to school sites. A recent example is the municipality of Põltsamaa,[9] where seven small schools merged into two schools that operate in five locations. When extended to and formalised for groups of municipalities, these types of mergers can have the additional benefit of increasing managerial decision capacities and the connection between school and municipal level decisions which remains an outstanding problem that can worsen as small municipalities become even smaller. Strategic and flexible use of digital education provision use in combination with school clusters can further reduce the need for staff and student travelling.

Furthermore, a modular approach for the integration and combination of school services can aid a joint restructuring process in neighbouring small municipalities. This can work for instance to improve the integration of pre-primary and primary school levels and to separate lower education where there is room for consolidation at the level. Beyond using pre-existing structures such as municipal co-operation organisations at the county level, the central level could actively promote strategic partnerships among urban and suburban municipalities as well as among small rural municipalities, for instance through additional financial incentives for joint municipal projects with clear quality-enhancing goals for students.

Consolidate higher education provision with a functional and strategic view

Estonia has advanced in recent years towards the goal of creating a network of state-run upper secondary schools, in an effort to take control over the consolidation process at that level. While faster consolidation can bring benefits in terms of infrastructure quality and cost efficiency, the placement of schools that assigns each county capital with a facility does not follow a functional view. Placement based on functional service provision areas that also take into account the future demand for education would optimise access to schools and avoid resource duplication. This includes the design of the right incentives and regulations that apply to the same degree to both public and private schools. Furthermore, the placement of upper secondary schools should be more aligned with other spatial planning policies to potentiate the role of newly constructed schools in built environment improvement and service provision integration strategies.

The regional education centres that are part of the Estonian Education Strategy 2021-2035 can help aid the transfer of capacity from the central to the local levels and co-ordinate all stakeholders involved in the strategic provision of vocational education, including local economic actors. More than a political scale such as the county level, this co-operation needs to be done at a level that is fully recognised and supported by the municipalities involved, for instance through bottom-up approaches leading to strategic partnerships. Moreover, regional education centres need to feed on early support systems in basic schools to support students in their transition from basic to higher education that in the case of many remote municipalities may also involve the physical relocation of students. To close persistent quality gaps, Ida-Viru may require additional investment in high-quality support systems to accompany students not only at the VET stage but throughout their school life.

Further develop demand-responsive transport (DRT) solutions to facilitate access to rural schools

The National Spatial Plan Estonia 2030+ aims to promote the combined use of passenger and public vehicles in low-density areas as well as to increase efficiency by adjusting public transport provision to demand (e.g. sizes of buses, routes, service schedules). In this context, the Ministry of Social Affairs is financing pilot projects for social transport, including DRT in rural areas. The first DRT service in Estonia, based on the passengers' behaviour and needs, has been launched in 2021 in Saaremaa Island, a private initiative part of the international project RESPONSE implemented in close co-operation with the municipality (RESPONSE-Project, 2021[25]). Other initiatives have emerged such as the MoNo bus for mobile youth work near Tartu, which is equipped with basic "tools" for work and serves as a transport vehicle for youth workers visiting villages without youth centres.

Despite the development of these initiatives and the availability of free public transport, school and vocational students in Estonia do not yet have access to transport-on-demand (DRT) services. The latter would allow Estonian rural areas to benefit from flexible transport services according to demand, prioritising flexible pre-bookable transport instead of scheduled services. The provision of DRT services will benefit the entire rural population, from dependent people needing access to basic services to teachers and upper secondary and vocational students – with more flexible schedules – living in remote areas. In Wales, for example, the Bwcabus service has reduced home visits by doctors and average journey times to the nearest employment centre from 52 to 27 minutes (Goodwin-Hawkins, 2020[26]). In France, Résa'Tao, the DRT service of Orléans metropolis and Icilà, the DRT service of the urban community of Sophia Antipolis, regularly cover school transport.

DRT services can incorporate sophisticated software that provides users and drivers with reliable and comprehensive real-time information and the possibility to make last-minute bookings from a mobile application or by phone. The routes, stops and timing of the service are flexibly adapted based on user demand. The software also has powerful algorithms that take into account itineraries, times and vehicle occupancy rates to optimise every trip, which has led to an increase in the rate of passenger grouping.

Finally, policies implementing DRT services can be complemented by other measures, such as the provision of an electrically assisted bicycle service, with the deployment of cycle connections, or the full or partial subsidy of driving licences for young people in rural communities.

Digitalise vocational education to broaden opportunities for rural youth

In general, to close rural-urban gaps in upper secondary outcomes and reduce the high VET dropout rates, Estonia can develop specific strategies to better integrate general and vocational upper secondary schools that serve rural students as well as to better connect VET with the skills needed for tomorrow's labour market. In this respect, the HEInnovate self-assessment tool is particularly interesting for VET schools wishing to explore their entrepreneurial and innovative potential. In addition, with consolidation, distances to upper secondary schools will increase for students in rural remote areas that already face the longest travel distances. In this context, the mechanisms employed should address not only the impact of consolidation on physical access but also the increased mismatch in the educational offer and local market demands, and the reduction in the variety of course offers.

A specific strategy for rural areas is to experiment with new digitally-based models of upper secondary provision that leverage curricula specialisation and high digital skills in Estonia. Vocational students in rural areas could be given the chance to complement their programmes by virtually attending courses offered outside their catchment area. The Estonian authorities should develop a strategy to support rural areas through VET and the OSKA forecasting system. This strategy would monitor not only leading sectors but also rural labour market needs in order to better connect VET with future rural jobs and, in particular, with the digital skills needs of rural employment.

Strengthening training on digital tools in all vocational schools would benefit key sectors for rural areas such as tourism, biotechnology, renewable energies, agri-food or the silver economy. This will require strengthened support for the development of VET teaching staff and student digital skills in using future technologies provided by ICT. The strategy should also encourage stronger collaboration between VET and businesses. This could include setting up talent meetings between final-year university students and small- and medium-sized enterprises (SMEs) in the above sectors as well as other highly demanded sectors such as science, technology, engineering and mathematics (STEM) or digital transformation services to rural areas.

Despite the extensive autonomy of vocational schools in Estonia, these efforts may need explicit government support as they are less likely to arise from private initiatives. They could also be used as a vehicle to ensure the integration of regional development objectives in decisions on VET curricula. This is especially relevant in regions with shrinking areas where a misalignment of VET offer and local needs could contribute to further brain drain.

Develop a common strategy of adaptation to shrinkage across all service sectors

It is imperative to align the adaptation of services in a coherent manner *across* sectors and not just in any one sector in particular. Such integration takes advantage of potential synergies and reduces inefficiencies in the use of fiscal resources. Estonia's existing network of service centres outlined in County-wide Spatial Plans (CSPs) should be better utilised to consolidate municipal services while still maintaining quality across all areas, including sparsely populated regions. This requires a coherent regional framework and strong inter-municipal co-operation, along with financial support from the central government. The integration of services through the service centre network should also bring cost savings based on economies of scale.

The recommendations outlined in this chapter are certainly not unique to the education sector. The need to bridge rural-urban gaps through financial incentives is important not only for teachers but also for other workers in healthcare, social protection and transportation. Digital service provision is also important to further bridge disparities in all services across regions, especially for remote areas that lack quick and convenient transport links to urban centres. Inter-municipal co-operation is critical to ensure a coherent response to shrinkage that maximises synergies across service sectors while preventing a destructive "race to the bottom" and central government incentives targeted toward joint municipal bodies can help in this regard. Developing DRT solutions linking service aggregation centres with residential areas will be much more effective than when implemented for schools alone. Overall, a common strategy of adaptation in Estonia is needed to best adapt service provision in a smart and sustainable manner.

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Notes

[1] Available at https://www.riigiteataja.ee/en/eli/513012014002/consolide/current.

[2] Before the teacher allowance was available to teachers outside Tallinn and Tartu.

[3] Urban areas include cities, cities without municipal status and towns.

[4] Available at https://www.hm.ee/sites/default/files/haridusvaldkonna_arengukava_2035_2810_0.pdf.

[5] Cyprus, the Czech Republic, Denmark, Estonia, Flanders (Belgium), France, Italy, Japan, Korea, the Netherlands, Norway, Poland, Russia, the Slovak Republic, Spain and the United Kingdom (England and Northern Ireland).

[6] Calculations based on OECD (2015[28]).

[7] Estonia is also one of Europe's leading countries for digital skills according to EC's DESI Index (available at https://digital-strategy.ec.europa.eu/en/library/digital-economy-and-society-index-desi-2021), ranking 5th on the human capital dimension in Europe with 62% of Estonians having at least basic digital skills.

[8] Problem-solving in technology-rich environments (PS-TRE) is the ability to use digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks.

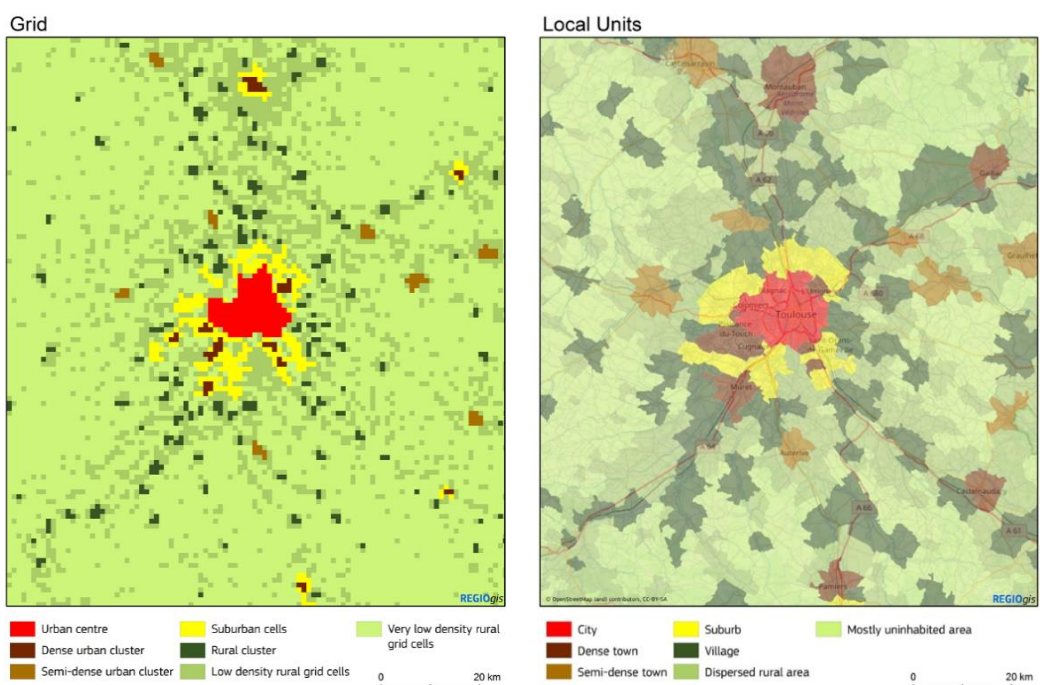
[9] See https://www.poltsamaa.ee/koolid.

Annex 4.A. Degree of urbanisation

The degree of urbanisation was designed to create a simple and neutral method that could be applied in every country in the world. It relies primarily on population size and density thresholds applied to a population grid with cells of 1 by 1 km. The different types of grid cells are subsequently used to classify small spatial units, such as municipalities or census enumeration areas (Annex Figure 4.A.1). The degree of urbanisation was endorsed by the United Nations (UN) Statistical Commission in March 2020 (https://unstats.un.org/unsd/statcom/51st-session/documents/BG-Item3j-Recommendation-E.pdf).

Degree of urbanisation level 1 classifies the entire territory into: i) cities; ii) towns and suburbs; and iii) rural areas. At level 2, towns and suburbs are split into: i) dense towns; ii) semi-dense towns; and iii) suburbs. Rural areas are split into: i) villages; ii) dispersed rural areas; and iii) mostly uninhabited areas. The settlement classification relies on 2015 GEOSTAT population data.

Annex Figure 4.A.1. Degree of urbanisation level 2 grid classification around Toulouse, France



Source: Ehrlich, D. et al. (2019[27]), *GHSL data package 2019: public release GHS P2019*, European Commission, Joint Research Centre, http://dx.doi.org/10.2760/729240.

- Cities have a population of at least 50 000 in contiguous grid cells with a density of at least 1 500 inhabitants per km^2.
- Dense towns have a population between 5 000 and 50 000 in contiguous grid cells with a density of at least 1 500 inhabitants per km^2.
- Semi-dense towns have a population of at least 5 000 in contiguous cells with a density of at least 300 inhabitants per km^2 and are at least 2 km away from the edge of a city or dense town.

- Suburbs have most of their population in contiguous cells with a density of at least 300 inhabitants per km^2 that are part of a cluster with at least 5 000 inhabitants but are not part of a town.
- Villages have between 500 and 5 000 inhabitants in contiguous cells with a density of at least 300 inhabitants per km^2.
- Dispersed rural areas have most of their population in grid cells with a density between 50 and 300 inhabitants per km^2.
- Mostly uninhabited areas have most of their population in grid cells with a density of fewer than 50 inhabitants per km^2.

In this chapter, these categories are collapsed into four categories: i) sparse rural areas (including mostly uninhabited areas and dispersed rural areas); ii) villages; iii) towns and suburbs (including dense and semi-dense towns and suburbs); and iv) cities.

Annex 4.B. Data processing

Basic schools

"Basic schools" include schools offering ISCED level 1 (both Stages I and II) and ISCED level 2 in 2011. It does not include general schools offering ISCED level 3 education, including those offering all prior educational levels. The resulting number of basic schools that fulfil this criterion is 315 schools located in 77 municipalities and serving 48 840 students at those educational levels (i.e. the sum of students only considers students in ISCED levels 1 and 2).

The simulated placement based on actual schools allocates 5-14 year-olds from a 2011 population grid to the same 315 actual schools based on the distance minimisation and balancing algorithm described in detail in the OECD/EC-JRC report (2021[4]). While the number of years is equivalent to ISCED levels 1 and 2 in Estonia (9 years), the age ranges differ, as in Estonia ISCED 1 starts at the age of 7. Nevertheless, the number of allocated students is roughly comparable (42 058). Across degrees of urbanisation, the simulated placement allocates: a larger share of students to sparse rural areas compared to the actual placement (42% versus 36%); a lower share in towns and suburbs (31% versus 37%); roughly the same share in cities and villages (20-21% and 7%).

In the estimations, "costs" include running costs such as salaries and ICT equipment and exclude capital or fixed investments such as school building construction or renovation. The excess of cost in an area is linked to the presence of small schools in areas with low local demand and can therefore be interpreted as a measure of the unavoidable costs of smallness and remoteness. Costs are measured at the place of residency of students so, when aggregated, they are meant to capture the situation experienced by students living in a municipality regardless of whether they attend school within the municipal borders or not.

Actual travelled distances to schools are not available. Travelled distances in the analysis correspond to the number of kilometres travelled by students according to the simulated placement of students to actual schools.

Annex Table 4.B.1. Comparisons on the share of students, teachers and students per teacher between actual and simulated school data, 2011

Degree of urbanisation	Share of students (actual, %)	Share of students (simulated, %)	Share of teachers (actual, %)	Share of teachers (simulated, %)	Students per teacher (actual)	Students per teacher (simulated)
Sparse rural areas	36	42	45	44	8.1	13.0
Villages	7	7	7	7	10.9	13.6
Towns and suburbs	37	31	30	30	12.6	14.2
Cities	21	20	18	19	11.9	14.3

Note: Degree of urbanisation classification based on 2015 data. Basic schools are schools offering ISCED levels 1 and 2.
Source: Author's elaboration based on (OECD/EC-JRC, 2021[4]), (Goujon et al., 2021[12]), (Jacobs-Crisioni et al., n.d.[13]) and (EC, 2021[9]).

Simulated placements

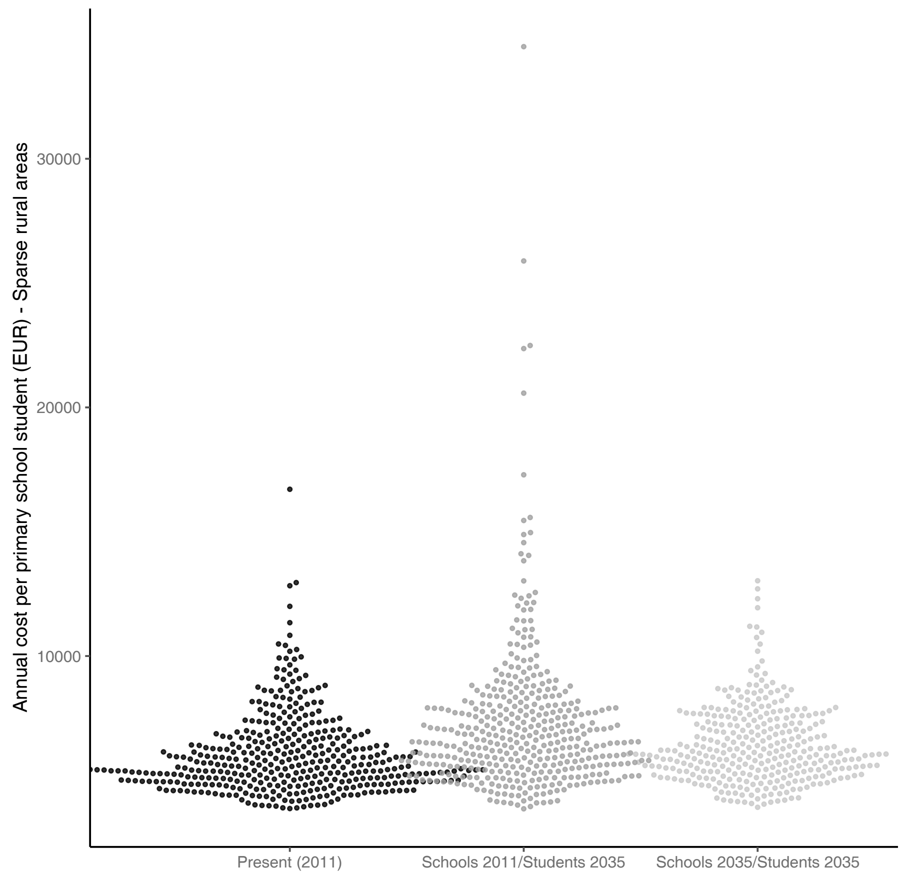
Annex Table 4.B.2. Simulated main education indicators for primary and secondary schools, 2011

Degree of urbanisation	Students	Share (%)	Schools	Share (%)	Teachers	Share (%)	Students per school	Annual cost per student (rel. to cities, %)
Primary schools (ISCED 1)								
Sparse rural areas	20 199	27	410	66	1 574	29	49.3	45
Villages	9 309	12	73	12	687	13	127.5	16
Towns and suburbs	18 842	25	75	12	1 344	25	251.2	6
Cities	26 982	36	65	10	1 831	34	415.1	
Total	**75 332**		**623**		**5 435**		**120.9**	
Secondary schools (ISCED 2 and 3)								
Sparse rural areas	13 498	18	74	35	1 209	20	182	20
Villages	14 758	20	51	24	1 243	21	289	11
Towns and suburbs	18 751	25	39	18	1 486	25	481	4
Cities	28 021	37	47	22	2 125	35	596	
Total	**75 028**		**211**		**6 063**		**355.6**	

Note: Degree of urbanisation classification based on 2015 data. "Estimated" refers to estimated cost based on actual school and student values.
Source: Author's elaboration based on (OECD/EC-JRC, 2021[4]), (Goujon et al., 2021[12]), (Jacobs-Crisioni et al., n.d.[13]) and (EC, 2021[9]).

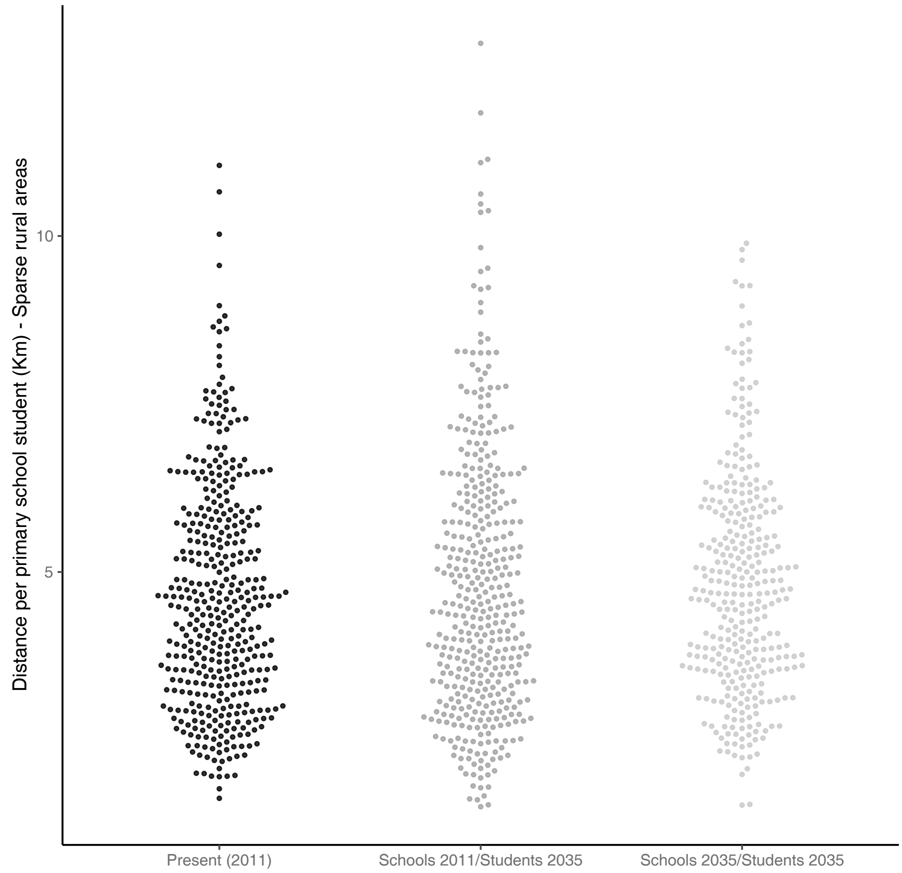
Annex 4.C. School-level results

Annex Figure 4.C.1. Simulated effect of school network policies on annual costs per primary school student in sparse rural areas, 2011-35



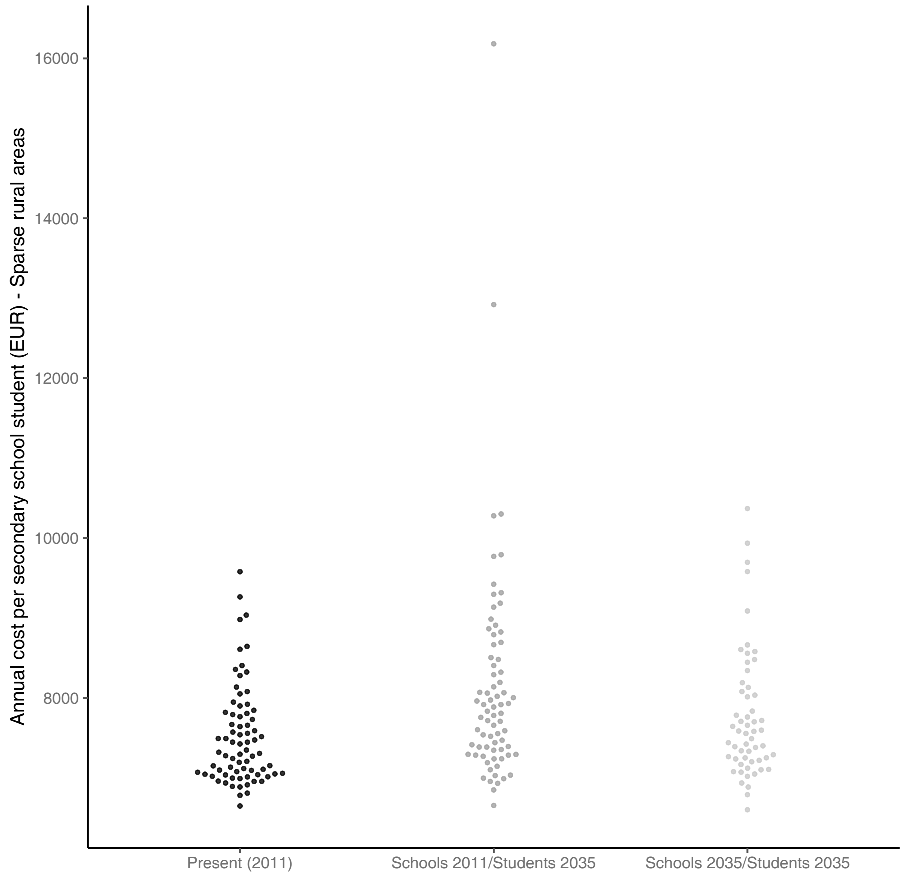
Note: Each dot represents a school. Costs measured at schools. Annual costs calculated at schools.
Source: Author's elaboration based on (OECD/EC-JRC, 2021[4]), (Goujon et al., 2021[12]), (Jacobs-Crisioni et al., n.d.[13]) and (EC, 2021[9]).

Annex Figure 4.C.2. Simulated effect of school network policies on distance to school per primary school student in sparse rural areas, 2011-35



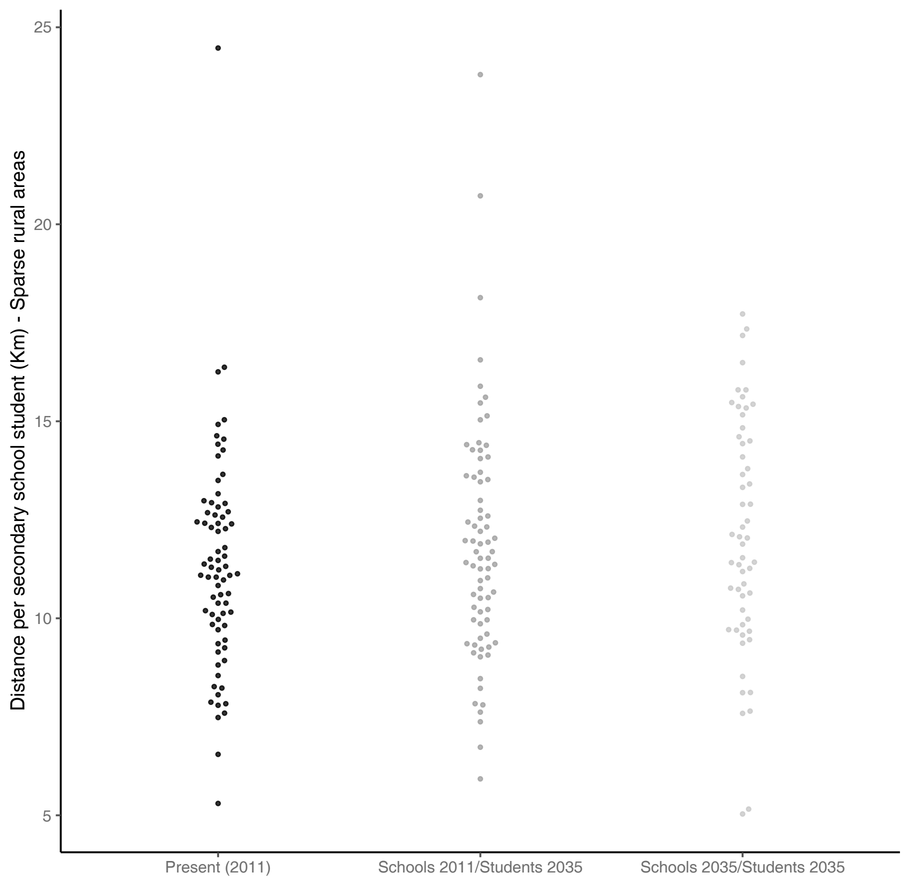
Note: Each dot represents a school. Costs measured at schools. Annual costs calculated at schools.
Source: Author's elaboration based on (OECD/EC-JRC, 2021[4]), (Goujon et al., 2021[12]), (Jacobs-Crisioni et al., n.d.[13]) and (EC, 2021[9]).

Annex Figure 4.C.3. Simulated effect of school network policies on annual costs per primary school student in villages, 2011-35

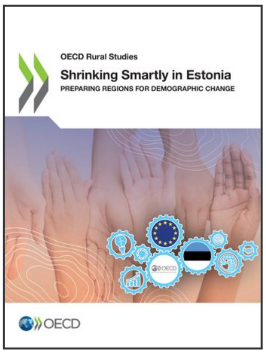


Note: Each dot represents a school. Costs measured at schools. Annual costs calculated at schools.
Source: Author's elaboration based on (OECD/EC-JRC, 2021[4]), (Goujon et al., 2021[12]), (Jacobs-Crisioni et al., n.d.[13]) and (EC, 2021[9]).

Annex Figure 4.C.4. Simulated effect of school network policies on distance to school per primary school student in villages, 2011-35



Note: Each dot represents a school. Costs measured at schools. Annual costs calculated at schools.
Source: Author's elaboration based on (OECD/EC-JRC, 2021[4]), (Goujon et al., 2021[12]), (Jacobs-Crisioni et al., n.d.[13]) and (EC, 2021[9]).



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