SCENARIO II. REGIONAL AUTONOMY

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Contents

I. The world in 2030

After hard-hitting and enduring energy, economic and financial crises between 2017 and 2025, the world in 2030 is a world of no growth with a multi-polar global economy. Resource scarcity and increased cost of living are the major attributes of this world. The global food system was disrupted by series of extreme weather events causing severe losses of production in strategic areas with less resilient large scale farms. Energy prices have increased five-fold since 2015 and contribute to disrupting global production chains, as costs of overcoming physical distance of goods and services have sky rocketed. The Euro was subject to devaluation at the peak of the financial crisis and is now complemented by regional currencies. The EU has a narrow focus on protecting the environment and eco-system services, and supporting the development of regional economies for the common good. Nation states with ageing societies are dealing with public debt overhang due to unsustainably managed pension and welfare systems. . National governments have ceded influence to municipalities and regions, lost tax income, and have shrunk in size and relevance. Households are struggling due to increased living expenses and reduced welfare systems. The working week is 30 hours long to counter unemployment and to allow for care-taking of dependent family members. During five years of economic turmoil resulting in un manageable high levels of unemployment, the system of attributing unemployment benefits was replaced in 2025 with a minimum

basic income, compensating for unemployment, and intending to foster health, creativity, self-motivated entrepreneurial activities and personal growth. The pension age is increased to 70 years also to alleviate pension funds.

This world is one of experimentation with alternative business, energy and governance models, focusing on interests and logics prevailing at the local and regional scales. Regional solutions for improving local quality of life in spite of the crises rely on fostering a dynamic local economy based on new principles of sharing and the common good. Local banks are financing the local economy that is tied to real values and working capital, New accounting measures have been developed, building on the concept of the common good balance. In successful regions renewable local energy supplies cover local needs; Most food is now grown locally. Most families engage in subsistence farming at home, on rooftops and façades, or in community gardens.

In Luxembourg diverse population groups have built local strongholds in different areas of the country, and after a period of intense crisis and struggle have learnt to do more and better with locally available resources. Fostering collective creativity and establishment of local small and medium enterprises was key to intelligent and sustainable local reindustrialization processes through building social enterprise networks. Successful universities provided platforms for social learning combining systems analysis, scenarios, and material flow analysis in social learning and monitoring processes to identify priorities for local economy and life styles that allow for improved balancing of the quality of environment, quality of life and wealth creation.

A decentralized school system with largely locally-driven schools equips children to translate global knowledge to address local needs and to engage meaningfully in the community and local economy. Collaborative systems thinking and anticipation, team teaching, and the use of tools for tapping into collective intelligence, also by using the web are considered most important. The role of government in the school system is to inform about diverse school offers, and to facilitate information exchange on teacher-led research and experimentation in schools. In successful regions, local business and communities engage in schools and contribute to develop and run education programmes equipping children for sustainably contributing to community life in a fulfilling way.

I.1. Geopolitical issues and energy

Today, the stability of the life support system of planet earth is threatened as the bio-geo-physical processes that so far had ensured stable climate conditions of the holocene have been disturbed to the point of tipping out of their natural equilibria. CO2 emissions could not be curbed in time and extreme weather events are more frequent like storms, hail or drought with high drops of production in monoculture industrial farms. Part of the earth's freshwater eco-systems have collapsed due to eutrophication caused by human interference in the nitrogen cycle. Biodiversity is at an all-time low with defunct food webs destabilizing most eco-systems. Most former farmland suffers severely depleted and or polluted soils. Warnings about the precarious state of the earth system across nine dimensions published in 2009 by Rockstroem et al., then hotly debated, proved more than warranted.[1] Coastal zones in the developing world are being evacuated as sea-level rise is accelerating. In consequence of two large tsunami's Bangladesh is as good as wiped off the map.

The differential distribution of natural resources such as water and fertile top soils, as well as the unevenly distributed occurrence of extreme weather events impacting vulnerable communities across the globe, are causing mass migration and further exasperate uneven development and social instability. The

[1] Rockström, J. et al. (2009), "A safe operating space for humanity," *Nature* 461, 472-475.

challenges at the food-water-energy nexus have become precarious for most countries. There is an energy crisis, and most formerly leading economies have turned inward fighting social unrest and impacts of the global economic recession, as well as national debt overhang due to poorly managed pension and welfare systems. Regionalization is the rule. Tensions between neighbours are rising in the fight for resources, and in particular for water.

There is now a severe global energy crisis: Droughts and storms between 2015 and 2020, particularly in the US coastal zones have finally brought the message home that use of fossil fuels has to be drastically reduced. After two more severe incidents with coastal nuclear power stations similar to Fukushima in 2011, most Western economies had to follow Germany in committing to decommission their nuclear reactors, due to public pressure. Starting in 2020, Russia started to deliver a large proportion of its gas to China, further to the obligations under a contract set up in 2014. [2]All contracts to deliver gas to the EU expired. Shale oil and shale gas have been abandoned as early as 2020 as it became clear that ground water table pollution is as good as inevitable[3].

There has been some progress for more reliable ways to harvest renewable energies for human use, however storage of energy in particular to ensure the reliable supply of energy for large scale industrial operations remain problematic, such operations have therefore become in many cases prohibitively expensive. Most energy is fed into local grids from local wind and solar systems, as smaller and medium scale energy storage including battery systems, or big scale storage through gaz thanks to Sabatier reaction processes and plants were significantly improved;[4] occasionally hydropower and geothermal is used, with great attention though not to jeopardize drinking water supplies. The energy supply into the grid is now fully decentralized, world-wide, and smart grids largely medium to small scale locally are the norm. Energy at large and in all forms amenable to human use is however 4 fold the price of 2014, whilst storage systems have improved there are still issues that demand can exceed supply, at times when sun and wind are low regional supply can be unreliable.

I.2. Global leadership and power distribution across governance levels

Globally there are high migration rates due to uneven distribution of scarce natural resources, sea level rise, desertification, and impacts of extreme weather. All nation states with ageing societies are dealing with public debt overhang due to unsustainably managed pension and welfare systems. National governments have lost influence, lost tax income, and have shrunk in size. In this world of slow to no growth with a multi-polar global economy, and increased cost of living, middle classes are struggling in many of the world's regions. Some regions have managed to foster the development of more resilient local economies with improved quality of life. Solutions from these regions are spreading slowly through knowledge networks.

There is no longer any one hegemonic power dominating world politics. The EU is protective of its borders focusing on governance for regional resource autarchy and protecting its natural capital.
The US has been forced to turn inward to fight internal problems. It was hard hit by the uneven spread of natural resources, including water, farmland and extreme weather and flooding in the coastal regions. The 'coup de grace' so to say was a series of earthquakes in shale gas and oil extraction zones that led to protests and social unrest over national energy politics disregarding citizen safety. Similarly, China's struggles with minority states who would like to break away have intensified. Impacts of increasing pollution of air,in mega cities, water and farm land, have brought a political focus on environmental remediation action, and curbing consumerism in a generation of golden princes. India is proficient at

[2] Anishchuk, A. (2014) As Putin looks east, China and Russia sign $400-billion gas deal. Reuters. http://www.reuters.com/article/2014/05/21/us-china-russia-gas-idUSBREA4K07K20140521. last accessed 21.8.2014
[3] R. D. Vidic et al., (2013) . Impact of Shale Gas Development on Regional Water Quality. *Science 340 (6134) DOI: 10.1126/science.1235009.*
[4] http://www.actu-environnement.com/ae/news/vgv-methane-electricite-intermitence-stockage-18505.php4

achieving self-sufficiency in its diverse country. Lifespans in large cities in particular in Asia are drastically shortened due to human health impacts of pollution. Australia is exploiting the natural resources of the Antarctic as there is no global mechanism to enforce the UN Agreement on the South Pole any longer. South America is dominated by Brazil. BRIC have a strong alliance, and Russia, as signed in a contract in 2014, is now selling all its expert gas to China. The EU is left out of that alliance and is focusing inwardly to develop joint measures on existential questions that jeopardize the survival of future generations.[5]

Since the Arab spring, several dictatorships could be overthrown by civil society initiating cross-sectoral strikes. For example, civil society in Turkey has achieved that autocratic leaders stepped down. The Chinese government had to relax their grip on the net and information here flows more freely, at least to all who can still afford to access the web. An open source culture amongst global digital citizens prevails. Intergovernmental organizations with global reach such as the UN, the OECD and IMF are breaking down, as countries devote most of their resources to inward problem solving. Asia has taken the forefront in experimenting with the setting up diverse regional bodies to join forces to tackle existential challenges. Multi-national firms have lost their clout and many are falling apart into regionally operating structures, largely in consequence of unsuccessful struggles with soaring costs of overcoming physical distance.

This vacuum has partially been filled with the power of the networked global society with instant access to global knowledge flows in an open source world. The internet and social media framing of political issues has largely moved from the level of nation states and intergovernmental organizations to organized civil society. However most individuals and organizations have to limit their time on the web and on computers due to high costs of energy and access to these global knowledge flows has thus become more inequitable. On the upside, as time on the web needs careful planning the quality of the information on average has also improved.

The EU in these turbulent times has abandoned the goal of an EU constitution. This is a multi-speed Europe focused on the grand existential challenges. EU member states have pragmatically focused the EU Commission, parliaments and councils activities on four main areas which all of its member states back as vital:

1. *Regional cohesion and structural funds* to counteract the great risk of local wars for natural resources. The EU institutions have successfully strengthened their regional policies and developed more direct relations with municipalities and regional leaders in areas of risk.

2. *Internalization of environmental and social externalities in the pricing* of goods and services and a monitoring systems promotes long term sustainable use of rapidly declining natural resources was established building on the concept of protecting ecosystem services.[6] This has led to further price increases of energy, food and consumer goods, but is acknowledge by all EU member states as the only way forward for a livable world for our children. The 2014 Directive on disclosure of non-financial information [7] has also contributed to the EU's effective accounting regimes for the rebuilding of and sustainable management of natural and social capital of enterprises, similar to the EIF Impact Accelerator's approach that was first instituted in 2013. These regimes today guide investment decisions throughout the EU.

[5] Loosely based on the book by Franck Biancheri (2010)« The Global Crisis: The Path to the World After – France, Europe and World in the Decade 2010-2020 »Editions Anticipolis: Brussels, although the Eu's rapprochement to the BRICs failed.
[6] EU Public consultation: 05.06.2014 – 17.10.2014 on the Consultation on the future EU initiative on No Net Loss of biodiversity and ecosystem services. http://ec.europa.eu/environment/consultations/nnl_en.htm last accessed 21.8.2014.
[7] 2014 Directive on disclosure of non-financial and diversity information by large groups and organizations. http://europa.eu/rapid/press-release_STATEMENT-14-124_fr.htm

3. *Environmental monitoring system* relies on citizen observatories and is connected to an ever more developed EU statistical system. It informs activities that significantly impact material and energy flows in specific geographic perimeters. This system for environmental monitoring helping regions and municipalities to keep track of their rights and responsibilities of consumption and production in view of their local natural resources. Stronger accountability through the European Statistical System for a set of sustainability indicators. Mapping local carbon stocks inflows and outflows as well as working with citizens observatories to monitor key biodiversity indicators have helped the EU to get to the world's leading most sophisticated system to manage natural resources and makes the EU an attractive target for well-educated immigrants.

4. The development and running of European early warning systems of extreme weather events and other natural catastrophes like earth quakes; it also informs about the spread of infectious diseases which have become much more of a global threat as the planet heats up and natural resources and functioning health care systems dwindle unevenly.

Many migrants seek to enter the EU, because of its relative stability, due to its successful policies on sustainable and inclusive growth it established and expanded since 2010. Whilst the EU is strong on issues that member states agree are common existential challenges, most individual national governments are weak and crippled by debt overhang from the unsustainably managed pension and welfare systems. Many countries are fighting with increasing nationalism, and right wing or left wing political parties are gaining in influence and sometimes win elections as in Greece in early 2015.

In successful EU regions success is defined through social cohesion, a sense of well-being and fulfillment. Health is defined in a broad sense largely with reference to fundamental human needs closely to the conception by sociologist Manfred Max-Neef that emphasizes the quality of human relations (see section II.3. below for more details).

The pressure on the EU's borders is growing, and threats of wars for natural resources are increasing. The financially ailing Member States have at long last agreed to pool spending on a common police force and to build up EUROPOL to have representation in Member States and to increase its role in policing the EU's borders and areas hard hit with natural disasters or droughts. More successful EU regions work proactively to promote proven approaches to foster local social cohesion and economy helping to overcome the multiple crisis, and growing tensions.

In Europe, like in Asia too, there is a growing number of regional governance bodies around specific issues. Municipal governments are more organized and have formed groups of shared interests often across borders. A prime example is set by municipalities of the Greater Region in Europe, which has at its core one of the first cross border megapolis formed from the former cities of Esch, Thionville, Metz, Nancy and Saarbrücken. These cities have built a common governance structure – from necessity as they had to down size the individual municipal governments due to sever budget constraints below the level of functionality.

Most municipalities have now a decade of experience in working with social media tools and participatory methods with their citizens to have volunteer groups carry out projects for sustainability and improving quality of life locally. Most schools are co-funded by municipalities and citizens groups and learning from early child hood is focused to tackling complex existential problems, locally, whilst also drawing on the web and translating global abstract knowledge in to locally applicable solutions in groups respecting diverse opinions. They are working directly with the EU institutions and lobby them, and are planning and spending regional and cohesion funds. Member States feel this is the only mechanism in these turbulent times to prevent civil war and strife, and thus pay their dues, even cringingly. Luxembourg is no exception in this.

I.3. The global economy and free trade

Hard-hitting extreme weather events, the energy crisis and the scarcity and uneven distribution of natural resources required to serve fundamental human needs have resulted in regionalization of the formerly global economy, and regions are connected with each other.

Too slack an approach of governments to regulate the financial industry after the 2008 crisis led to a second and even worse crisis in 2017, as predicted by leading experts on the global financial system.[8] This crisis was brought on by the collapse of Goldman Sachs, too much engaged in derivatives products, which also pulled down like a card house several other multi-national investment banks and insurance firms. Most Western economies had to invest further billions to reduce damage caused, but refused to bail out these reckless companies. Eventually the global monetary system broke down. The Euro was subject to devaluation at the peak of the crisis and is now complemented by regional currencies; state banks have reassumed the right to issue money with low interest rates and former national debt was canceled. Local banks are financing the local economy that is tied to real values.

In 2019 resolute action was taken by the EU to a) institute taxation of individual financial transactions; b) regulate the trade of derivatives out of existence; c) tightly couple again the issue of credits with the risks associated and cracking down on the practice of subprime lending; and d) placing a ceiling on the leverage factor by individual banks to a maximum of 5; and changing the incentive system to one that involves medium term accountability. Most countries in Asia, led by Singapore, Japan and China, followed suit. The former CEO of Goldman Sachs resigned his post as US Secretary of the Treasury, and he and his colleagues leave a huge vacuum in the global financial system, which has to be thoroughly reinvented. China developed its own credit rating system in 2014, and the EU followed suit in 2017, so as to no longer to depend on the three US rating agencies which had labelled bonds made of exclusively subprime lending credits and derivatives thereof triple A. The sector now operates regionally, as the global monetary system has been forced apart in the 2017 crisis. This also prompted the exodus of international banks from Luxembourg. Foreign direct investment, flows of money have drastically gone down since the second financial crisis. Obligatory disclosure of non-financial information informing regional investment activities further directs attention to local benefits and impacts of firms, and selects against entities attempting to report aggregate impacts over too great areas. A more functional European financial space that allows for cross-regional investment has been established - there are winning and losing regions.

Local currencies have cropped up on all continents, usually developed by groups of municipalities. This trend is well exemplified by the situation in Europe. The Euro, which was repeatedly devalued in consequence of the enduring second financial crisis, is complemented by hundreds of local and regional currencies that have been developed as tools to steer groups of municipalities towards autonomy (Autarchy). The Euro is however still recognized as prime tool enabling the EU to become largely self-sufficient again.

Sky rocketing fuel costs directly impact costs of overcoming physical distance due to internalization of environmental externalities in fuel prices combined with increasing fuel scarcity. These combined circumstances are causing the progressive break-down of global production chains, with a concomittant decrease of international trade, direct foreign investment, and increasingly inward looking continents.

Global free trade has broken down. The recognition that neo-liberal doctrines assuming and thereby reinforcing static resource allocations have actually hindered learning to cope with rapid change in a

[8] Rajan, R.G. (2012) Fault Lines: How Hidden Fractures Still Threaten the World Economy. Princeton University Press. (2005) "Has Financial Development Made the World Riskier?". National Bureau of Economic Research. ; see also film 'Inside Job' Oscar winner 2010 best documentary.

society, advanced by Stiglitz in 2014, became dominant discourse in the 20's.[9] Bilateral talks between the US and the EU on the *Transatlantic Trade and Investment Partnership (*TTIP) failed in 2015, largely due to fears of this agreement giving too much power to multi-national corporations to file law suits against decisions of elected national governments and as such undermining the functioning of democracies; further anchoring of principles of neo-liberalism also was seen to cause further learning blockades in the face of sustainability challenges humanity can't afford.[10] An unexpected consequence was that the failure of the bilateral talks caused so much animosity that the entire GATT was shaken to its foundations and fell apart. Economies rapidly regionalized, further driven by resource shortages and rising costs of overcoming physical distance due to the energy crisis.

The severe economic crisis has led to re-organization of the economy to an economy of shared goods, infrastructures and services.[11] Many manufacturing jobs of Europe's industries have been moved back from China. The EU firms have re-localised most of their manufacturing operations, largely due to the significance of transport costs and logistics. The logistic sector has shrunk. Boats or by trains became the main transport and logistics media but train infrastructure has still to be improved. In society at large there is more emphasis on services establishing and maintenance of shared products and infrastructures such as cars. Life styles are no longer centred on the accumulation of material goods as status symbols. Most were industries re-localised, and a shift to small and medium firms, reuse and recycling, of consumer products, etc. Citizen cooperatives around food, housing and energy systems abound. The European car industry greatly declined, because of the demise of the car as social status symbol, and cities relying quasi exclusively on car-sharing systems reducing the car ownership ratio from well over one car per household in 2014 to less than one car for five households in 2030. Forward looking firms jumped on the band wagon of car sharing early, as did Volkswagen who integrated the provision of shared cars and associated services early on in their strategy. This however did not make up for the plummeting demand and associated sales. The car fleet on the streets has declined accordingly, now there is on average in the EU one shared car for five users. This trend is indicative of what happened in other sectors for the production of consumer goods, tens of thousands of jobs in manufacturing were lost. Asia too experienced a shift towards an economy of sharing, defying many forecasts of rampant consumerism in China creating huge markets and fuelling global growth. There is growth in Asia, but it is modest and self-served in comparison to expectations of some free marketers in the West between 2010 and 2015.

Material flows around the globe have also gone down due to rising cost of crossing physical distance, whilst global flows of knowledge via the internet have increased. This is the age of 3 D printing, allowing ever more complex consumer products to be produced in a very delocalized manner, ranging from simple clothes to vaccines.[12] Benefits for the environment are obvious, and this technologies had a massive role in helping local communities towards autonomy. The EU has become self-sufficient in producing all basic input materials for the entire range of consumer products for which open source protocols are available on the web. For food the concept of eat it here grow it there is fully out of date and not only in rural areas but also in cities most families are close to self-sufficient with fruits, vegetables and eggs.[13] As in Cuba after the collapse of the USSR, food autonomy was defined as regional goal, forward looking regions such as Torino or Liège had already started to work towards this goals as early as in 2014.

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[9] Stiglitz, J.E. and Greenwald B.C. (2014) Creating a learning Society : a new approach to growth, development and social progress. Columbia University Press: New York.

[10] Monbiot, G. This transatlantic trade deal is a full-frontal assault on democracy, , The Guardian, 4 November 2013

[11] Amin, A. (2009) The social economy. Zed Books Ltd.

[12] Pearce, Joshua M.; et al. 2010 "3-D Printing of Open Source Appropriate Technologies for Self-Directed Sustainable Development (Journal of Sustainable Development, 3 (4),17–29.; New Scientist magazine: Make your own drugs with a 3D printer, 17 April 2012 ; "3D Printed Clothing Becoming a Reality". Resins Online. 2013-06-17. Retrieved 2013-10-30. ; Michael Fitzgerald (2013). "With 3-D Printing, the Shoe Really Fits". MIT Sloan Management Review. "Print me a Stradivarius – How a new manufacturing technology will change the world". Economist Technology. 2011-02-10.

[13] See project CityFarm of the MIT media lab: http://www.media.mit.edu/research/groups/changing-places

Whilst high energy costs restrict physical material flows of materials and people, knowledge knows no territorial borders, it is a highly networked world with access to global knowledge flows for all who can afford it. An open source culture enhances social learning for resilience to rapid global change.[14] Technological development that promotes simplification and localization of production and overcoming economies of scale, such as 3 D printing have further encouraged local and regional actors in their strife for autonomy. There is much creativity including for types of materials with diverse properties suitable for 3D printing. This world is one of experimentation with alternative energy, business, and governance models, with a focus on interests and logics prevailing at the local and regional scales.

The global economic crisis has now lasted 22 years, market mechanisms of our neo-liberal economic system have continued to erode natural and social capital. Most Western economies are thus still failing to recover from recession due to a combination of a) an unfavourable age pyramid, which can only be partly off-set by immigration of a young labour force; b) the pension crisis in an ageing population which further reduces spending; c) sky rocketing energy, food water and land prices.

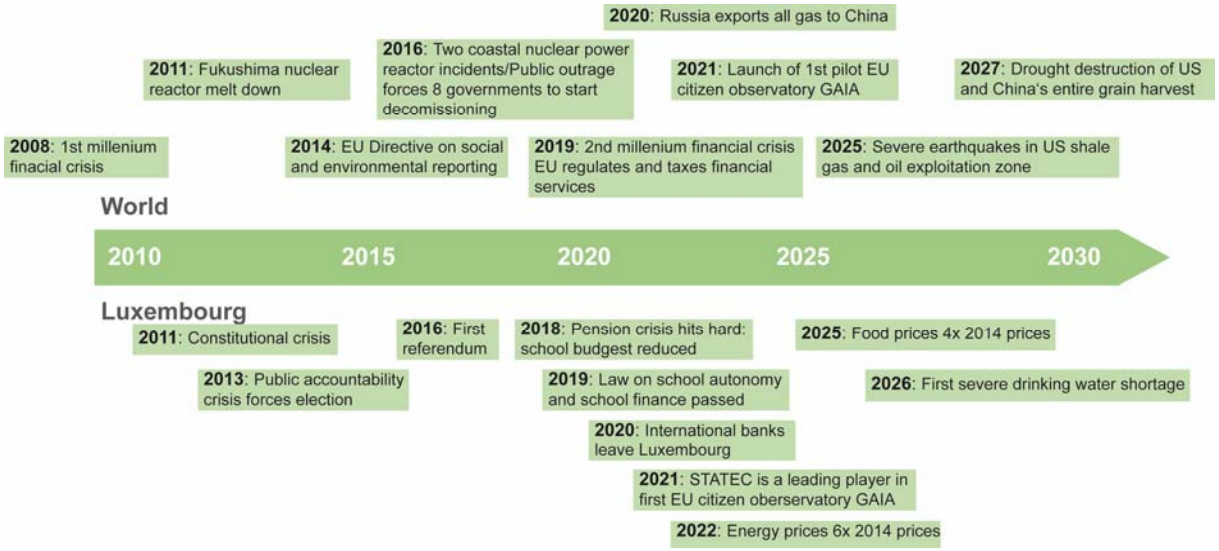
One fundamental policy change necessary to ensure we are not taken over by our economy is to assess progress not in terms of productivity as many leading economists still advocated even in the 1990's but in terms of human flourishing . The conception of flourishing and health and governmental policies focus very much on prevention and precaution as hospitals are overcrowded and in sufficient medically trained persons are available. This also has repercussion on employment policies. Not only are jobs requiring repetitive tasks, movements or postures for over 30 hours a week considered unhealthy (working time is reduced to 30 hour weeks). Also insights from biomedical research on preventive strategies including very early after birth relating to findings that stress from early separation of babies from parents results in vulnerabilities of the respiratory system and stress management are taken serious. Maternity and paternity leave provisions are changed but integrated in the policy of provision of a basic salary.

As part of the global movements promoting concepts such as the economy for the common good and associated balance sheets, or the 'Blue Economy' promoted by Gunter Pauli, a complementary set of national and EU indicators beyond GDP, building on Stiglitz, Sen and Fitoussi first ideas in 2010 was adopted that provides a real new focus on well-being and the common good, and the development of an economy of sharing.[15] Investment into education of workers is deemed fundamental. Social enterprise and social entrepreneurship and assessment of social impacts beyond mere productivity measured in material and financial terms is key. In this society, robots have a hard time finding someone who purchases them, energy is dear, and social enterprises more than any other rely on buildings local networks of communities of interest and serving them.

[14] Stiglitz, J.E. and Greenwald B.C. (2014) Creating a learning society : a new approach to growth, development and social progress. Columbia University Press: New York, pp. 429-457.

[15] www.ecogood.org; www.theblueeconomy.org; www.zeri.org

Figure 2. Timeline
Landmark events in the world



Landmark evens in Luxembourg

II. Luxembourg in 2030

There was no real resistance to fundamental changes of the working of economy, society and school systems as solutions merged from imperatives of the crises. The second financial crisis in 2017, a concomitant energy crisis and consequences in terms of loss of value of the Euro ending in a money devaluation, high inflation, rapidly rising interest rates and severe repercussions on individuals in Luxembourg – in ability of servicing of paying mortgage debts of over 50% of the population, in addition to rise in food and energy prices and cost of living. National government faced (and still faces) tough choices and trade-offs in terms of payment of salaries of civil servants, pensions, hospitals and health care, and education. All these events triggered a point of rupture in the logic of how societies can function at this day and age.[16]

Luxembourg reached the point, where Iceland was in 2010 in the wake of the complete collapse of the national financial system, and Japan in 2012 with the worst energy crisis in the aftermath of the disaster at the Fukushima nuclear power station, a point where citizens and governments alike recognized the need to fundamentally reinvent how society functions, including fundamental values driving economic exchange and ideas of well-being and living with nature. The accumulation of break downs of our system forced the general public to loose trust and governments to change tack in 2019. A survey in 2010 by the German Bertelsmann-Stiftung showed that 88% of Germans and 90% of Austrians wished for a new economic order, in 2022 no Luxembourger believed the status quo of disrupted economic and energy systems could be upheld any longer.[17] Initiatives like the German Gemeinwohl-Oekonomie Initiative promoting the same values for economic exchange that also underlie the success of personal relationships, such as trust-building, appreciation, cooperation, solidarity, and sharing, multiplied and

[16] Diamond, J. 2005. Collapse: How societies choose to fail or succeed. Penguin Books.
[17] REF :

became influential in the building of local and regional economies, and eventually also gained influence at national and EU levels. These values are most strongly linked to happiness and personal motivation. Incentive schemes and measurement regimes for individuals and organizations engaging in economic activity are entirely made-over to be adapted such that achievements are rated according to these values in terms of addressing diverse and unmet fundamental human needs, quality of life and the common good.[18]

Consequences of calls for renewal of government included that government organized a consensus conference in 2020, as in Denmark in 2010. In complement, a national referendum was run about a commitment to engage in social learning processes and start a societal conversation in a range of bottom up participatory processes on how to define and address fundamental societal needs largely with local resources in a sustainable manner. Whilst political parties all back overarching ultimate goals with a time horizon of 2050 that emerged from the consensus conference process, they advocate different means to reach them. The social learning process that draws on citizen science for monitoring social change and environmental impacts, the staging of dialectical debates to critique prevailing ways of life, and scenario planning to think creatively about alternative futures, also serves to cross-question and continually adapt the consensus goals.

The combination of these 'social technologies' and social innovation processes largely driven at the local and regional level, that influence and are effectively connected to governance and policy making at the national level allow for a fundamental rethinking of what fundamental human needs are and how they can be better addressed with local resources, - solutions emerge from societal conversation, often largely at the municipal level. Luxembourg and the Greater Region have successfully positioned themselves as a region whose strife for local autonomy is successful and that has a relatively high quality of life and social cohesion compared to other regions in the EU.

New regions have formed according to large cross-border regroupings of municipalities with shared interests. There are in Luxembourg four regions with close-knit local economies and social networks that extend beyond the national border:

- The North that has close ties with the Belgian German minorities and the adjacent municipalities in the Eiffel.
- The West that closely relates with cross-border Belgian municipalities in the Belgian Province du Luxembourg
- The East that collaborates with Trier and the Saarland
- The South that collaborates with the French Lorraine

The four regions are strongly connected to the Centre with the capital not only through social and economic networks but also through the Luxembourg City food belt cooperatives.[19]

Regional knowledge networks across the greater region have contributed to building the strength and success of this region. The fact that the Saarland and the Lorraine, as peripheral regions in decline with structural problems felt badly served by their national governments in the two first decades of 2000, and thus made an above average effort to engage in cross-border initiatives and build up cross-border regional governance structures in 2020 finally paid off, and how successful regions work with neighbouring areas to scale up/expand solutions for which there is evidence that they improve quality of life at the local level.

Schools have a close link and much exchange with private ventures and organize DIY workshops every year and offer DIY services such as bike repair to contribute to fund selected student activities.

II.1. What are the drivers in the Luxembourg economy?

[18] www.ecogood.org

[19] Ceinture Aliment Terre Liégeoise en cours de construction http://www.catl.be/

Most of the diversification strategies for the Luxembourg economy initiated at the turn of the century have born fruit by 2030. Small and medium enterprises predominate in particular in the sectors that have been targettedly developed since 2010: life sciences for disease prevention; information and communication technologies (enterprises in these sectors are regionally clustered); regional tourism & spas; eco-technologies in the energy and construction sectors, and recycling and repair. Production of electricity fed into the grid is now largely decentralised. Since slow starts in 2012 with pioneering municipalities founding energy cooperatives such as Junglinster and Beckerich, now many municipalities are close to energy autarchy. The University's interdisciplinary centres and the Luxembourg Institute for Science and Technology effectively supported these developments with R&D. Urban design focuses on social cohesion and on infrastructure integrating eco-technologies and green jobs. Luxembourg now has a number of fully autonomous districts with a high quality of life that contribute to an innovative and locally adapted regional economies.

However, since the global recession persisted over 20 years, there was low foreign direct investment. Loosers included the logistics and the finance industry, which have suffered due to the long lasting economic crisis leading to the break-down of global production chains, the increasing costs of covering physical distances, and the fragmentation of the global monetary system. The reform of the financial services sector led to most international banks reducing their operations in Luxembourg. Luxembourg remains a platform for the fund industry thanks to legal tools, human resources and tax subsidies to socially responsible investment funds, local or international.

National banks across the EU assume the right to create money and to make debts at lower interest rates with strict limits and only to finance the real economy and development of local economies. Most share the aim to create a new economy mostly driven by local networks of small and medium size companies, taking in account environmental and social impacts through a systemic analysis, source of multiple cashflows and opportunities. Enterprises with strong bottom lines for common good and quality of life enhancement receive legal advantages such a s slightly lower taxes, more advantageous credits, , which has immediate repercussions on the pricing of their products. The use of profits and surpluses is regulated for all economic actors: Investments in social and ecological projects, payback of credits and limited distribution to all employees are allowed; not allowed are hostile take-overs, investments on financial markets (most ofthese collapsed), and donnations to political parties. There is no more growth imperative, but optimal size and quality can be enhanced. Maximum revenues are limited.

The principles for the new economy were put to debate in a referendum during the national consensus conference period.The principles and values underlying this interpretation of the common good and economic activity for it are firmly embedded din the education system.[20] Beyond the thinking of a circular or local economy the concept of an economy of sharing and development of diverse common goods and services now prevails in societal discourse. There is a shift in thinking from formal employment and contracts to 'occupation' in a broader sense where formal employment amounts to a maximum of 30 hours a week (a measure developed also to counter rising 'unemployment'). The development of this new economy again reinforces the development of communities of interest that are more tightly associated with community of place.

There is a shift of skills towards those required in a local economy that strives towards local autonomy that. Agriculture, construction and retrofitting for energy and water efficiency, energy, recycling and repair, through social entrepreneurship, care services.

Luxembourg has experienced a rise in social entrepreneurship, social reorganisation and collaboration. New forms of social entrepreneurship with business models giving primacy to achieving social and

[20] More information on the Gemeinwohl-Oekonomie Initiative: www.ecogood.org; an alternative model is described as the 'Blue Economy' see Gunter Pauly www.gunterpauli.com , www.zeri.org or www.theblueeconomy.org

environmental impacts have benefitted from increasing value of local production and new types of services have merged to do with repair and reuse and exchange of goods and services. In consequence the distinction between 'blue' and white collar communities is eroding as all who recognize opportunities in crisis benefit from skills of both types. Cooperatives become a frequent legal form of enterprise, with housing cooperatives and energy cooperatives modelled largely on the early Junglinster Equienercoop,[21] having established all over the country. Diverse forms of social enterprise including cooperatives and Société d'Impacte Sociale abound. Local agriculture has become predominant through urban agriculture and food belts around population centres, offering new opportunities for businesses, jobs and local clean food, some say they can prove a correlation with sinking medical expenses.

Table 1. Employment by sector

Sector	**2010**[22]	**2030**
Motor vehicles:	50 000	20 000
Financial/ins:	43 000	20 000
Construction:	40 000	50 000
Health&social:	34 000	54 000
Manufacturing	33 000	25 000
Food	5 000	25 000
ICT	5 000	10 000
	10 000 (Metal)	5 000 (Eco
Prof. Sci&tech	32 000	tech)
Logistics:	25 000	25 000
Public sector:	20 000	15 000
Education:	18 000	25 000
		20 000
Total jobs	**315 000**	**300 000**

To combat unemployment and to counter incredibly high rates of burn out from increasingly unmanageable stressful conditions at work and at home, as well as to curb growth and unnecessary consumption, in 2023 the 30 hour working week was introduced.[23] The working population is dividing up their time across child care, care for elderly relations and subsistence farming. These more balanced working life styles have had a favourable impact on the public health system and divorce rates have started to come down. However, given the ageing society, some of the positive measures to combat unemployment from the exodus of the financial services industry and multi-national manufacturing firms, young immigrants now compete with Luxembourgers for jobs. Salaries in Luxembourg no longer compare so favourably with the neighbouring countries, and the cost of travel has resulted in the number of cross-border workers to drop drastically from over 160 000 in 2014 to a mere 60 000 in 2030. Unemployment of Luxembourg nationals and residents has sunk back to 5%.

Jobs and skills required in the Luxembourg economy: Middle classes suffers as technological advances erode traditional jobs including not only blue collar jobs in factories and warehouses but also office clerks and secretaries: The salary gap between low skilled and high skilled work is further pushed apart by technology. The logistics sector is particularly hard-hit. Skills needed apart from computer and network engineers and managers are local food producer and restaurant workers, builders and engineers, medical assistants, janitors and other personal service work that can't be automated. [24]

[21] www.equienercoop.lu

[22] STATEC. 2013 Luxembourg in Figures.

[23] Sharing the work and improving the work-life balance was one of twelve steps to a sustainable economy in Jackson, T. *Prosperity without growth? The Transition to a Sustainable Economy* (Sustainable Development Commission, London, 2009). Similarly, UNEP identified "channeling productivity gains toward more leisure time instead of higher wages that can translate into ever-rising consumption … increasingly makes sense from an ecological perspective." UN Environment Programme (UNEP). *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World* (UNEP, Nairobi, 2008).

[24] Rotman, D. 2013. How technology is destroying jobs. MIT Technology review 116, 28-36.

National and local policies in the EU and in particular in Luxembourg counter these trends pro-actively fostering policies for a social and solidarity economy of sharing to ease social tensions and the risk of unrest and aggression as in the UK in summer 2013. Changes in ownership in the energy sector are a good example: A large number of municipalities and firms are close to energy autarchy thanks to investments by group of citizens in solar and wind energy systems and improved storage technologies. Many municipalities have purchased the grid and also have developed capacity to service and maintenance of the energy grid (electricity as well as district heating), as well as of computer networks and systems.

The business propositions of the social economy is knit around societal conversations on how a social system can evolve to address fundamental human needs in an increasingly self-reliant manner. Including considerations in the societal conversation on our relation to nature and technology, as well as the relation of global to local; the personal and the social; and the citizen and the state are key.

New social enterprise sectors have evolved as well as more traditional social enterprise sectors have evolved to have stronger business models allowing them financial autonomy rather than to depend on dwindling state subsidies. New models include schools that are run entirely as social enterprises developed by communities of interest, such as the international community active and settled in Luxembourg that still persist around the web-related services that have gathered here. But also social enterprise models exist around turning waste into recycling and repair, or network and computers system management, and energy-grid or water pipe maintenance services. Public infrastructure repair jobs are often executed by experts operating as social enterprises supported by troops of semi-trained volunteers (e.g. detecting leakages in water pipe systems, etc.). Social canteen and catering services knit around local food grown also in community gardening projects. More traditional forms of social enterprise offering inexpensive care services are also major sector offering employment – here business propositions include gardening and livestock keeping (mainly chicken, sheep and goats) to help where part of the pay is in the form of a fraction of the harvest where this makes sense. So the provision of food, care and support for subsistence farming have evolved into a closely knit community network that largely relies on regional currency. Many building projects of public structures are now executed by volunteers in municipalities. Many housing projects are now developed by housing cooperatives. Builders, electricians and carpenters are highly welcome members in such housing cooperatives as well as more polyvalent craftsman.

Diversification of the economy and the prevalence of SMEs requires healthy adaptable work force with adaptable skill sets to service the wide range of local needs, values, and contexts. SMEs already in 2015 represented over 99% of companies, 64% of the turn over in the EU and 68% of jobs. Rapidly changing technologies and thus expertise required at work strongly affects diversification of schools. Regional clusters of small and medium enterprises in particular sectors, such as the life sciences in Esch Belval, affects the finance and regional diversification of the school system. Many small and medium enterprises have opened up internship programmes beyond just summer internships starting at the age of 15. Activity demonstration days are also regular events, and employees have contracts with schools to teach a set of hours of applied science starting at the age of 15 in more specialized tracks.

In consequence local enterprises strongly collaborate with schools and push programmes to build collaborative and empathy buildings skills for building social networks of communities of interest made up of up stream and downstream chain stakeholders and clients that local businesses rely on. Skills related to food cultivation and provision, computing, healthcare, construction and polyvalent craftsmanship and education are most highly in demand.

II.2. Government

Luxembourg's government is weak and downsized in consequence of the public debt overhang from the pension/welfare system crisis. Rising demographic diversity and increasing regional differentiation within Luxembourg threatens social cohesion. Given public debt there is little that can be done at national level. The country is divided in pockets of more homogenous populations a trend already identified in 2013 based on statics has become ever more extreme.[25]

The national government is experiencing a severe public debt crisis, and in consequence was massively downsized relying on improved computing, artificial intelligence and big data have allowed to replace a great share of secretaries and office clerks including accountants with intelligent computing systems. Main spending is on the health sector due to costs incurred form pensions and health care commitments of an ageing population. Tough choices between government spending on health, pensions and education have to be made, as was already the case in 2014 in Japan. Spending on schools was reduced to a level that still makes the social contract just viable for the young, such that they further contribute to the pension system. Time spent in school and formally spent in class with teachers was reduced to lower school costs but instead spending on education contributes to ensure more equitable web access in the interest of fostering social stability.

To counter rapidly rising unemployment that is now at 15% and the severe lack of young people in caring jobs for the advanced in age, a policy of the 30 hour week was introduced to ensure a more equitable access to jobs, but also to counter the retirement age that was notched up to 70 due to the pension crisis. Every fifth year a minimum basic income is paid, yet again compensating for unemployment and freeing up the job market for 20%; this policy, which was trialed for the first time paying minimum basic income just every tenth year in 2023, proved to have huge impact on well-being and individual creativity and productivity and founding of exciting new community-minded local enterprise ventures.[26] Taxes have risen and there is a scramble between European countries to attract the last few multi-nationally-operating corporations largely in sectors providing materials for 3 D printing. Luxembourg was successful in the medical computing domains – both key strategic choices to ensure a higher quality of life than average.

A range of Luxembourg municipalities on the borders are closely cooperating with municipalities with related interests in the Greater Region across the frontier. Local and municipal governments in the greater region have developed improved mechanisms for cooperation to deliberate and find solutions to shared problems that are unknown to national governments in Paris and Berlin who consider Lorrain and Saarland as the poor periphery. The Greater Region has been making a great case through the European Groupings of Territorial Coordination as region in industrial decline from exodus of steel industry and is a target for the few still existing and further dwindling cohesion and structural funds also from EIB and EIF in high risk areas. What started modestly with cooperation to develop biking and walking infrastructures to foster sustainable transport has developed in offering regional financial solutions for housing cooperatives as well as education campaigns for citizens wishing to engage in such social enterprises. Grevenmacher is firmly embedded din a more Germanic regional club, Esch with French municipalities in the Alzette-Belval area, whereas for example Beckerich is interacting more with Belgian neighbours. Strong municipalities practice new more effective forms for regional cooperation.

Luxembourg within itself has become culturally segregated in itself as foreseen by the gentrification report. On the one hand this is an upside, as such relatively more homogenous communities culturally and linguistically tend to function better with fewer frictions in their strife to agree on priorities for human needs and how the community including the municipality and citizens can ensure there to address these

[25] see CEPS report 2013.

[26] See also the German initiative : die Gemeinwohl-Oekonomie www.ecogood.org; www.zeri.org And www.TheBlueEconomy.org

better. A culture of civic engagement at the local and regional level has developed. Local opportunities for engagement of non-national residents in municipal and regional politics and planning are also encouraged. Diverse dimensions of citizenship and associated rights and social responsibilities are taken more seriously, due to engagement at the local level and teaching in schools.

Municipalities have developed ingenious ways of soliciting volunteers for municipal projects by offering them tangible returns other than financial in the form of access to the internet and services of social enterprises offering care services and restauration related services, but also computer, network and energy-system related repair services. Waiting lists for some such services exist, but priority is determined through hours of volunteer work absolved for local public (infrastructure) projects. Moreover, volunteer work is designed to be as much fun as possible and associated with events and parties at which community grown and produced food is served. And future municipal projects are prioritized. National and local policies exist to reserve a percentage of new buildings or refurbishing projects to ownership by housing cooperatives.

However tensions across these communities of interest in municipalities grow – especially in areas where there are more several resource constraints or inherited unfair allocations of these where municipalities in the 2010-2020 purchased sources from less foresighted neighbouring municipalities.

Urban planning aims to further develop local identities as well as to attract diverse communities to counter growing inequity. Examples of such schemes include the promotion of cooperative forms of housing are designed to accommodate a range of different pricing options and cross-finance between short term of travelers, medium for students and long term for social low income house-holds rental units. Improved solutions to include community building measures and shared services in urban design for density better lived. Including like in cooperatives governance system and mediation options.

II.3. Society

The population of Luxembourg counts 630 000 residents in 2030, with 55% non-national residents.[27] Luxembourg migration policy is moderate: non-national residents have no voting rights; immigration from outside of the EU is not favoured, education is a major selection criterion for entry. Migrants wishing to enter Luxembourg still largely come from Portugal, the Balkans, and Africa. Luxembourg society is slowly becoming more diverse with a steady stream of immigrants. The number of languages spoken in Luxembourg is increasing, however minorities cluster in pockets across the country. There is a fairly high naturalization rate due to local engagement politics. Migrants distribute themselves and settle in culturally more homogenous pockets across Luxembourg. Whilst this greater national workforce from attracting a young immigrant workforce to partially off-sets the unfavourable demography, the dependency ration in the population is as high as 66%.[13]

The number of cross-border workers has dropped from over 160 000 in 2012 to 60 000, largely due to increasing fuel and transport prices making a daily commute unattractive and smaller differences in salaries between Luxembourg and the neighbour states, and fewer jobs in Luxembourg available for non-residents. There is a shrinking middle class and a more inequitable distribution of salaries, as robots replace blue collar jobs in manufacturing and warehouses and more importantly improved computing systems replace many job profiles the yield middle of the range salaries such as accountants and other office clerks, e.g. postal services, secretaries, and . With local striving for autarchy in food and energy and water provision as well as recycle and repair services – the valuation of diverse roles becomes less differentiated.

The structure of society, evolution of the medical system and conceptions of health: Hospitals are overcrowded by the aged and public health service was forced to outsource at high cost services to

[27] Bulletin du Statec no. 5-2010. Projections socio-économiques. P.268 Scénario baseline – with climate, compatriots and demographic structure of the population being the main driving forces for immigration choice according to EUROSTAT experts.

private hospitals as there are not sufficient numbers of medical doctors and medical assistants working in the public sector, similar to the situation that Japan met already in 2015.

The government has based on recent research in medical science that focusses on prevention. There are ongoing publicly financed campaigns with these recent insights on preventive medicine that are also integrated health education in schools that largely focus on diet – to eat less meat and more complex plant foods including pulses and the right sort of physical exercise. There is also a growing array of diagnostic tools to identify imbalances in the body. Such microchips for personalized blood analysis that immediately provides advice on health-improvement practices can be printed with 3D printers. Luxembourg's Centre for Systems Biomedicine together with the Biobank that cooperative closely with the hospital system have, as planned when it was set up in 2012 become a pioneer in preventive medical research and health systems.

The understanding of health relates closely to Manfred Max Neef's eight dimensions of fundamental human needs of subsistence; protection; affection; understanding; participation, leisure; creation, identity; and freedom (and later he also added spirituality).[28] Government policies in relation to this include apart from the 30 hour week, fostering adequate parental leave and arrangement to work part time in order to care for family members of advanced age. It has also been recognized that 40 hour working weeks involving repetitive motion (either at desks or in menial labour) is simply too much of a burden for the body, this is another reason for the 30 hour working week with more diverse tasks distributed across formal employment and informal occupation. The working week is 30 hours long to counter unemployment and allow for care-taking of dependent family members; every fifth year a minimum basic income is paid, yet again compensating for unemployment and freeing up the job market for 20%. The pension age is however increased to 70 years.

Energy cost-related challenges to the transport system have the upside of fostering cycling and walking – with recognized health benefits. Subsistence farming in cities and rural areas has proven to improve our understanding of how we relate to nature and also to serve as a kind of occupational therapy to counteract jobs relying on narrow skill sets and repetitive work and counter risks of social tension. Vegetables and beans grown in subsistence farming gardens, where also chicken are kept, and even in Luxembourg façade hydroponics prevail cities and compete for roof space with photovoltaïc systems (for example, in poorer districts with largely Portuguese rooted housing cooperatives façade food cultivation systems there is a greater share of food façades and roofs).

Regional autonomy has helped that basic subsistence is secured for most. However protection depends on the functioning of one's municipality community and social network including family, as the state welfare provisions and public health service is overcrowded and under resourced. There is more time for affection, understanding, and participation mainly at the local municipality level, strong collaboration also depends on a strong sense of identity and community. There is however less time for leisure and creativity, as existential needs and care taking of family and friends within one's network take a larger share of one's personal time.

Given the new focus on common good and Max-Neefs emphasis on social relations as fundament of human well-being since 2025 there was also a revival of local enterprises investing in cultural and art as

[28] Manfred A. Max-Neef with Antonio Elizalde, Martin Hopenhayn. (1989). Human scale development: conception, application and further reflections. New York: Apex. Chpt. 2. "Development and Human Needs", p. 18. **Human Needs and Human-scale Development** stemming from the condition of being human are conceived as constant through all human cultures and across historical time periods. What changes over time and between cultures is the strategies by which these needs are satisfied. Human needs can be understood as a system - they are interrelated and interactive. In this system, there is no hierarchy of needs (apart from the basic need for subsistence or survival) . simultaneity, complementarity and trade-offs are features of the process of needs satisfaction. communities can identify their "wealths" and "poverties" according to how their fundamental human needs are satisfied. --- Satisfaction of fundamental human needs, depends on the generation of growing levels of self-reliance, and on a societal discourse on the following relations: people with nature and technology; global processes with local activity; the personal with the social; planning with autonomy; and civil society with the state." Discussing these relations can help foster the emergence of improved collective social systems that aim to satisfy individual fundamental human needs in a sustainable society.

avenues to foster creativity and social cohesion in every-day life and in terms of thinking of personal ventures in the service of the community.

Housing: Gentrification leads to social housing concentration and ghettos where insecurity and unemployment are located. Innovative companies design ecological neighborhoods where mixity and social networks provides better places to live in.

II.4. Prevailing household family structure

Living expenses are very high as food prices are five-fold those in 2015, high energy and water prices. The cost of land and renting living and office space have not come down, to the contrary, thanks to the precarious food energy nexus land prices have increased as well. Salaries have not kept apace due to the ongoing global economic crisis, compared to the mean disposable household income in 2013 of 5138 Euro[29] there has been a decline of over 25%. A much greater proportion of the income has to be spent on food (an increase from 10% to 20% of household spending, and due to increased land and energy prices smaller housing surfaces and less travel are the norm. Most families take the time to cultivate their own vegetables using roof top or façade cultivation systems if they do not own a garden. A significant share of fruit and vegetables consumed in Luxembourg are produced by subsistence farming – edible landscaping also in public green areas, and community gardens are widely established. Many households rear chicken. In some areas where geothermal energy can be drawn upon at low risk (in the South of Luxembourg where the soil is too contaminated to allow for drinking water use anyhow), farmers are cultivating vegetables and fruit in large greenhouses to ensure an all-year round supply of fresh produce to complement subsistence farming.

The working week has been reduced to 30 hours. Taking care of one's own children and senior parents is expected. What-ever form the unit 'family' has, its functioning has been recognized as key for a well-functioning society. The pension crisis coupled with soaring food, water and energy prices have brought most families with children to join forces with their parents; three generation house-holds are frequent. Most families can no longer afford retirement homes with humane living conditions and care-taking. Most retirement homes are overfilled and under resourced. The internet, teleworking and learning resources makes this possible , however not always effective as many organisations and private households must limit the time on computers and the internet as the energy prices make this ill-affordable. There is a revival of the quality of personal attention in family relationships, and most importantly, growing strength of communal and community relationships. Most (but not all) family relations benefit from this.

These chores on top of solidarity and volunteering chores the functioning of all municipalities depends upon, but that also give voice and shaping opportunities to citizens there is little if any time and spare money for holidays or leisure activities the way they were conceived still 20 years ago. Annual holidays in exotic destinations are a thing of the past. Short holidays travelling in the region, for example biking, walking and horseback riding, are more usual. Grand-parents take more care of their grand-children. Parents and children work at home at least one if not 2 week days, that is a quarter of half of their work or school time.

II.5. State of the environment

The state of the natural environment has deteriorated, largely because policies and regulation in the areas of agriculture, water and energy continued to support business as usual between 2010 and 2020. Overly intensive agricultural practices further depleted soil and polluted ground water tables. Investments into biofuel co-generation plants continued unhaltedly until 2018, with the consequence that nearly all private woodland and associated habitats were cut down and sold for incinerations as bio fuels 2020 and

[29] STATEC 2013 Luxembourg in Figures. STATEC.

2025 as fuel prices and food prices sky-rocketed. Practices of developing photovoltaic systems on façades as well as roof tops were adopted late, such that challenges at the energy-food- water nexus became rather pointed, leading to increased prices of energy and food.
The installation of solar and wind energy systems increased drastically after a series of innovative measures to foster this, and rose to 29% in 2030.

Drinking water access has become a reason for conflict between municipalities. The dam in Esch-sur-Sure had to be dismantled for repair in 2018, though reparation costs proved too high to be financed. Legal loop holes had led to some foresighted municipalities buying up sources for drinking water in neighbouring territories, leaving now other municipalities forced to buy drinking water elsewhere. The number of sources with adequate quality to provide drinking water had rapidly declined until 2018 the regulation on the protection of source zones was changed such that polluting activities were banned rather than just leading to the closure of the water sources themselves. Water became much more expensive.

The implementation of the foresighted transport policy MODU starting in 2014 left Luxembourg with an adequate public transport systemto allow society to cope with the rise in energy prices and associated costs in covering physical distance. In spite of this, commuting to work large distances on a regular basis has become expensive – fuel prices. Together with high land prices the concept of living at home and working in the office can no longer hold up,[30] and most employees spend at least 50% of their time working from home. Most live close to their work place and schools. These developments in the individual and public transport sphere, together with shutting down the last steel works and gas power plants and the decline of the logistics sector left Luxembourg with very favourable CO2 emissions, but also with high energy bills to pay to France and Germany. Thanks to the booming eco-technology sector, the recycling industry is excellent, close to 100% of all material can be recycled is, and most firms have zero waste policies.

*In sum, t*he precarious situation concerning the state of the ground water and freshwater as well as the state of the farm land in Luxembourg and the low biodiversity, make environmental monitoring programmes a corner stone of social learning processes in sustainably governed municipalities. Feedback on permissible degrees of exploitation of natural resources and environmental impacts is recognized as key to safe guarding Luxembourg's future and a matter of every citizen. These monitoring programmes often relying on citizens observatories which are run together with schools. Regular contribution of data collected on mobile devices with simple apps is one element of the new notion of environmental citizenship for which children are already prepared at school, which also helps to enroll families in participation in such activities.

II.6. Science, technology, knowledge: Social learning for resilience

The fundamental problems of civilization in the 21st century are complex, as they involve human-environment interactions. Systems thinking and interconnected thinking are key for recognizing trade-offs of potential solutions in social learning processes.[31]Traditional disciplinary fields of science can only play a limited role in resolving such complex problems, especially considering the prevailing rift between the natural and the social sciences. This was already recognized in the foresighted European Research Framework Horizon 2020 that was launched in 2013, and the results of which led to fundamental changes of the conception of science, in particular environmental science.[32] Nature protection, understanding its

[30] http://www.media.mit.edu/research/groups/changing-places

[31] Vester, F. (2002) Vernetztes Denken. Dtv Wissen.

[32] Stefan Kuhlmann and Arie Rip (2014) . The challenge of addressing Grand Challenges: A think piece on how innovation can be driven towards the "Grand Challenges" as defined under the prospective European Union Framework Programme Horizon 2020. http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=former-expert-groups . Last accessed 21.8.2014.

inherent ability to sustain life and to provide states of abundance, as well as common good values are the bases of the systems thinking and science, the collective interests are above the individual. In this concept, the whole is more than the sum of its parts, providing multiples opportunities and creating values. The development of the whole permits the development of the parts so that all individual interests are eventually in a win-win situation.

This world is one where local context-specific (tacit) knowledge about local community/environmental needs has value. The world is analyzed as interrelated and nested complex systems and systems thinking is a key skill, not only for example for ensuring life-cycle analysis of production and consumption activities but also to better understand inter-relations of economic, social and ecological circumstances [33]and the co-production of science, technologies and knowledge with social norms, structures and practices.[34] Enhancement of social learning processes for increased resilience at the local, regional and EU level is the main political priority and at the heart of most research and technological development. Social learning today is a process of developing an enriched understanding and repertoire of action on problems as a result of open experimentation and judgment of results.[35] Learning at any level of social organization (in individuals, groups, societies) results in the acquisition of competences, a gain of knowledge, and lasting changes in prevailing behavior. Progress then builds on the evaluation of and passing judgment on a direction of development.

As for innovation and intellectual outcomes emerging from social learning processes, this is an open source world, in –line with Stiglitz's early recommendations on how to overcome the learning blockades of neo-classic economies clinging to a framing of static efficiency.[36] Quality knowledge on the web is considered a common pool resource and its applications are developed in collective processes and crowd sourcing of ideas and improvement in the virtual world. Proprietary technologies stood no chance once crowd sourcing in R&D took off in the 2020's.[37] Discovery is reinvented akin to the process by which the operating system Linux for example was devised. Most research and development processes draw on sophisticated ICT based tools to tap into collective intelligence. The same holds true for protocols for 3D printing. However, privacy concerns and abuses by McCarthy-like regimes are the basis for widespread caution: Individuals access the web using identity scrambling software derived from products such as Track erase or Cyberscrub.[38] In result Big Data plays much less role in development and marketing as some thought in 2014.

Sustainability science for our purpose of societal transformation is conceived as a particular kind of social learning process that requires recognition of uncertainty, ignorance, value conflicts and complexity, and will offer collaborative, reflexive learning experiences for all of society. The main outcomes is shared new knowledge for concerted action by diverse groups of stakeholders in a shared common resource, for it improved protection. In 2019 STATEC took the lead following a foresighted environmental engineer to build the EUs first pilot project national citizen observatory for environmental monitoring and improving farming and water management practices in municipalities that was tied to the school system and the EU statistical system. These projects are now fully operational across the EU and both feed reliable statistics on biodiversity, water and air quality into the EU statistical system as well as leading to transformed local practice in view of improved care for these increasingly scarce and expensive resources. In the more foresighted municipalities science transfer officers set up together with the university started sustainability science and social learning projects on diverse topics including the development of an iterative social learning process that is driven by bottom up participatory development sustainability indicators.…

[33] Vester, F. 2008. The art of interconnected thinking.

[34] Jasanoff, S. 2004 States of knowledge. Routledge.

[35] Jaeggi, R. (2011). *Kritik von Lebensformen*. Berlin: Suhrkamp.

[36] Stiglitz, J.E. and Greenwald B.C. (2014) Creating a learning society : a new approach to growth, development and social progress. Columbia University Press: New York, pp. 429-457.

[37] Nielsen, M. 2012. Reinventing discovery: The Era of Networked Science. Princeton University Press.

[38] http://privacy-software-review.toptenreviews.com/

*In sum, s*chools distinguish between teaching abstract disciplinary sciences and practicing to leverage science on local issues in project work in an interdisciplinary manner. Practicing tools for tapping into collective intelligence in real and virtual communities are key. Systemic thinking, and characterizing complexity through diverse perspectives of experts and interests is a key skill. New approaches to social learning for sustainable transformation to solve complex problems at the interface of social norms and practice and energy and resources use now draw on citizen engagement, practitioners and weave in science on tap rather than on top. Conveying knowledge, competences and behaviours to engage in sustainability science for social learning is perhaps the most important goal of schools. Silo thinking and scientific disciplines are frowned upon and it becomes increasingly harder to find people ready to develop very focused expertise.

III. Luxembourg's school system

Today in 2030, Luxembourg's regionalized economy and society thus benefits from a highly diversified school system in which schools have sufficient autonomy to adjust their curricula to local needs in collaboration with local stakeholders and municipalities. Building awareness how we relate to our physical and social worlds is key. Learning to perpetually relate to the rapidly changing natural and material world with its constraints and at once threatening uncontrollable and vulnerable nature is considered just as important as social relations without which challenges of the physical world are hard to affront.
Since the manifestation of the pension crisis in 2017 and the near collapse of the public finances due to mismanagement of the public debt overhang, and severe pressure from expenditures on health care and pensions, the cutting back of school budgets in 2018, the resulting discontent with the school system has resulted in action largely at the municipal level to complement the core curriculum with an improved curriculum that addressed local interests. In 2019 the government was forced to implement legislation for increased school autonomy.

Much enhanced school and teacher autonomy and research-driven teaching practices[39] helped Luxembourg to develop a more diversified and nimble school landscape, which in turn has much enhanced the country's education system adaptive capacity to respond to global change in turbulent times. Education for life long effective participation in social learning is the overarching goal of the school system. The learning and developmental sciences experienced a turn to place humans in the center of study since 2010, and have since then emphasized the importance of the quality of human relations and how we relate to the physical environment in learning environments.[40] Equipping students for tapping into collective intelligence and selecting and translating global knowledge from the web, to knowledge that makes sense and is tailored for locally specific circumstances, is considered as the foremost challenge by schools. Individual schools offer diverse possibilities for specialization according to regionally prevailing needs at age 15.

There are a total of 55 000 students in primary and 50 000 students in secondary schools, with well over 65% non-national residents.[41] Since the year 2010, forty new small primary schools and fifteen new Lycées were built to accommodate the growth in schooling needs that is concomitant with population growth. Of the fifteen new Lycées eight are cross border Lycées built in collaboration with municipalities in Germany, Belgium and France, respectively, modelled on the first cross-border built and inaugurated in Schengen.[42] The schools were built with the motto 'small is beautiful, with target sizes of 250 students for

[39] Carnegie Mellon on networked teachers research
[40] Budwig, N. (2013). The Learning Sciences and Liberal Education, *Change: The Magazine of Higher Learning*, 45 (3), 40-48.
[41] These figures also correspond to the baseline scenario in the Bulletin du Statec no. 5-2010; we assume immigrants have more children than nationals.
[42] Perl – Schengen – German as main language; Diekirch – German as main language; Grevenmacher – German as main language; Steinfort – French as main language; Clervaux– French as main language; Mondorf-– French as main language.

primary schools with classes of fifteen to eighteen, and 600 students for Lycées with classes of eighteen to twenty five.

The main reforms compared to the 2014 system concerning governance of the school system, the curriculum, and adoption of innovative and forward looking approaches to learning, teaching and evaluation are described below.

III.1. Governance and finance of the school system

A decentralized school system has allowed the emergence of a diversity of schools with education offers that are regionally adapted. The regionalization of the school system does not impact its quality negatively, to the contrary.

All five regions ensure a comprehensive offer amongst diverse schools. Schools are differentiated not only in terms of their educational offers and local business networks they are embedded in, but also in terms of state subsidies where local distribution of intellectual resources can be compensated for with state subsidies.

Central roles of the national Ministry of Education is to contribute to the finance of public and public-private partnership schools; to manage the system of governance, monitoring and accountability in a decentralized system; to co-design the core curriculum in close collaboration with leading regional actors and stakeholders of the schools system; to map with digital technologies diverse education offers and teaching projects; and to provide centralized data bases for big data generated in class rooms with research-driven teaching. Schools in turn have autonomous governance structures and complement the core with a locally designed curriculum. Each of these points is considered in turn in this section.

Most schools are now considered as holdings and receive over 70% of their operating costs from the state and complement this with 30% resources from regional bodies with representation of municipalities, local enterprise, and organized civil society. More private schools exist. Local school steering committees raise crowd funding for particularly salient school projects. Partially crowd-funded schools exist. The state makes allocation proportional to spending – depending on what schools commit to deliver and associated expense (e.g. schools offering specialization in the life sciences/crafts get more due to lab needs, equipment etc.) The main cost factors are teaching, establishment of a tutor system, and technology, as well as expertise on information and communication technologies, and special needs including support for newcomers in particular in language learning. Substantial cost savings compared to spending patterns in 2014 come from no school year repetitions due to the cycle system. Average school spending per student varies greatly depending on the regional specializations on offer and the level of volunteer engagement in supervising project- and problem based learning experiences. The greater involvement of parents in school life and education (thanks to the 30 hour week) also contributes to reduce teaching costs.

Evaluation of the school system at the national level is based on a minimalist national school accountability regime that also considers cost-efficiency and effectiveness. Efficiency is determined in terms of means used compared to results achieved, and effectiveness in terms of the relation between objectives and results. Means include staff and their qualification and life-long learning, and materials including infrastructure, equipment, technology, etc. Nationally standardized testing every 3 years assesses a minimum set of literacy, numeracy, and scientific/problem solving skills, as well as creativity, social and team-teaching and -learning competences and ability to reason in the face of uncertainty and complexity. PISA has not much influence. Ministerial guidelines on ‘school organization’ and broad

criteria for comparability of school performance have been developed, these are not binding. Several schools have opted for certification with international schemes that serve for benchmarking the school's governance and management processes that complement that national school assessment scheme.

Mapping diversity and the role of big data: The central government maintains a data base that provides a map of Luxembourg's diverse educational offers at school. The data base is connected to

1. A big educational data reservoir to which empirical data flows from class rooms with observations, results from surveys and assessment and evaluation schemes on individual courses and projects. Each year the government issues reviewed guidance on the collection of such data in order to ensure comparability of methods.
2. A social network used by parents and students to rate schools, programs and courses.

These measures ensure parents and children can optimize their choices if for a particular reason the local offer does not meet their needs. The application process to attend schools in other regions however requires good reasoning, and expects proof by parents of having worked with local schools to improve on their points of critique first. There is high transparency also through a complemented by bottom-up, regionally community /stakeholder designed school accountability regimes around social/equity and environmental impacts and conveyance of strong social and community engagement skills based on loose national guidance. See 2.4. below.

Schools have more autonomy and capacity for self-governance has been built over fifteen years. All schools are self-governed, with a director, governing board, executive team, advisory board with strong parent, student and local economic actors with advisory capacity and veto power on budget and hiring decisions. Self-governance follows principles for a 'learning organization'.[43] There are improved practices and tools for school governance, and models for 'democratically run schools' have been developed as guidance. Monitoring and accountability is a *sine qua non* in this system, and is achieved by testing key sets knowledge, competences and behavior in students at the age of 18; and self- developed indicators for success that are adapted to a schools self-defined mission focus and target community it is embedded in. Each school has developed their own overarching set of guiding values and vision, adapted to that of the local community they are embedded in.

*Self-evaluation of schools***:** Each school runs a participatory process with representatives of parents, children, stakeholders of the municipality and local economy to develop a vision for the school, performance criteria, and a process for measurement and evaluation of the performance which is implemented every three years. Monitoring further education and employability of students who left school and student satisfaction with school and life satisfaction during and after school are key criteria. Key strengths, weaknesses and points for improvement are published.

Regional school networks: Schools have developed strategies to anticipate needs of the local and regional job market and start briefing classes about future job market needs in an inspirational manner as of the age of 13. Locally and regionally co-created curricula with attention to national distribution of regional offers and their complementarity; they are big data driven. The focus on regionalization in schools occasionally poses problems to children with different interests/plans. This is why the state's overview on the offer nation-wide is very important. Diverse and adapted to regional needs in terms of local ecology monitoring projects & local enterprise and social work internships.

School transport has become self-organized relying on shared vehicles and volunteers and optimized to cover minimal distances. Regional schools work in networks relying on shared teachers with specific specializations, and co-creating and sharing of teaching resources that more regionally specific, they have dedicated web platforms for this purpose. Teachers conduct research on learning experiences with new materials in class, this research driven optimization of material is a regional process. Children are

[43] Peter M Senge (2012) Schools That Learn. Nicholas Brealey Publishing: 2nd Revised edition.

occasionally taught in other schools, resulting in more contact across different age groups, and thus easier choices of future paths for the younger children.

III.3. What would the curriculum look like?

What is needed? Students from the earliest age on wards are aware of relations of human activity and state of the environment. They are aware of needs of the local society, economy, environmental management and perpetual improvement of quality of life and environment. In times of scarcity crisis and provision problems to fulfill basic human needs of food, shelter, and clothing. Schools are there to translate form the global school house to local projects and needs – train methods and eye for what are the facts that matter here and now; how to look at them through diverse perspectives; identify local and global interdependencies and tensions/contra-dictions. In this section we consider teaching languages, the curriculum, and guidance on time spent at school. The curriculum as all school life is based on values: equity, humanism, respect of persons and nature. Consequences will be participation, negotiation, collaboration, initiative, open mind.

Requisites to the curriculum: In consequence local enterprises strongly collaborate with schools and push programmes to build collaborative and empathy buildings skills for building social networks of communities of interest made up of up-stream and downstream chain stakeholders and clients that local businesses rely on. Skills related to food cultivation and provision, computing, healthcare, construction and polyvalent craftsmanship and education are most highly in demand.

*T*he precarious situation concerning the state of the ground water and freshwater as well as the state of the farm land in Luxembourg and the low biodiversity, make environmental monitoring programmes a corner stone of social learning processes in sustainably governed municipalities. Feedback on permissible degrees of exploitation of natural resources and environmental impacts is recognized as key to safe guarding Luxembourg's future and a matter of every citizen. These monitoring programmes often relying on citizens observatories which are run together with schools. Regular contribution of data collected on mobile devices with simple apps is one element of the new notion of environmental citizenship for which children are already prepared at school, which also helps to enroll families in participation in such activities.

*S*chools distinguish between teaching abstract disciplinary sciences and practicing to leverage science on local problems to identify how the local community can better address fundamental human needs in project work in an interdisciplinary manner in ways that match local natural and social resources. Practicing tools for tapping into collective intelligence in real and virtual communities are key. Systemic thinking, and characterizing complexity through diverse perspectives of experts and interests is a key skill. New approaches to social learning for sustainable transformation to solve complex problems at the interface of social norms and practice and energy and resources use now draw on citizen engagement, practitioners and weave in science on tap rather than on top. Conveying knowledge, competences and behaviours to engage in sustainability science for social learning is perhaps the most important goal of schools. Silo thinking and scientific disciplines are frowned upon and it becomes increasingly harder to find people ready to develop very focused expertise.

Languages: There are many diverse schools in Luxembourg with respect to main teaching language. Schools have autonomy to define one to three core teaching languages. Progression across the entire school cycles in the core languages must be ensured. Building on accumulating evidence that comprehension of complex problems correlates with level of language acquisition of a core learning

language[44] triggered this fundamental change shortly after the school reform allowing for greater diversification in the school landscape in 2018. Most schools adapt to the main languages spoken locally, and most schools have opted to build two parallel language tracks. Most schools teach in German and French, French and Portuguese, German and English (close to German border), or French and English (close to the French border). There is a French-Spanish school. In addition to the core language of their choice and one first foreign language made at the age of six, students must learn at least one second foreign language starting at the age of 12[45]. All schools have language teachers dedicated to bring new arrivals up to speed in their chosen main language and first foreign language up on arrival in the community.

To bring 'primo-arrivants' migrants who do not speak the local school's languages there is a popular host family program which ensures all new arrivals are joining local families on at least three days a week until bed time and at least one weekend a month in the first year to accelerate language acquisition by complementing forma informal and non-formal learning opportunities. All parents at school realize the value of acting as host families to ensure an adequate standard of teaching at school. This approach heavily relying on a nation-wide volunteer network was accepted after a massive communication campaign by the government started since sea-level rise and a tsunami disaster wiped Bangladesh from the map and Luxembourg in response to pressure from the international red cross accepted uptake of 10 000 Bangladeshi immigrant half of whom were children. The program also helps integration and conveyance of cultural values.

*Curriculum***:** In turbulent times, *the process* by which a curriculum is developed and perpetually adapted to a changing environment is more important than the actual content. There are however guiding principles and corner stones issued by government to ensure a minimum of coherence across teaching in schools and at a high level comparability across schools.

The 2030 curriculum places the individual learner in the center with the goal of offering each learner from age 3 to 19 the possibility to develop their own personalized learning path. Personal development is facilitated by 'learning by doing' and can be adapted to the person according to their personality, development, personal interests, and walk of life. Fully assuming responsibility for own learning is expected from an early age onwards concerning knowledge; competences and skills, and self-awareness and reflexivity of one's relation to one-self, others and the environment. In particular relational knowledge is gaining importance in educating regional entrepreneurs who engage in respectful economic activity frugally considering local needs, the state of the environment and material and energy flows they generate. In consequence, the 2030 curriculum distinguishes between a core curriculum and a local curriculum.

Since 2020, many secondary schools have started to offer both the tracks "enseignement supérieur" and the "enseignement supérieur technique" and to blurr the boundaries between these tracks in optional specializations as of the age of 15. The rang of drivers for this development includes that many skills such as knowledge and competences to engage in industrial co-design processes is much more highly valued than proficiency in French literature. Most Lycées combine offers of a range of subjects from social, natural science, arts and humanities with technical education for individual combination and specialization. Flexible combinable choices to compose individual bouquet of subjects – few restrictions to combinations exist within schools (which adapt their offer of subjects to regional needs). At the age of fifteen students develop their own curriculum with 50% obligatory subjects and 50% of individually combinable options. In fact, it can be said that since 2025 the distinction between ES and EST has finally been eroded. Since 2025 an increasing number of schools are opting to formally become comprehensive schools. About 40 % have acquired that status.

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[44] EMACS – Brunner et al. (2012). Epreuves Standardisées: Nationaler Bericht 2011/2012. Universität Luxem bourg. OECD (2013) PISA 2012: Nationaler Bericht Luxembourg. OECD. http://www.epstan.lu/cms/de/ last accessed on 4 September 2014.

[45] Individual schools choose 1 or 2 main teaching languages (from French, German, Portuguese, English) plus 1-2 foreign languages (from the above + Chinese, Spanish)

Le compagnonnage dans la Grande Région et dans d'autres pays permet aux jeunes de se former dans une famille de métiers. La fin réussi du compagnonnage donnera une equivalence avec un diplôme universitaire. La revalorisation des métiers manuels donne des debouches d'emploi sûrs aux jeunes.

The development of *the core curriculum* is coordinated by ministerial officials and a ministerial advisory board with parent representation, defines standards for comparison of how students master knowledge and competences. This core curriculum is divided into 5 cycles of 3 years, and one final cycle of 2 years. *The core curriculum* places social learning, interconnected thinking and sustainability science at the centre to ensure local resilience and adaptive capacity to maintain a high quality of life for the local community in turbulent times.

The core curriculum defines four interacting pillars (Figure 4.), where each pillar presents a combination of theoretical knowledge, practical skills and guides the development of certain mind sets and behaviours. The four pillars are: i) Complexity and sustainability science; ii) Creativity and critical thinking, iii) Community health, well-being and sports, and iv) Culture, citizenship and collaboration. It provides some suggestions on working methods for each cycle; it provides sufficient guidance to allow evaluation and certification at the end of the cycle. Schools have complete autonomy in matters of pedagogy and working methods within the framing provided for each cycle.

Figure 4. Core curriculum of 4 C's.

The pillar 'Complexity and sustainability science' stands for knowledge, competences and behavior to engage in sustainability science which is a particular kind of inquiry-driven social learning process for societal transformation to enhance adaptive capacity and resilience to rapid change at the local level**.** These processes of participatory inquiry that engages diverse perspectives from a wide range of scientific expertise, professions, interests, and experiences. One main learning outcome is to produce shared actionable knowledge on complex problems. This new vision of science to tackle complex problems is that of a collaborative process that incorporates (1) diversity of theories and methods; (2) recognition of uncertainty, ignorance and humility; (3) co-creation of knowledge and respectful dialogue among participants, relying on empathy promoting tools; and (4) self-awareness and reflexivity. Engagement in

such processes is part of the curriculum from the age of 5, in an age-adapted manner. For example, environmental monitoring by taking photos of indicators species for the state of eco-systems eventually with data being fed into the national and European statistical system is a key activity already in the first school cycle in primary school. Training self-control and reflection in the face of complex problems with the help of serious games is an integral part of this pillar.[46]

The pillar 'Culture, citizenship and collaboration' combines theory and practice for preparing children in effective engagement in social learning. The importance of explicitly defining concepts for citizenship to be taught at school in particular in multi-lingual countries has been emphasized elsewhere.[47] The nature of citizenship taught in Luxembourg in 2030 places emphasis on the concepts of ecological and digital citizenship (see Box 1.), as well as more traditional notions of social and civic citizenship. Ecological citizenship emphasizes the importance of relational and local knowledge and that active engagement in local politics and community matters for ensuring sustainable human environment interaction. Digital citizenship on the other hand highlights rights and responsibilities with respect to global knowledge creation on the web. Both concepts are combined with problem and practice-based experiential learning opportunities requiring tapping into collective intelligence for characterizing complex problems – in groups in nature as well as on more abstract problems on the web with virtual communities. The school system supports shift in individual values from material consumption to solidarity. It also supports a shift in valuation in the economy towards internalization of social and environmental impacts in pricing.

Box 1. Ecological and digital citizenship.

Digital citizenship concerns rights and responsibilities to contribute to the content and quality assurance of knowledge accessible via the web. Observing privacy and data protection requisites are central, as well as managing your own digital footprint and shadow is key.

Ecological citizenship concerns a new awareness of the place of 8 billion human beings on a finite planet with now super fragile eco-systems that are representative of the state of our life support system. A new set of rights and responsibilities includes active engagement in environmental monitoring and restauration projects, and self-monitoring and reporting of one's own environmental impacts.

The local curriculum is developed by the local curriculum steering group including representatives of teachers, parents, students, economic actors, and municipal officials, guided by local interests. The development of individual learning strategies that are of salience for the local economy, environment and society is kept at the centre of interests. Recommendations of the steering committee to the school and teachers in individual cycles can include themes or larger projects the entire school gets engaged in, engaged learning experiences in the form of practical projects designed to advance a group of economic actors or the municipality or both, research projects, award schemes effecting transformation for sustainability drawing on the core curriculum, internships, a lecture series by practitioners or teachers. The local curriculum is adjusted for every new cycle in 3 or two year intervals.

Contents of the curriculum feature more subjects learning to relate – to yourself, to others, to society, and to the environment: Subjects as psychology, sociology, mediation, law and justice, politics and citizenship, rural and urban planning and ecology with consideration of vital ecosystem services and their

[46] Sonnleitner, P., Keller, U., Martin, R., Latour, T., & Brunner, M. (in press). "Assessing Complex Problem Solving in the Classroom: Meeting Challenges and Opportunities". In B., Csapó & J., Funke (Eds.), The Nature of Problem Solving. Paris, France: OECD.

[47] See for example Tröhler, D. (2014) Citizenship and education in a plural world. *Education Letter*, 9(2), 15-17.

invaluable nature are taught from a much earlier age and are not considered specialisations, but a basic mission of schools.
[48]

Time spent at school: The school stays opened all day for schooling and different activities. Students however only have instructed classes on three days a week (about 60% of their time spent on schools work), as a large share of self-tuition using the web's knowledge resources in a guided manner, and independent project and research work in groups of students is expected. Parents and grand parents are expected to supervise work at home, amounting to at least 8-12 hours a week. Parents can take turns in supervising project work closest to their occupation, and all work is presented at school and written up and meticulously commented upon by teachers. Rigour in framing and researching the issues and stringent quality criteria for information cited, independent thought and critical analysis, as well as a high level of attention to detail is expected**.** Most students come to school four days a week. Students can however also stay at school five days a week. The diversity of group work and project choices adapted to regional needs helps the students to gradually experiment with roles in society they feel most comfortable with and to develop their own study portfolio.

III.3. Learning, teaching and the teaching profession

Learning: In this school system the conception of learning in this that of 'transformative' or 'triple loop' learning for sustainability, which engages learners in groups in rethinking and acting upon how societies and individuals interact with their environments.[49] linked to diverse local community requirements (rather than those mandated by centralised national government as in 1 000 000). One main learning outcome is to produce shared actionable knowledge on complex problems. We consider transformative learning as a life-long iterative process, doors to which may be opened through engagement in projects that integrate education, research and civic engagement. Rigor, readiness to engage with others, and critical dialectical thinking and perseverance are prerequisites. Relational and personalized learning requires relationships, between students, between students and teachers, and to their learning environments. Relational learning helps understanding responsibilities we all can assume as we mature and others have, including towards non human animals and other life on earth.

Role of students: Students have a wide range of choices and have to develop their own learning strategies, as well as an understanding of an ability to work with their strengths and weaknesses, relying on auto-evaluation approaches. Learning in the collective, social competences and citizenship are at least as important as mastering the content of the local curriculum. Learning is not only based on personal experience in the sense of Kolb (1983),[50] but learners including teachers need to be challenged by and open to the experiences and perceptions of others in a dialectical manner. Transformative learning has to rely on collective learning in diverse groups, organizations or networks, participation in team inquiry is of advantage.[51] Individual practice of basic literacy and numeracy skills largely happens at home and is reinforced with a personal tutoring system. Knowledge is co-constructed, and competences are developed from interaction with others. Such collaboration is prevented from competition, marks are abolished, in order to facilitate students to compare just their own performance over time with respect to their self-set goals.

[48] Philippe Perrenoud Quand l'école pretend preparer à la vie ISBN 978-2-7101-2294-4
[49] Sterling, S. (2001). Sustainable Education: Re-Visioning Learning and Change. Schumacher Briefings.

[50] Kolb, D. A. (1983). Experiential Learning: Experience as the Source of Learning and Development. Prentice Hall.
[51] Thomas, D. and Seely Brown, J. (2011). A new culture of learning: Cultivating the imagination for a world of constant change.

Teaching: A teacher's attention and deep listening skills are directed at the individual learner and learning needs in order to develop meaningful relationship between student and teacher.[52] Teaching must be sensitive to how learners form personal perspectives by linking to their own personal experience. In order to embrace uncertainty, complexity, and the unknowable we need to draw on plural experiences, rationalities and contradictory behavior. Successful learning interventions need to be managed to ensure that experiential situated knowledge from diverse individuals and groups is made explicit, communicated and understood by others. Personal coaching on learning styles is another key aspect of what happens in the class room, this includes feedback on structured reasoning and communication. Team-teaching such that students obtain feedback from diverse perspectives is the norm. There are dedicated teachers at all schools who work with children with special needs on a one-to-one basis, by taking them out of classes at opportune moments. Schools develop details for implementing the core and the local curriculum by developing schemes of collaboration of teachers and grandparents; guided social media use, gaming to build bridges, tutoring, and private learning labs. These labs offer subjects, which are not included in the curricula. These can include very specialized aspects of informatics or specific programming languages, astronomy, attitude and communication training, politics, rhetoric, theatre. They also offer additional alternative, more individual learning techniques for children with special needs. They herein are supported by the government. Formal learning at school, non-formal learning from the web and in the learning lab, and informal learning at home in the family need to be bridged by design.

Diverse teaching modes are practiced at school. Knowledge acquisition relies on a wide range of didactic means including conferences, posters, and explanations through various communication channels including the web, films, cartographies, graphics and statistics. There are still some classic lectures, however, these rarely exceed 20 minutes in length based on insights from cognitive sciences. Most *ex cathedra* teaching was however replaced with web teaching materials with inspirational video talks what in 2010 was still considered the main teaching mode.

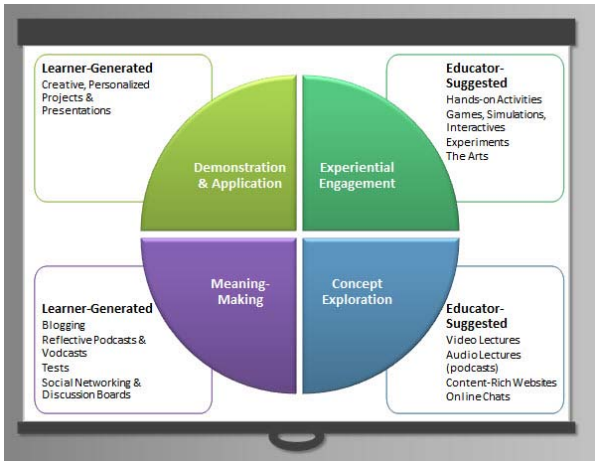
The widely adopted 'flipped class room' concept relies on team-teaching and group learning (Figure 5.). A flipped classroom students learn new content often at home alone, *content exploration by individuals*. Teachers develop *experiential engagement opportunities* in class, usually hands on activities for students to apply their new knowledge to practice on assigned problems, which are often of local salience and special meaning to the learner. *Meaning making* by learners alone or in groups happens through applied problem-solving. Projects are then *demonstrated* and discussed in class. Teachers can thus offer more personalized guidance and interaction with students, instead of lecturing.

Teachers are agents of change and contribute to regional adaptive capacity by permanently researching and learning about how to better teach to respond to local needs.[53] Most teachers are experimenting with diverse web resources relating to their interpretation of the curriculum, and observe and track learning, feeding their empirical data into the national central data base established for this purpose. This in turn is drawn upon by teachers for selection of combinations of teaching methods and tools and projects.

[52] See for example Hattie, J. and Yates, G. 2014. Visible learning and the science of how we learn. Routledge. pp.16-26.

[53] For closely related discussion of teachers as agents of change in reinventing the curriculum see Priestly, M. and Biesta, G. (2013) Reinventing the curriculum. Bloomsbury.

Figure 5. Flipped classroom learning



http://ileighanne.files.wordpress.com/2013/01/flipped-classroom-learning-cycles.jpg

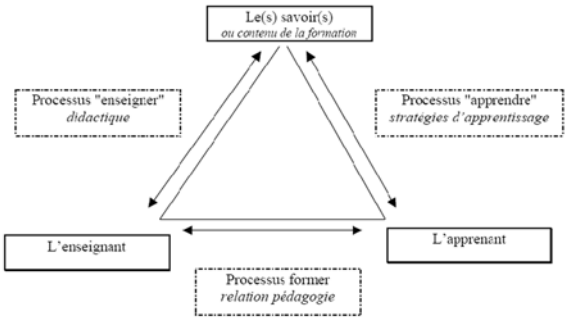
Role of parents and grand-parents: Supervise home learning. Pensioners can take adjunct jobs; close collaboration with local firms for internships. Parents and grandparents are often attending class room meetings and performances and presentations at school to bridge learning at school and at home, and they have a good contact to the teaches of their offspring.

*Design of learning environments***:** Spaces for peer group work inside and outside. Flexible furniture & possibilities to divide large spaces. All this has to be linked to local community requirements. Therefore it is organized by school leaders, students, parents, teachers locally/regionally in collaboration with local/regional authorities, local/regional enterprises, local/regional handcrafts, local/regional associations (sport, culture, music,..). Plan for diverse learning environments in real world settings – enterprises, nature, diverse social groups. linked to diverse local community requirements (rather than those mandated by centralised national government as in 1 000 000)

*School technologies***:** Selective use of web-resources to co-create curricula with parents, children and teachers – careful systemic translation of global fields of knowledge to local needs. Technologies are used to make schooling more humane.

The teaching profession: Highly qualified teachers with university degrees in the learning and developmental sciences as well as in subject matters they teach. Specialised staff serves children with special needs children at risk of exclusion; learning disabilities, but also to build ICT/computing skills; music and art teachers as of age 3. Much is invested in teacher education and life-long recurrent training. Social skills, high empathy and individual attention, facilitate group work. Teachers are also trained as researchers seeking perpetual improvement, by collecting, feeding into data bases and evaluating big data from learner-computer interaction that informs co-creation of curriculum with students, colleagues and stakeholders.
Schools have become learning organizations in which teachers will be participants and drivers of the learning process. All teachers are trained in action research in the learning and developmental sciences.

All acts of teaching can be represented with the triangle, in particular the distance between its corners, developed by Jean Houssaye, below:

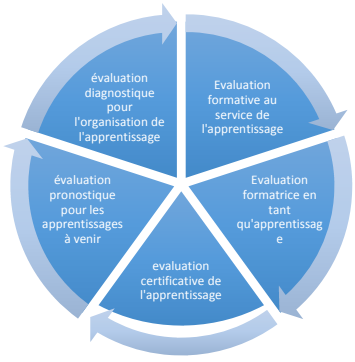


In 2030 the relation between teacher and student is primed for allowing to learn to master new knowledge, know-how, and the development of competences.
Apart from that schools have developed their own networks of experts , largely from the local community, who often but not always serve as volunteers, they draw upon on an as need basis, External experts can for example contribute to supervising project work and internships.
Schools combine forces with local sports clubs and artists allowing to develop projects in which for example scientific and environmental matters are not only explored by collecting and analysing empirical data but results then are also communicated through the arts and by writing and performing theatre plays.
A program of school buddies pairs up children with other children at least five years older than they to guide them through school, problems with friends and family. Engaged family members receive courses to guide how they provide assistant for the personal development of their children and themselves. In this regional system with heightened transport costs there is less segregation between expats and locals – the local schools are deemed as good as the parents and other local actors who engage in them.

Each school, primary and secondary has a director who plays a central role in giving direction and the management of the school. School directors also follow a life-long training programme and are highly qualified in the learning sciences as well as in management, administration, leadership, evaluation and coaching. Trust is his main asset, gained from personal engagement and collaborative development of strategies and action plans and educational offers with student staff and the school's stakeholders.

Evaluation of staff of the school system: Staff (including directors and staff in the ministry of education) is evaluated every two to three years based on two processes: a 360 degree feedback evaluation of groups of staff working closely together, and an evaluation by the person they report to (e.g. for teachers the school director) based on observation, student interviews and a personal interview. The main goal is to obtain feedback for self-improvement and give life-long learning initiatives direction, with respect to personal strengths, weaknesses and the school's objectives, it is formative and has no influence on salary or career.

Figure 6. Five dimensions of evaluation



Translation: Diagnostic evaluation to organize the learning process; formative evaluation to regulate learning; educative evaluation as part of the learning process or 'self-evaluation'; assessment of the learning; prognostic evaluation for future learning streams

*Evaluation of students***:** Diverse evaluation approaches are designed to respond to five overlapping objectives: evaluation that is formative and that effects learning (e.g. self-evaluation or 360 degree feedback evaluation in groups), evaluation to certify what has been learned as evidence for progress, evaluation that helps to predict future learning and evaluation as diagnostic tool for the organization of learning (see Figure 6.). Learning outcomes including social and creativity are embedded in assessment schemes. International benchmarking through PISA plays little to no role in this world.

IV. Outlook

In sum, this world, globally and in Luxembourg is characterised by unevenly distributed scarce natural resources and extreme weather events, and a severe energy crisis. The global system and production chains have collapsed, resulting in protectionism and regionalisation. Luxembourg, like most Western governments are struggling with public debt overhang from unsustainably managed welfare provisions. Costs of living are very high, household disposable income very low. This world is one of experimentation with an economy of sharing, alternative business models, alternative energy models, and alternative governance models, with a focus on interests and logics prevailing at the local and regional scales. Diverse population groups in Luxembourg have built local strongholds in different areas of the country. The school system is decentralized and is largely adapted to local needs to enhance the resilience of local communities. Whilst local communities grow more strongly together, there is a perpetual threat of tensions between neighbouring communities, for example in squabbles of increasingly scarce resources such as drinking water, and resulting social unrest, as there is not much that fosters social cohesion across Luxembourg. Whilst in 2030 these problems are not so accentuated as yet, and the national school system is still sufficiently held together by services the Ministry of education is providing in terms of mapping offers and informing teacher-led research through maintaining the central data base of big data, concerns have been expressed whether sufficient measures are taken to help Luxembourg continue to persist as a nation state within Europe and not to entirely loose its national identity.

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