IPE JUNIOR FELLOWSHIP PROGRAMME 2020

FITTING CROATIA WITHIN THE DOUGHNUT

Tomislav Cik

Institute for Political Ecology

Preobraženska 2, 10000 Zagreb, Croatia

TABLE OF CONTENTS

LIST OF ACRONYMS & ABBREVIATIONS

AOIS	Availability of Inpatient Services
AP	Air Pollution
CBS	Croatian Bureau of Statistics
CCN	Climate Change Nonchalance
CF	Carbon Footprint
CO2	Carbon dioxide
D	Distrust
DS	Degrowth Support
EA	Educational Attainment
EEA	European Environment Agency
EU	European Union
FP	Flourishing Perception
GDP	Gross domestic product
GI	Gender Inequality
GOS	Green Open Space
HDI	Human Development Index
HP	Health Perception
IPCC	Intergovernmental Panel on Climate Change
IPE	Institute for Political Ecology
ISSP	International Social Survey Programme
IV	Index value
MW	Municipal Waste
OF	Organic Farming
OW	Overwork
RE	Renewable energy
RED	Renewable Energy Dismissal
REP	Renewable energy production
SDG	Sustainable Development Goals (of the United Nations)
SJOS	Safe and Just Operating Space
TEP	Total energy prodution
TRWR	Total renewable water resources
UN	United Nations
UNDP	United Nations Development Programme
USA	United States of America
VT	Voter Turnout
WHO	World Health Organization
WU	Water Use

ACKNOWLEDGMENTS

I would like to express my sincere and heartfelt gratitude to all those who provided me with their time, support and expertise in this endeavour. The pages to follow could hardly have been possible without the hard and pioneering work of all current and previous IPE team members associated with the SUPER DONUT project, which in many ways guided my own efforts. In this regard, a special debt of gratitude is owed to Clara Léa Dallaire-Fortier, Jenny Ufer and Logan Richardson, for their invaluable and inspiring work on national and regional applications of the doughnut model. I'm extremely grateful to dr.sc. Marija Brajdić Vuković for her time, expertise and methodological contributions without which this work would have been much harder. I extend my gratitude to my brother, Igor Cik, and my friend, Josip Motik, for the interesting and extremely useful philosophical and methodological discussions which helped me frame this work. I would also like to thank all current IPE team members for providing me with the institutional and emotional support, along with a stimulating working environment needed to complete my assignments. Most of all, I would like to express my deepest gratitude to the project lead and mentor dr.sc. Mladen Domazet for providing me with this opportunity and for spending many hours reviewing and disucssing with me some of the insights presented in the following pages. Without his expert guidance and constant encouragement, this work would not have been possible.

1. INTRODUCTION

1.1. What on Earth is happening?

The public discourse of climate change and environmental protection over the last decade could have hardly disinterested even the most disinterested of bystanders. While the Earth's ice sheets continued to shrink and the Great Pacific Garbage Patch continued to grow, the world saw a 16-year-old schoolgirl turned environmental activist become Time's 2019 person of the year and a Nobel Peace Prize nominee. Some would perhaps deem such a conclusion of the decade a surprise, considering that it happened in the second hottest year of the hottest decade on record, a decade that started with the largest accidental oil spill in history. It was a period in history that did not witness a breakthrough in the widespread acceptance of radical political transformation necessary for addressing the impending environmental and social catastrophe of the 'business-as-usual' scenario, but it did witness total fossil fuel subsidies rise from $4.7 to $5.2 trillion. In the last ten years, we have also witnessed at least 20 million people displaced due to weather disasters and an abundance of record-breaking weather events. In this same decade, 467 animal species have been declared extinct, among them being the Bramble Cay melomys, a coral cay-dwelling rodent and the first mammal believed to have gone extinct due to anthropogenic climate change. In the world of international politics, we have witnessed the birth of the Paris Agreement, with an ambitious global climate goal, signed by 196 countries agreeing to keep the temperature increase caused by global warming well below 2°C compared to pre-industrial levels, by the end of the century.

However, we have also seen the USA initiating a formal withdrawal from the agreement under the new political leadership in the White House. Coming from the other spectrum of US politics, we have witnessed the proposal of the Green New Deal. The proposed package of extensive political reform goals has implicitly challenged to take on the dominant economic model for causing relentless growth of environmental degradation and social inequality on a planetary scale. Despite the fact that the ambitious plan has been criticised for naivete in its assumption that economic growth can be absolutely decoupled from material throughput and carbon emissions, it has gained legitimate traction among policymakers. In Europe so much so that in 2019 the European Commission has announced the European Green Deal, a roadmap for the EU to become net carbon neutral by 2050 while maintaining job growth and

competitiveness. To some, this was perhaps an unsurprising turn of events. Ever since 2016 local and national authorities around the world have been declaring "climate emergencies", the term even receiving endorsement from the Pope. The climate crisis has finally begun to receive the much-needed spotlight on the stage of international politics. This was in part due to the rise of new environmental movements, one of the most notable being *Fridays for Future*, a series of protests and demonstrations of millions of school students and activists around the globe who were demanding immediate climate change mitigation and adaptation efforts from policymakers. The movement even rallied thousands of environmental activists in Croatia, spurring several school climate strikes and protests all over the country. Perhaps inspired by increasingly outraged youth, Croatia's scientific community has soon after made a public appeal to the government to declare a "climate crisis" and initiate an inclusive and collaborative systematic approach for confronting its challenges.

There is a lot to take into consideration when accounting for this perceived increase of public attention on the topic of climate change and sustainability in Croatia. For instance, in the last decade, devastating effects of weather and climate-related events were recorded in regards to the agricultural sector. It has been reported that the total damage caused by extreme weather and climate events in Croatia has increased from an annual average of €68 million of a previous 33 year period to an annual average of €295 million for the 2013 – 2018 period. In regards to weather events, within the scientific community and leading climate change experts, there is little to no doubt that extreme geophysical, climatic and hydro-meteorological events, such as, for example, intense changes of precipitations patterns, are frequent manifestations of climate change (Župarić-Iljić, 2017). In this regard, it comes to no surprise that some meteorological analysis have concluded that the disastrous flooding of May 2014 in Serbia, Bosnia and Herzegovina and Croatia could have been partially exacerbated by anthropogenic climate change (Stadtherr et al., 2014). In the past decade, we have also witnessed a number of record-breaking temperatures at various weather stations across Croatia. In fact, 7 out of 10 highest temperatures ever recorded occurred in the last decade, with well over a half of 50 highest temperatures (over 40°C) ever recorded in Croatia originating in that same period. It should come as no surprise then that over half of these measurements have been recorded in 2017, a year that has been one of the most fire-struck seasons in Croatia's history, according to the Breakdown of the fire season of 2017 report, issued by the State Administration for Protection and Rescue and communicated by some media. Two years later, the fire season of 2019 has been ranked at the 3rd place in the number of significant fires during a single fire season in the

last 11 years. On the other hand, strategies for climate mitigation and adaptation are still missing, and Croatia's capital Zagreb has been placed by the European Commission at the bottom of the list out of all EU capitals when it comes to recycling and separation of waste, forcing activists to declare it the "European capital of thrash".

1.2. How we got here

If the above-mentioned series of events, facts, and figures raise any concerns, with the provided collection of phenomena not being an exhaustive one, then it is worth reminding ourselves how we got to where we are today. For the last several decades, there has been increasing evidence that the relatively stable environmental conditions of the Holocene that have been supporting the expansion and development of civilizations around the globe for 10 000 years are shifting. For the last two centuries, and especially in the latter half of the 20th century, the extent of human activity has grown so large and became so influential that some scientists are suggesting that we are living in an entirely new geological epoch – the Anthropocene (Crutzen and Stoermer, 2001; Steffen et al., 2007; Rockström et al., 2009, Waters et al., 2016), by which it is presumed that the sum of human activities today acts with the force similar to natural geological processes that drove environmental changes on the planetary scale in the past. The obvious problem, however, with the notion of an Anthropocene is that it indiscriminately blames the entirety of the human species for such interventions and appropriates the extracted benefits of such endeavours to all humans equally. This is not the case.

In his historical analysis of the origins of global warming, Swedish human ecologist Andreas Malm (2016) demonstrates this by explaining how our contemporary addiction to fossil fuels and the development of capitalist social relations are inextricably intertwined. In contrast to classical economic thinking, the analysis shows how the ingenuity of Watt's steam engine did not unconditionally determine the shift of Brittain's Industrial Revolution from renewables and animal power to energy systems powered by fossil fuels. Rather, it was a set of complex social relations, an entirely cultural and political cause that ultimately brought about the material shift to fossil-fueled steam power in Britain's factories and the consequential expansion of fossil fuels in centuries to come. There are many conclusions to be drawn from Malm's comprehensive analysis, one certainly is that the roots of global warming are not to be found in the naturality of humanity's aspirations for progress, but in the unequal distribution of power and thus responsibility and benefits of historical social protagonists. Therefore, and as would

follow from Malm's analysis, if the rise of steam power and the subsequent domination of the fossil economy was not a material necessity, then it is a historical contingency, one which, albeit unintentionally, introduced a self-destructive model of social reproduction that needs to be reassessed and challenged. More importantly, it introduced a systemic change in the entire Earth system, such change being motivated by the perceived benefits of a small elite class, not the entirety of the human species, even despite centuries of resistance to ecologically unsound principles of the *laissez-faire* economics, as contained in the marginalised histories of the Polemocene (Bonneuil and Fressoz, 2017). Nevertheless, the "self-sustaining growth", a structural characteristic of capitalism and upon which Malm's definition (2016: 11) of the fossil economy is predicated remains the ideological imperative of mainstream economic thinking and modelling today.

Keeping in mind that it would be dishonest to emphasize that the benefits of a fossilized development that took place over the last two centuries haven't in various aspects been beneficial to some, it is worth pointing out some of the above mentioned "self-destructive" by-products of a growth-oriented development. Even though "growth" has become a sort of a common-sense principle by which all and every development must be based upon, it has become obvious that uncontrolled economic growth is no longer a sufficient strategy for decreasing poverty, reducing inequalities, and improving wellbeing on a global level, as it has ceased to do so from the latter half of the 20th century until today (Kallis et al., 2020). The world has changed since the global fossil fuel consumption rose from 1880 levels of 97.2 TWh to 133,853.38 TWh in 2017. According to Steffen et al. (2007) in the period from 1800 to 2000 the global economy grew about 50-fold, the population grew about six-fold and energy use has increased approximately 40-fold. At the same time, global inequality has risen from the estimated 50-55 Gini points at the beginning of the 19th century to an estimated 65-70 points today, with a dramatic increase in differences of mean country incomes which today accounts for more than 50 Gini points, compared to 1820 levels of 15 points (Milanović, 2011). CO2 concentration in the atmosphere has risen from pre-industrial levels of 280 ppm to above 400 ppm today, along with a 26% increase of acidity of oceans, compared to the beginning of the industrial era. Over the period approximately ranging from 1900 to 2015, the globally averaged surface temperatures have risen by 0.87℃, and ever since 1979 Arctic sea ice has been decreasing by around 13% each year. For the period from 2006 to 2015, the combined mass of Antarctic and Greenland ice sheets has been decreasing at an average annual rate of approximately 433 Gt, while glaciers outside of Greenland and Antarctica have been losing ice

mass at the rate of about 220 Gt per year. In the period from 1902 through 2015, sea levels have risen by 0.16 m and they continue to rise with a growth rate of 3.3 mm per year.

In a world in which 70% of the global ice-free land surface is directly impacted by human use, and in which about 70% of global fresh-water is used for agriculture, 25-30% of the total food produced is wasted. At the same time, about 2 billion people today are hungry (Hickel, 2016) while an estimated 2 billion people are either overweight or obese. Although the above-offered snapshot could have focused on other important biophysical and social aspects of our contemporary natural and socio-economic realities, it can serve as an incomplete summary of present challenges to overcome and conversation-starters on how to strategize for the future. Such discussions are more important now then they have ever been.

UN's Emissions Gap Report of 2019 warns that we are most likely heading for a 3.2℃ global warming by the end of the century, and that is if the nationally determined contributions of the Paris Agreement are fully implemented, which they are currently not. The ultimate dangers of such warming are of course irreversible environmental changes which will be impossible for humans and ecosystems to absorb in a short period of time. Even if drastic measures are implemented, and emissions do fall by proposed 7.6% each year in this decade, this will put us on track of reaching the 1.5℃ target, which is a scenario that retains significant risks to human health, livelihoods, food security, water supply, human security, and the economy, according to IPCC's Special Report on Global Warming of 1.5℃. However, although a 1.5℃ warmer world is a bad, and probably unavoidable scenario[1], one which will pose disproportionately higher risks to vulnerable and disadvantaged populations, to indigenous and local communities that are especially threatened by collapsing ecosystems and environmental hazards, it is still a scenario to strive for as the adaptation efforts are much more manageable and has significantly less negative effects on Earth systems.

1.3. Risks and vulnerabilities on the European semi-periphery

But what does all that have to do with Croatia, a country with less than 0.01% share in the world's population, global GDP, and the world's total annual CO2 emissions? Although

[1]According to the World Meteorological Organization, the global average temperature in 2019 has risen by approximately 1.1 degrees Celsius, in comparisson to the pre-industrial period

Croatia did follow along a somewhat alternative modernization trajectory, Croatian society today enjoys high levels of material development and integration in the cultural sphere of the Global North, and it achieved this at comparatively lower levels of environmental costs (Domazet et al., 2012). In more recent history, structural changes of European economies of the 1990s from heavy manufacturing towards service-based economies, along with a transition from coal to a higher share of gas in energy supply supported the process of emissions reduction across Europe. However, it is important to note that these reductions were not a result of a well thought out transition by Western European countries to green practices and infrastructure, but primarily by the dissolution of the Soviet Union, as a result of reductions in meat consumption and massive conversions of abandoned farmland areas to carbon sinks.

Although Croatia is, much like other countries located on the European semi-periphery, comparatively poorer than European core-countries, it nevertheless displays higher levels of environmental concern than them, along with less willingness to make necessary material sacrifices on an individual level (Domazet and Marinović Jerolimov, 2014). Furthermore not only are Croatian citizens worried about climate change, but they are also at the same time concerned about the lack of strategic focus of national authorities on climate change adaptation and mitigation efforts (Ančić et al., 2016). These kinds of affirmative attitudes towards a collective climate change action are sometimes complemented by culturally widespread and potentially spearheading sustainable practices, like food self-provisioning (Ančić et al., 2019). Croatia is thus uniquely positioned for challenging mainstream development models and an interesting unit of study for examining the potential for transitioning to more sustainable modes of socio-economic practices. It is of interest of this study to examine if such a transition could be achieved at a comparatively lower social cost for Croatia while maintaining relatively high levels of development.

Despite all the benefits historically reaped from a fossil fuel-powered development, Croatia is especially susceptible to all the harmful consequences of such a development and is vulnerable to many threats of climate change. Even the Croatian Ministry of Environment and Energy has described Croatia as a country exceptionally vulnerable to risks of climate change due to its climate and geographical features. Some of the most vulnerable sectors in Croatia, as identified by the EEA, include water resources, agriculture, forestry, biodiversity, fisheries, energy, tourism and health. According to the UNDP Human Development Report for Croatia, it is to be expected that Croatia will become hotter and drier in the future, especially in the summer.

More precisely, it is thought that if emissions do not decrease, the period between 2040-2070 can expect a 3 °C to 3.5 °C increase in Croatia during the summer, which may cause an increased frequency of heatwaves. In contrast, related to precipitation alterations, Croatia's annual rainfall has already decreased. On the other hand, the country is vulnerable to climate change-induced floodings, with 15% of Croatian territory at risk. Although it is difficult to predict the extent and effects of sea-level rise, a 50 cm increase in sea-levels would submerge approximately 100 km^2 of land. The above mentioned and combined risks of increasing temperatures and decreasing rainfall increases the risks of droughts, which could endanger natural environments, hydropower production (accounting for around 25% of country's electricity production) and agricultural production, which is an extremely vulnerable sector accounting for more than 9% of Croatia's GDP and 20% of employment (Franić et al., 2014). Much agricultural land can be lost and combined with shorter growing seasons and lower crop yields, this represents a serious socio-economic risk for Croatia (via loss of income/jobs of farmers, food security as well as higher cost of food in general). Another weather dependent sector is tourism, an industry that accounts for 25% of the national GDP, and 25.1% of total employment. Uncomfortably hot summers along the Adriatic coast, reduced landscape aesthetic, altered wine production, increased natural hazards, etc. can impact tourism to varying degrees and introduce significant instability to a country's economy. In addition, the infrastructure in some of the most popular tourist areas is at risk from coastal flooding if sea levels were to rise. Croatia's economy will therefore be seriously destabilized by long-lasting and/or extreme weather abnormalities caused by climate change.

1.4. Theoretical aspects of measuring sustainability

There are many other vulnerabilities and risks to ecosystems and societies that these opening remarks haven't taken into consideration, and it is understandable that no one study is capable of detecting all of them. What previous chapters made evident is that there are significant risks and immediate dangers that manifest alongside higher levels of development. Of course, once such observations are made and processed through the filter of public criticism and deliberation, appropriate solutions ought to be proposed and implemented. However, although ecological unsustainability, in particular, has been the subject of international policy since the 1970s, it remains a big challenge. It could be that an adequately systematic and globally

coordinated approach is missing because of the complexity of the task at hand. At first glance, one could dismiss this argument and be quick to proclaim it as escapist and unaffordably pessimistic. However, even such ostensible defeatism can serve as a platform upon which new perspectives can be built. One favourable start of a project that recognizes the complexity of the issue but still chooses to address the task at hand, could be, as Latouche formulates (in: D'Alisa et al., 2016), to "decolonize our imaginaries", or more simply put, to emancipate our mental and social realities from the ideologies of economic "growth" and "development". Various understandings of these "imaginary meanings" have been conceptual cornerstones of some of the most influential responses to issues of global inequality, unsustainability, and injustice. However, there is mounting evidence that the very idea of economic growth is uneconomical, unjust, ecologically unsustainable, and that it does not increase overall well-being (D'Alisa et al., 2016). It should then not come as a surprise that, as Kothari et al. (2014) demonstrate, the "green economy" and "sustainable development", models predicated upon economic growth, have failed to deliver an adequate conceptual and political framework. One of the main oversights of these models is that both approaches are based on neoclassical economic theory, according to which economic growth disconnects (de-couples) itself from its environmental foundation at appropriate levels of resource productivity and decreased pollution. This economy-environment relationship is perhaps most commonly illustrated by the (in)famous environmental Kuznets curve, a diagram that ultimately legitimizes economic growth in the name of increased environmental quality.

However, as there is serious criticism on account of the model's reliability (Stern, 2004), there is no evidence that economic growth, most readily recognized as GDP growth, can ever be absolutely and permanently decoupled from resource use and emissions. Moreover, in their extensive empirical analysis of the effects of economic growth on CO2 emissions, Schroeder and Storm (2020) find that even though production-based CO2 emissions and economic growth do show signs of decoupling, consumption-based CO2 emissions are increasing with rising per capita GDP. Indeed, as their analysis concludes, these findings do call for a reconceptualization of "decoupling", as outsourcing of carbon-intensive activities to low-income countries obscures the real driver of increasing CO2 emissions, which is growth in consumption. These findings, along with many others, indicate that a more sustainable future guided by (GDP) growth-oriented policies is completely unfeasible. Some of these considerations have been supporting the theory, culture and sociopolitical practice of "degrowth" since its inception in the 1970s. Degrowth, as an "imaginary" and theory, is a critique of economic growth,

capitalism, and commodification of social artefacts and socioecological services (D 'Alisa et al., 2016). As a movement, degrowth emphasizes the need for a structural reorganization of social metabolisms, which can be most simply defined as a form of humanly controlled energy and material flows between (and within) societies and nature (Molina and Toledo, 2014), and their corresponding sociometabolic practices, in order to achieve well-being within the physical means of the planet. Unsurprisingly, degrowth has received much criticism, one of them being that degrowth can not be accurately measured and is thus scientifically and politically unproductive. However, even though measuring sustainability is understandably complex and challenging and despite the more or less obvious theoretical and methodological limitations of visualizing conceptualizations such as degrowth, discussions on how to approach measuring sustainability have become increasingly important over the last decade.

The impending environmental and social crisis facing humanity in the 21st century, along with the identified failures to adequately address it, has resulted in new modes of sustainability modelling. Among these efforts emerged the Safe and Just Operating (SJOS) framework, designed to reflect the holistic disposition of sustainability-related discourse. In the broadest sense, it provides a single visual representation of social metabolisms in order to achieve or maintain the sustainability of sociometabolic structures and processes. Historically, the framework has evolved based on the concept of planetary boundaries, which has been developed by Rockström et al. (2009). This quantitative approach defines nine biophysical boundaries to determine a safe space of material development for humanity. The framework highlights the danger of irreversible environmental changes caused by exceeding the defined limits. Kate Raworth soon after (2017) proposes an advancement to the model by complementing the physical boundaries with 12 social standards derived from the UN's SDGs in 2015. Within this model, however, the visualized "ecological ceiling" and "social foundations" combine to form a doughnut-resembling graph within which a safe and just operating space for humanity in the 21st century is defined as space within the two circular boundaries (Raworth, 2017). Additionally, along with identifying the SJOS, the doughnut model simultaneously visualizes potential transgressions in the physical and social sphere, providing a holistic but visually simplified snapshot of the distance between the analyzed and the aspired social metabolism (Raworth, 2017). Within the scientific community, the theoretical doughnut-shaped model was perhaps most famously applied by O'Neill et al. (2018) in their comparison of 150 nations relative to the values of 11 social and seven biophysical indicators. More interesting than the somewhat unsurprising conclusion that no country

achieves high values of human wellbeing with sustainable levels of resource use, is the established and conceptually paralyzing trade-off between human wellbeing and its environmental foundation. Typical to common understandings of social metabolisms, these findings define wellbeing as a function of resource consumption. More importantly, they present progress as a cost-benefit tradeoff between social justice and environmental destruction.

In an effort to diverge from conventional and politically paralyzing sustainability metrics analysis and the above-identified tradeoffs, a group of researchers from the Institute for Political Ecology designed the Degrowth Doughnut model (Domazet et al., 2020). As a conceptual and an analytical tool it highlights key biophysical and social aspects of transitioning to a (reconceptualised) safe and just operating space and remaining within it by providing comprehensive overviews of social and sociometabolic performances of individual nation-states, with quantitative data already collected for the majority of UN-recognized countries. In this model, however, the social and biophysical components are supplemented with a cultural component. These segments comprise of ten themes containing 33 indicators overall. These themes are agriculture, climate change, and biodiversity (biophysical); energy and materials, material security, democracy, and health (socioeconomic); democratic potential, environmentalism, and well-being (cultural). Despite the fact that the themes are conceptually close to one another, they provide a broad enough coverage for displaying holistic visualizations of complex systems in easily understandable yet meaningful images. This aids in avoiding the trap of further entrenching policy-making debates in highly academic and technical terms of experts, as well as expanding the potential of the model to provoke interdisciplinary explorations. Another significant modification of the previous models is that the Degrowth Doughnut identifies boundaries and thresholds for all three segments. In other words, it presents potentials for growth and injunctions for a reduction in biophysical, socio-economic and cultural aspects of life. Another important aspect of the model is its openness to downscaling of themes and indicators to an appropriate level of "specific metabolically integrated areas" (Domazet et al. 2020: 8). In relation to regional or urban comparisons of various doughnut models, the research is sparse, but some research suggests conceptual blueprints for downscaling of the model (Nykvist et al., 2013; Dao et al, 2015.; Dearing et al, 2014). Moreover, downscaled doughnut models are starting to appear as policymaking tools aimed at transformative action in major world capitals, such as Amsterdam.

These kinds of efforts could be of monumental importance for the future as some projections estimate that 68% of the world population will live in cities by 2050, which, along with the already present concentration of economic activity and political power in urban areas, could be crucial in securing a successful transition to a safe and just operating space. This is especially true for Europe, where cities accommodate 74% of the population (Reckien et al., 2018). In this sense, cities are major factors in the ongoing aspirations of reaching sustainable and just levels of social reproduction and environmental protection. Globally, urban environments are not only important because of their responsibility for 70% of all carbon dioxide emissions and close to 65% of energy consumption. At the same time, cities are especially vulnerable to the negative effects of climate change, primarily by rising sea levels and coastal storms, as 90% of the world's cities are located on coastlines. It is to be expected that the necessary ideological and technological shift to the desired state will depend on cities spearheading transitional efforts by exploring new ideological and technological terrains and implementing transformative innovative strategies aligned with the latest research trends and scientific discoveries.

Recognizing the methodological advantages and limitations of visualizing planetary and social boundaries, along with their possible transgressions, will provide a solid foundation for legitimizing further downscaling of the Degrowth Doughnut model. Analyzing how Croatia fits within the Degrowth Doughnut model is a continuation of ongoing efforts of IPE to utilize the model for assessing the alignment of strategic policies with the attainment of sustainability. It is also an addition to previous downscaling efforts of the model conducted by IPE for regional analysis of France, USA, and Croatia. Therefore, this analysis paper will assess local sustainability performance to further inform decision-making. The analysis will not be focusing on all indicators originally included in the model but rather on those representative of and paradigmatic for the degrowth theoretical landscape and the methodology of visualizing the Degrowth Doughnut. Analyzing how Croatia and four of its localities fit within the model will identify key areas of vulnerabilities and strengths of its social metabolism and sociocultural practices and structure a vocabulary for addressing them. Reflecting on how these insights could be used for determining possible policy trajectories of Croatia is of major interest to this analysis. In addition, reflections on the methodological aspects of visualizing the Degrowth Doughnut will be provided to further establish the validity of potentially downscaling the model for optimizing policy-making efforts on lower levels of decision-making. Finally, recognizing that all nation-states are themselves comprised of a patchwork of national subunits,

of regions, counties and municipalities, could contribute to their affirmation as conceptually available and analytically susceptible to the application of the model.

2. METHODS

The sampling method aimed to provide a relatively balanced representation of localities, according to pre-established criteria that could potentially indicate differences in socio-metabolic performance between municipalities. However, at the final stage of sampling, the selection of the sample was somewhat intentional, as it aimed to analyse different cities than the regional model to gain novel insights. Although this study often refers to "cities" and "towns", the physical and administrative space of its municipality is what is referred to. However, there is a significant discrepancy in the case of the town of Gospić, as the municipality of Gospić covers an area of 969,2 km² (which is an area larger than Zagreb, Paris or Berlin), with a population of 12,745, while the actual urban centre, the referred to "town" of Gospić has the population of approximately 6,575 and covers only a fraction of the area of the municipality of Gospić. This, however, does not make Gospić an unavailable unit of analysis, as the utilised data is collected at a municipality level, referring to the whole area and all inhabitants of Gospić. It seems reasonable to assume that most of the socio-metabolic processes of the municipality of Gospić, its infrastructure, economic, cultural and social activities, are centred around its urban core. In this regard, all units of analysis are not just the centres of their immediate, municipal surroundings. They are also the main administrative headquarters and sociometabolic hot spots of their respective counties. This, combined with the absence of other large and nearby urban centres that could significantly impact the sociometabolic processes of the analysed cities, and, thus, render our snapshots unrepresentative, justifies relying on data that refers to the administrative space of municipalities.

Fig. 1 Map of municipalities of the Republic of Croatia: geographical distribution of the sample.

Four cities were selected for this analysis. These cities are Slavonski Brod, Gospić and Zadar. The map below displays their geographical distribution, with the selected units of analysis marked in red. Although various sampling techniques were considered, in this research it was most important that cities differ in only some of their most basic characteristics, for instance, size, geographic features and predominant sectoral activities. Additionally, Zagreb somewhat stands out as it is the country's metropolis and, as such, an unavoidable sample unit in this explorative analysis. The sampling technique offered in this research serves primarily as an additional measure of making sure that our selection may yield interesting differences. In any case, as the selected cities display different sizes, geographical attributes and levels of development, it is to be expected that they produce different ecological footprints, and therefore different doughnut visualizations.

City	Geo.feature	Sector	Surface (km²)	Population	Density per km²	County-level HDI
Gospić	Mountains	Agriculture & Forestry	969.20	12,745	13.20	0.809
Slavonski Brod	Plains	Industry	50.30	59,141	1,284.50	0.788
Zadar	Coast	Tourism	71.50	75,062	386.90	0.820
Zagreb	Diversified	Diversified	641.00	790,017	1,232.50	0.895

Table 2 Sample characteristics

It is important to note that sometimes, due to data unavailability on a local level, indicators for a particular city had to be calculated using county data. Of course, this has been applied only when it was justified to use such proxy data (e.g. Organic Farming, Renewable Energy Production etc.) because production of those resources occurs in the wider surrounding area, but their utilization or consumption is again driven by the major city. Also, all cultural indicators were estimated using regional data based on international surveys, as that kind of data is not coded for a lower spatial unit and there is no reason to assume that the measured values and attitudes of citizens of Gospić differ significantly to those living in the surrounding area of its urban centre.

2.1. Segments and themes

The constructed local doughnuts consist of 18 indicators and eight indicator themes, with six indicators (three boundaries and three aspirations) divided over three segments. These downscaled holistic images represent, in symbolic terms, something like a “blood test” of an urban social metabolism. As it is safe to presume that the nature of sociometabolic practices of cities significantly differs from those of nation-states, a relatively different set and a fewer number of indicators has been selected than those established by the national model (Domazet et al. 2020). Indicators are grouped by a set of differing themes, each one of which refers to a specific segment of the model. Specifying themes within predefined segments allows for a more comprehensive and consistent analysis, contributing to a coherent understanding of researched phenomena. In other words, by defining themes within segments we precisely specify those performative aspects of social metabolisms of cities that we wish to closely monitor. The order by which the themes are visually and narratively presented in this analysis is determined both by the fixed order of placement of segments to the SJOS, by initiating the data overview and analysis with the biophysical and ending with the cultural segment. This to some extent relates to the specific intention of this analysis to describe how cities (fail to) achieve wellbeing standards by relying on their existing natural and socio-economic systems. This is why the doughnut begins with the topic of “access to nature” and comes full circle with the theme of “well-being”. In such a way the analysis conveys its previously defined theoretical assumptions in a more intuitive and obvious manner while providing a sensible interpretative structure for data analysis. Concerning determining the visual placement of the themes within each segment, the model additionally aspires to logically connect neighbouring segments, allowing for a narratively “smoother” transition between qualitatively different sets of indicators.

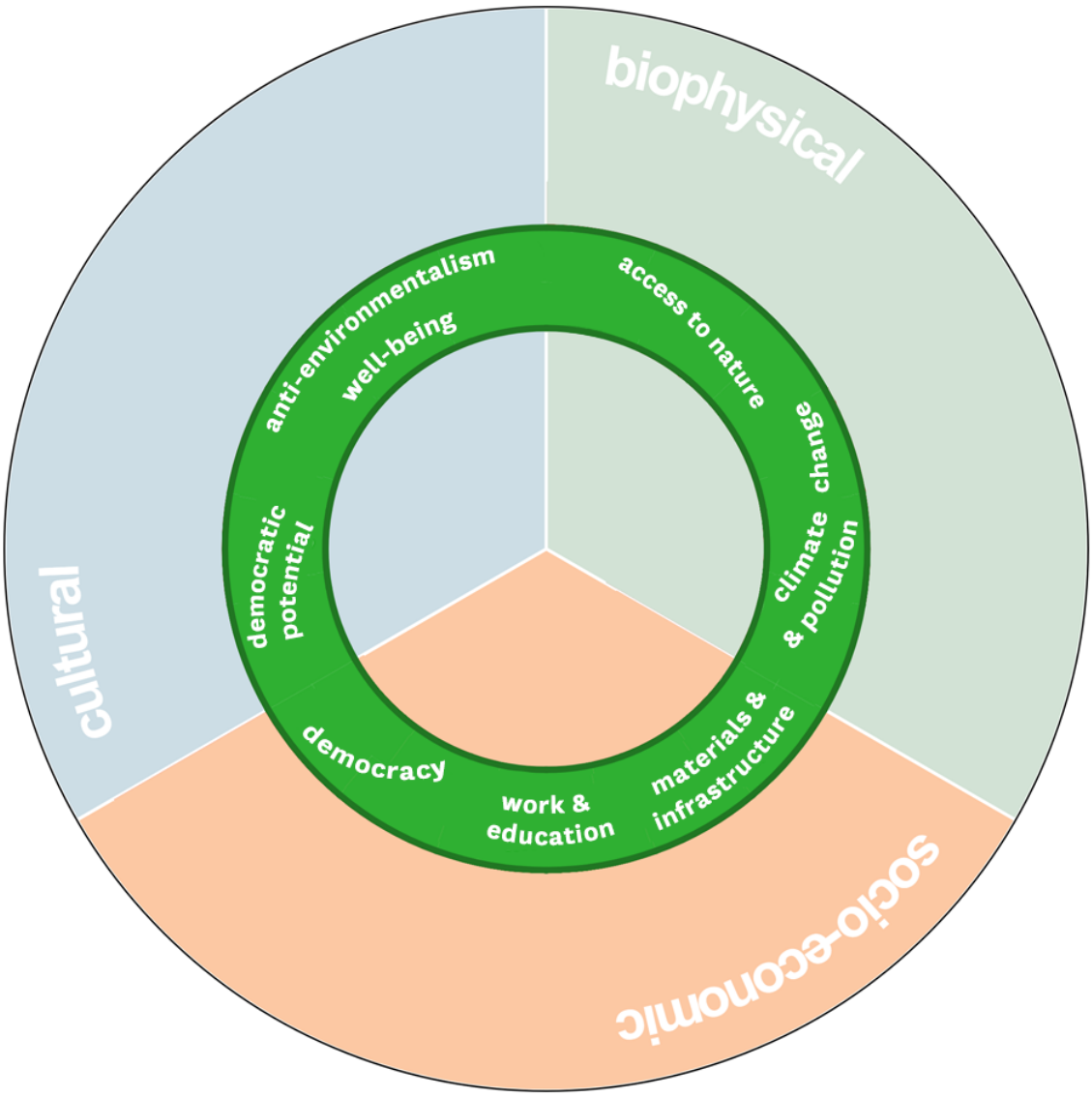


Fig. 2 Degrowth Doughnut diagram, by segments and themes.

In some cases, the themes join indicators which conceptually could fall under completely separate themes (e.g. “climate change and pollution”, “work and education” etc.). In these instances, two main criteria were applied to successfully merge seemingly incompatible indicators into a conceptually valid theme. The basic principle was adhering to the original thematic structure, as presented in Domazet et al. (2020) for the national model. This is not to say that every “national” theme perfectly translates to the local model, but that the original model has been used as a blueprint for identifying themes that could prove equally significant for sustainability analysis and relate to subnational levels of analysis as much as for the national level. In these cases, many indicators have been retained within their original thematic superset, but they do form a slightly different thematic structure overall. For example, the theme of “democracy” comprises of indicators “voter turnout” and “gender inequality” in both models, but differ in the overall structure of the set (the national model includes an additional indicator of Expected Education Years).

The second principle of merging qualitatively distinct indicators into an independent theme was their capacity to fall under potentially larger dimensions that can’t be attributed, by existing frameworks and thematic structures, to a specific, well-established theme. However, such indicators may be factors of more established concepts. For instance, indicators of “overwork” and “educational attainment” do not intuitively form a distinct theme themselves, but education and work burden are usually important aspects of social mobility. Nevertheless, as those aspects do not conceptually exhaust the concept of social mobility, in a way in which it would be valid to assume that social mobility is in fact what is being measured, the theme has been labelled as “work and education”.

The biophysical segment of the model concerns natural resources, their conservation, stability and utilisation. Within the biophysical segment the themes of “access to nature” and “climate change and pollution” are included. The theme of “access to nature” joins a boundary of urban pressure on water resources with a threshold for organic farmland in the urban surroundings, along with a threshold for access to green open spaces in a given city. On the other hand, the theme of “climate change and pollution” merges two relatively similar and core boundary concepts of the biophysical segment, carbon footprint expressed in terms of annual CO2 emissions per capita and air pollution, with a threshold for renewable energy production in the city and its hinterland. This indicator has been included in the biophysical segment of the model for pragmatical methodological reasons, as it could be placed in the socio-economic segment,

similarly as in the original national model. However, in this research its conceptual and operational proximity to the socio-economic segment of the model justifies such a placement.

The socio-economic segment refers to the social and material infrastructure supporting vital socio-economic processes. In a similar way that air pollution refers to acceptable levels of environmental quality, the first theme of the socio-economic segment includes a boundary for municipal waste generation per capita. Merged with a threshold for available hospital beds per 1000 capita in a given city, these indicators form the theme of "materials and infrastructure", to approximate and assess levels of key urban public infrastructure of cities, such as those of health and waste management systems. The theme of "work and education" includes indicators measuring educational attainment of citizens by calculating the share of tertiary-level degrees in specific age groups, along with a quantification of weekly hours of work per each citizen. Gender inequality, expressed as the measure of underrepresentation of women in local governing bodies, and voter turnout forms the most conceptually similar theme to that of the national model in the socio-economic segment. This theme addresses, in the broadest sense, questions related to the democratic functioning of municipalities, and is thus named "democracy".

The cultural segment concerns opinions and attitudes relevant to a democratic transformation and overall wellbeing. Three themes are included in the cultural segment of the model. The majority of indicators included in this segment monitor popular perceptions on topics of democratic engagement to decrease human impact on local biospheres. This is important as such attitudes can be regarded as the result of democratic sociometabolic practices of reflective citizens (Domazet et al., 2020). The theme of "democratic potential" follows logically from the last theme of the socio-economic segment and refers to those indicators that track support for degrowth-oriented policies, along with excess in averagely expressed levels of distrust within a society. Two boundary indicators are joined to form a theme of "anti-environmentalism", to assess attitudes according to which citizens deny the importance of renewable energy and the dangers of climate change. As stipulated in previous chapters, all sustainability-related strategizing should be aimed at achieving greater levels of overall life satisfaction. In this study, this is monitored as self-reported "well-being", in terms of shortfalls of adequate levels of a variety of positive mental health states, along with a shortfall in the adequate perception of personal health.

Segment	Theme	Indicator	ABBR.
Biophysical	Access to Nature	Water Use	WU
		Organic Farming	OF
		Green Open Space	GOS
	Climate Change & Pollution	Carbon Footprint	CF
		Renewable Energy Production	REP
		Air Pollution	AP
Socio-economic	Materials & Infrastructure	Municipal Waste	MW
		Availability Of Inpatient Services	AOIS
	Work & Education	Educational Attainment	EA
		Overwork	OW
	Democracy	Gender Inequality	EA
		Voter Turnout	OW
Cultural	Democratic Potential	Distrust	D
		Degrowth Support	DS
	Anti-environmentalism	Climate Change Nonchalance	CCN
		Renewable Energy Dismissal	RED
	Well-being	Health Perception	HP
		Flourishing Perception	FP

Table 2 Overview of applied indicators, relative to their respective segments and themes

Although the local model introduces some new indicators, other indicators of paradigmatic importance for understanding sustainability potentials of units of analysis have been retained, like “Water Use” and “Gender Inequality”. This is why some indicators that intuitively do not reflect specific aspects of urban social metabolisms, like “Organic Farming”, have been retained in the model. By doing so, on the one hand, we not only acknowledge the large-scale strategic value of a retained indicator but also recognize the complex interconnectedness of urban environments with their physical and social surroundings, its functional sub-systems, referring as such to the holistic nature of the model. On the other hand, there was an understandable necessity to operationalize entirely new indicators that would more adequately reflect the specificities of urban environments, like “Green Open Space” and “Air Pollution”.

The applied analytical breakdown of the national social metabolism to multiple (selected) micro-units of analysis can perhaps offer valuable insights about the differences within a given national social metabolism, as it would be reasonable to assume that different regions and localities are usually the results of different dynamics of socioeconomic developments and ecosystem structures. These seemingly obvious differences may not prove to have significant

impacts on the analyzed socio-metabolic output of given regions and localities and in this stage of the analysis, they only provide more structure to the sampling framework used for these initial explorative endeavours.

2.2. Indicators

As was previously stated, 18 quantitative indicators have been grouped into eight themes across three corresponding segments. In a way, each of these indicators represents an empirical proxy assessment of a corresponding predefined theme, that is to say, what is considered to be a pertinent component of a healthy and sustainable urban environment. In technical terms, to visualize the doughnut any given indicator is constructed using numerical input data for mapping abstract values on the doughnut graph. The provided visuals rely on the latest publically available data, ranging from 2009 to 2019. County data has been applied when city-level data was unavailable and when theoretically and methodologically justifiable, as explained in the previous sections. In addition, all values for cultural indicators have been calculated using appropriate regional data, as there is no reason to assume that there is significant deviation within the defined regions, and thus between different cities in a specified region. All cultural data, except data used for the Flourishing Perception and Degrowth Support indicators (which has been obtained directly from the Institute for Social Research in Zagreb) has been obtained from the most recently available ISSP modules for Croatia (Environment III, Health and Role of Government and Networks) and processed using IBM SPSS Statistics 23 software for the purpose of index creation.

Before providing a brief description of each indicator used in the analysis it is necessary to describe the process of converting input data to visual index values for the model, in order to map the indicator value in relation to the SJOJ framework. As was previously stated, the SJOJ framework is a green circular doughnut-shaped ring inside of which a set of indicators is positioned to allow for assessing sustainability performance by comparing the extracted data against the set criteria for remaining within the green space. To map the location of an indicator value against said criteria and calculate the abstract visual index value, the formula presented below has been used.

$$IV = \frac{c - x}{r}$$

IV = doughnut index value
c = constant (threshold or boundary)
x = indicator input parameter
r = range

Fig. 3 The formula for calculating abstract (doughnut index) values to be plotted within the doughnut graph

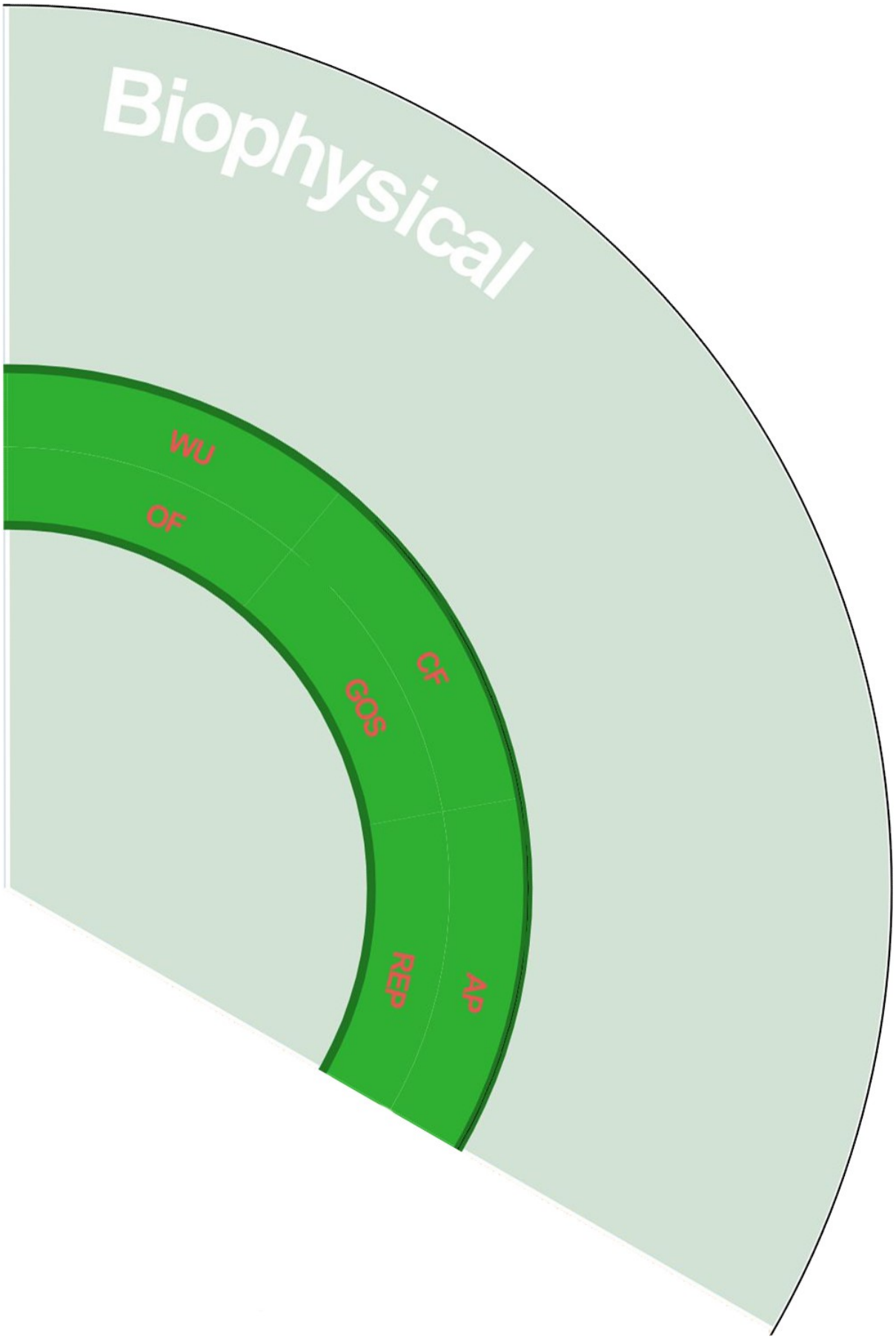
Index values used for visualizing the doughnut are calculated abstract values that inform us if certain indicators exceed (overshoot) or fall short (shortfall) of certain criteria. They also inform us about the magnitude of the transgression to be mapped on the doughnut visual, relative to the SJOS. In this regard, the doughnut index value can have a positive or negative value. If an indicator value (x) is "overshooting", that is to say, if its value exceeds the numerically defined boundary, the doughnut index value (IV) will have a positive value, in order to display such an overshoot relative to the SJOS and map it along the outer rim of the green ring. In contrast, if the doughnut index value is negative, the indicator is displaying a "shortfall", meaning that the doughnut produces a visible transgression along the inner rim of the SJOS. At the same time, a key operation ingrained in index value calculations and visualizations on the doughnut graph is being executed. This refers to simultaneous comparisons of input values with numeric criteria for visually remaining within the SJOS framework. In other words, for the purpose of index value mapping on the doughnut graph, an if-operation is performed that determines if an indicator is "overshooting", "shortfalling", or remaining within the green space. In the case of boundary indicators, this means that all input values larger than the predefined boundary values will produce positive index values larger than the value of zero, and a visual, red cone-like shape will be displayed along the outer rim of the SJOS. On the other hand, if the input value of a boundary indicator is less than the numerically defined boundary, the final output of the index value computation will be zero and no excess will be mapped. Similarly, for threshold indicators, all input values greater than the

defined threshold will also reult in IV being equal to zero, and no visual transgression will be displayed along the inner rim of the SJOS ring. In this way, the doughnut visual logically reflects the fundamental approach to the aspired sustainability modelling, exemplified by the dynamics of reducing negative pressures on Earth's systems (e.g. via carbon footprint reduction) while increasing positive socio-economic and cultural performance (e.g. via improving wellbeing outcomes) that renders a social metabolism sustainable. Also, in some cases (Gender Inequality and Distrust) it was necessary to multiply the original index values by a factor of two. This way the visual transgressions on the doughnuts reflect the scale of the identified problematic more appropriately.

All boundaries and thresholds (c) are used as constant values in the formula for the purpose of index value calculations and refer to specific indicators within the doughnut graph. For most indicators, these values are justified by appropriate literature review and corresponding theoretical considerations. For some indicators for which no such method of boundary or threshold allotment could be applied ("Municipal Waste"), these values have been set by analysing available comparable empirical data to justify boundary/threshold setting. It is important to note that it is not the intention of the model to compare magnitudes of visual transgression and overshoots between individual indicators. Such comparisons would not be meaningful, considering qualitatively different characteristics of indicators, i.e., their distinct input parameters and differing normalization values (r) used. It is also notable that there are different "topographies" between the space within our SJOS and the surface of the visualized transgressions along its inner or outer rim. This means that the distance from the midpoint circle of the green ring to its inner and outer rim could be contracted or expanded in relation to the visual overshoot or shortfall outside the doughnut boundary or threshold, in order to highlight the differences between visual overshoots and shortfalls. For example, a whole good 50% can fit within the narrow space of the green ring, while the remaining problematic 50% can stretch between the rim and the edge of the graph.

Along with setting of boundaries, thresholds and extracting raw data for index value computation, a crucial parameter for calculating the relation of indicator values to the SJOS framework, and determining magnitudes of visual shortfalls or overshoots is the range (r). In the context of boundary setting, we are referring to the range so stay within the doughnut, while, when defining thresholds, the range from the centre of the doughnut to the doughnut threshold is what is being referred to. Moreover, range values also depend on theoretical and

empirical maximums and minimums of utilized input values. For most indicators, the lowest possible value was set to zero. For instance, the range to stay within the doughnut for the "Carbon Footprint" indicator is 2, as the lowest possible annual CO2 emissions per capita are zero (as justified by the possibility and necessity of transitioning to net-zero carbon economies), and the boundary for sustainable levels of CO2 emissions is set to 2 (as justified by literature review). This means that all indicator values ranging from 0 to 2 are within the SJOS green ring, so the range (r) to stay within the doughnut is 2. On the other hand, a minimum value of zero was not meaningful for some indicators. For example, the range from the doughnut centre to the doughnut threshold for the "Voter Turnout" indicator is set to 55, as the lowest possible limit was set to 25, and the threshold value set to 80. The lower limit of the range was set to 25% turnout because the cities with the lowest voter turnout empirically come in at around 25%, making anything significantly lower than that unrealistic to expect. For practical purposes, all range calculations have been excluded from the following indicator overview and are included in the provided supplement.


Biophysical
WU
OF
CF
GOS
AP
REP

Water Use. The percentage of the locally abstracted volume of water per capita in the national total renewable water resources (TRWR) per capita, in the latest available year. The data has been obtained from online databases of the Croatian Bureau of Statistics (CBS). Freshwater is an important resource in all modes of production, an essential ingredient of human nutrition and the basis which supports entire ecosystems. Thus, adequate access to freshwater is crucial to render all present and future societies sustainable. However, global freshwater is not only limited but also unevenly distributed. This means that freshwater withdrawal in one area can affect the access to freshwater of other areas that share the same basin. Even though Croatia has naturally been endowed with the highest per capita freshwater resources in the EU, this is an important indicator to track on a city level if a just and sustainable future is to be attained and maintained. A boundary of 40% of the abstracted volume of water per capita in the national TRWR per capita has been selected, as this value has been confirmed as a critical limit that should not be exceeded (Röckstrom et al., 2009). County-level data has been applied as it was reasonable to assume that water used in those counties to the largest extent supports many vital sociometabolic processes of the analysed cities, for example, food production activities.

	x	**IV**
Gospić	0.72	0
Slavonski Brod	0.23	0
Zadar	0.85	0
Zagreb	0.56	0
Croatia	0.43	0

Carbon Footprint. The carbon footprint indicator in this analysis serves as an approximation of CO2 emissions assigned to individual cities based on their economic activity and carbon weighting, measured in annual tons of CO2 per capita. Carbon dioxide is a major greenhouse gas whose emissions are causing global warming. Reduction of CO2 emissions is imperative to successfully adapt to the impacts of climate change and decrease its harmful consequences. CO2 emissions data for each city has been derived from the total national CO2 emissions data, published biannually by the European Commission, for the latest available year. A weighting method has been applied to the original CO2 emissions dataset to assess city-level CO2 consumption. The weighting method relied on the Croatian Bureau of Statistics data detailing the sectoral structure of a given city, in terms of people employed in legal entities. To obtain the necessary weights, this dataset has been analysed relative to the overall national structure of those sectors that were available for calculations, in terms of the percentage of people employed in specified legal entities in a given city in the national total for those sectors. These sectors include the energy industry (excluding renewables), manufacturing, construction, agriculture, forestry, fishing, transport and residential consumption. During the calculation process, necessary data adjustments and additional calculations have been applied to align the model with its methodological assumptions, which are described in-depth in the provided supplement. These interventions primarily refer to logical steps in standard pre-analysis variable computing, from those such as extracting specific values from aggregate data (e.g. transportation sector), to major expert corrections of variable input values (e.g. energy sector). After weighting, the sum of sectoral CO2 emissions has been divided by the appropriate share of the total (local) population, to express the city's carbon footprint in terms of annual tons of CO2 per capita. Data availability and the methodology applied in this analysis required that CO2 emissions be optimized for 80.02% of the total local population living in a given city. The boundary was set to 2 t/cap/yr, as this represents the limit to sustainable levels of carbon dioxide emissions when globally standardized at current population levels. It is important to note that due to data availability emissions contributed to international air travel and cruisers, whether for touristic or shipping purposes, have been excluded from the analysis. This is worth mentioning as it is reasonable to assume that tourism's transport footprint has a significant negative impact on the overall carbon footprint of Croatia's social metabolism, and, if included, could potentially reflect visually larger transgressions on the doughnut. This could prove to be especially true for the touristic city of Zadar and Croatia's metropolis Zagreb.

	x	IV
Gospić	3.68	0.842
Slavonski Brod	3.78	0.888
Zadar	2.84	0.421
Zagreb	4.09	1.045
Croatia	3.72	0.858

Air Pollution. The number of days when the PM10 pollutant exceeded the recommended levels of retention in the city's ambient air, in the latest available calendar year. All data has been derived from the online Air Quality in the Republic of Croatia map, maintained by the Institute for Environmental and Nature Protection of the Ministry of Economy and Sustainable Development. According to the WHO, ambient air pollution is responsible for 4.2 million deaths worldwide every year due to stroke, heart disease, lung cancer and chronic respiratory diseases. At the same time, more than 80% of citizens living in cities that monitor air pollution are being exposed to air quality levels that exceed the limits recommended by the WHO. There are many types of air pollutants. One of them is PM10, particulate matter 10 micrometres or less in diameter. Furthermore, there is a close link between air quality, earth's climate and global ecosystems, as many processes causing air pollution (i.e. fossil fuels combustion) are those causing high levels of CO2 emissions. Some of the negative effects this pollutant has on the environment include negative health effects on wildlife, negative effects on aesthetic and utility of areas through visibility reduction and negative effects on vegetation and buildings. PM10 pollutant has been selected as it one of the more commonly measured pollutants across Croatia's measuring stations, and therefore it was convenient for data analysis as it provides a level of comparison between the selected sample. For those cities in which there was no active measuring station, the highest data from the closest active measuring station in the same region (county) has been applied. In the case that there was more than one active measuring station measuring PM10 levels in the city, the data was extracted from the station that displays the highest transgression levels in regards to the said pollutant. As the cited source does not display aggregated data for Croatia as a separate unit of analysis, an annual (2019) average value was used, by examining 48 out of 50 measuring stations monitoring the PM10 pollutant across Croatia, due to data availability. For maximum estimation accuracy, a hierarchy of data was established and applied during the data collection process, with daily validated data considered most accurate. However, in the absence of daily validated data, daily validated data using

gravimetrical methods were considered. If neither daily validated data or gravimetrical daily validated data were available, the daily source data was used for calculation purpouses. The boundary of 35 permitted exceedances each year has been selected as per air quality standards and objectives defined by EU legislation (Directive 2008/50/EU).

	x	IV
Gospić	3	0
Slavonski Brod	77	1.200
Zadar	5	0
Zagreb	53	0.514
Croatia	17	0

Organic Farming. This indicator measures the percentage of total farmland of a city or its surrounding countryside, that is cultivated using organic farming methods, in the latest available year. Data was obtained from CBS' online databases concerning agriculture statistics. Industrial agriculture is damaging to the soil, water, and even the climate it relies on. Many alternatives to industrial farming are known, one such alternative is organic farming. There are many benefits to organic farming. Overall, organic farming aids in environmental protection, it preserves and improves the health of citizens, and it helps create crucial, climate-friendly and quality jobs. Out of all other alternatives to industrial farming, organic farming is at the moment the most widespread option, especially in the EU, and cities should aspire to support as much organic food production and consumption as possible. There are already such exemplary cities in Croatia, as Poreč has been a member of the "Organic Cities Network Europe" initiative since 2018. The threshold for all cities was set to 20%, as this percentage was extracted when analysing top performer countries. For cities for which there is no publically available data, the share of organic farmland was estimated using county-level data.

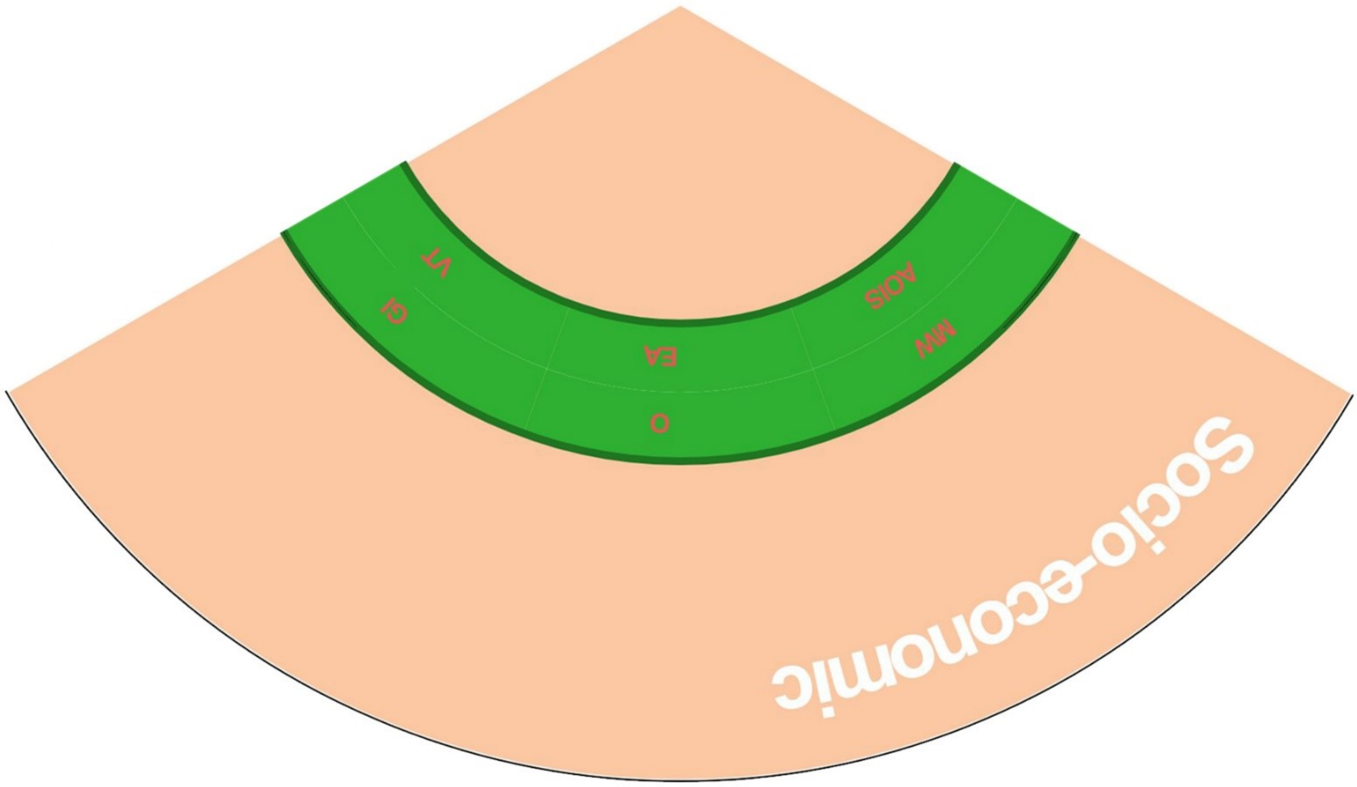
	x	IV
Gospić	15.97	-0.202
Slavonski Brod	8.12	-0.594
Zadar	5.60	-0.720
Zagreb	11.37	-0.432
Croatia	5.99	-0.701

Green Open Space. This indicator measures per capita m² of public green spaces of a city. These areas include parks, grassy areas, botanical gardens, park-forests, alleys and public playgrounds, with the exclusion of zoos, as zoos are not considered public, "open" spaces due to an entrance fee citizens usually pay to access these areas. There are also ethical considerations because of which zoos have been excluded from the analysis of green open spaces we would like to create and preserve in the 21st century. In an urban context, green open spaces fulfil various important functions and improve the quality of the urban environment and overall quality of life for citizens. Among just some benefits that urban green spaces can provide are increased biodiversity, cleaner air, reduced risks of flooding, reduction of heatwave impacts, improved opportunities for leisure and aesthetic life, and longer and healthier lives of citizens. Combining CBS' press release from 2008. on the numbers and surface (in thousands of m²) for some of Croatia's municipalities and CBS data concerning local population levels, the input value has been derived and used in the above-specified formula. To estimate levels of green open space for Croatia on a national level, the average value was used by examining values for 69 Croatian cities, for which data was readily available in the cited source and which contain 61% of Croatia's total population. The boundary of 9 m² per capita was selected, as per WHO's recommendations.

	x	IV
Gospić	8.08	-0.131
Slavonski Brod	2.79	-0.887
Zadar	10.3	-0
Zagreb	3.18	-0.831
Croatia	16.8	-0

Renewable Energy Production. Share of locally produced renewable energy in the total energy produced locally. All energy will need to come from renewable sources by 2040, according to the Paris climate agreement, if we are to decarbonize our energy systems and avoid dangerous runaway global warming. Energy balance data has been obtained from the European Commission for the total energy (TEP) and renewable energy produced (REP) in Croatia, expressed in millions of tons of oil equivalent and converted to megawatt-hours. However, to approximate the share of locally produced RE in the total energy mix of a specified locality, we had to estimate how much energy is one city producing and how much of that energy is renewable. In order to do that, data from the *Integral Analysis of the Effects of the Development and Construction of Renewable Energy Sources in Croatia in the period from 2007 to 2016* report has been obtained on shares of production from renewable energy sources power plants, by counties, for 2016. This was justified as we can assume that even though energy systems of core urban centres are the main drivers of unsustainable fossil-fuel-based energy consumption, most of the renewable energy used locally is produced on the city's hinterland, outside of densely populated urban centres. Thus, the regional shares of REP in the national total have been used as weighting factors and multiplied by the national REP figure, in order to estimate local levels of renewable energy production in MWh. To gain an estimate of TEP for each city, MWh per capita of Croatia's TEP has been multiplied by the total population of Croatia and her regions. From here the index value has been calculated using the share of regional REP in the regional TEP as the input value for the above-specified formula. A threshold of 90% has been used to assess city-level performance. This ambitious, yet imperative threshold was applied to reach net-zero carbon emissions by 2040, in accordance with the Paris climate agreement goal, with the hopes of reaching 100% of energy coming from renewables in the near future.

	x	**IV**
Gospić	374.46	-0
Slavonski Brod	27.83	-0.691
Zadar	231.37	-0
Zagreb	3.90	-0.957
Croatia	51.75	-0.425


Socio-economic
MW
AOIS
O
EA
GI
VT

Municipal Waste. Per capita annual kilograms of total municipal waste generated in a city serves as a proxy indicator for material usage effectiveness. The data was extracted from the yearly Municipal Waste Report, issued by the Ministry of Economy and Sustainable Development for 2018. Municipal waste is waste generated in the household and waste that is similar in nature and composition to household waste, excluding production waste and waste from agriculture and forestry. Municipal waste is an important indicator for approximating material-use efficiency, as it informs how many resources are only used once and very temporary. This is especially true for Zagreb, as it is referred to as the "EU Capital of trash". According to the World Bank, on a global level, 2.01 billion tonnes of solid municipal waste is generated annually, with at least a third of that amount not being managed in according to environmental safety standards. Although it can be regarded that the success of any sustainable waste management system depends on the socio-economic and physical infrastructure governing such efforts, households are still primary units of consumption and end-of-pipe delivery and/or collection points for almost all types of waste. As such, households need to be addressed equally by theoretical considerations, along with political strategies for a safe and just transition in the 21st century. The boundary is set to 165 kg/cap/yr, which is the lowest appropriate empirical value calculated for a city based on the data reported by The World Bank. This value has been selected as this is approximately (164.80) the lowest empirical value for a city with relatively comparable levels of development and population to Croatian cities – the Swiss city of Bern. The current target is, thus, a realistic one, while we are ultimately striving for a zero-waste society.

	x	**IV**
Gospić	314	0.903
Slavonski Brod	221	0.339
Zadar	473	1.867
Zagreb	317	0.921
Croatia	432	1.618

Overwork. This proxy indicator is used to indicate how overworked the workers of a given city are. Overwork can most easily be understood as that amount of work that exceeds the restorative capacities and endurance of individuals (Rhoads, 1977). There are many negative impacts on health, life quality and happiness associated with long-term overwork (Prasad and Thakur, 2019). In extreme cases, it can significantly provoke risk factors associated with fatal cardiovascular diseases and strokes (Ke, 2012). Moreover, according to Cha (2013) excessive work has negative impacts on gender equality as it contributes to the perseverance of gender segregation in male-dominated occupations. Furthermore, according to some theoretical understandings, we need to reduce hours worked per week to increase care potential and other creative endeavours in our everyday lives (Coote & Franklin, 2013). Furthermore, a shorter workweek has the potential to reduce emissions of greenhouse gases (Nässén & Larsson, 2015) and other harmful environmental pressures (Rosnick & Weisbrot, 2007). The indicator used to approximate city-level overwork in this research relies on officially reported mean usual hours worked per week by people employed in legal entities in a given city. For the purpose of this research, the cumulative weighted mean monthly average of hours worked in all sectors by people employed in legal entities was calculated using the data concerning persons employed in legal entities in a given city, published by the CBS. By dividing this value with the total population of a specific region, the weighted average of hours of work per month was calculated and subsequently converted to weeks per month. This input value has been compared against the boundary value of 32 hrs/week (sometimes referred to as the four days work week), as proposed by some post-growth policy advocates.

	x	**IV**
Gospić	39.20	0.901
Slavonski Brod	39.15	0.894
Zadar	39.24	0.905
Zagreb	39.19	0.899
Croatia	38.08	0.760

Gender Inequality. Percentage of male representatives in city councils serves as a proxy indicator for measuring gender justice within local politics. Data on shares of women and men in city councils has been extracted from official web pages of the analysed cities, in the year 2020. Gender inequality at the level of local representative bodies has been chosen as this is one of the main prerequisites for reaching and maintaining a just distribution of genders throughout all spheres of public life. Gender equality is a necessary prerequisite for a socially and ecologically stable and just society as it is hard to imagine a democratic transformation to a such a state without a larger share of women positioned at places of political decision-making. According to the Constitution of the Republic of Croatia, gender equality is a fundamental value, according to which men and women should be equally represented in all areas of public and private life. However, underrepresentation of women in Croatia's politics is present, and especially visible at local levels of political decision-making, according to the CBS' report *Women and Men in Croatia* in 2018. There are many mechanism and methods aimed at achieving gender balance in political institutions. One such mechanism is the quota system, aimed at increasing the presence of women in governmental institutions. Although there are many iterations of the method, in their essence, gender quotas in politics rely on pre-defining a certain share of women to participate in political structures and processes. As we are striving for total gender inequality, for index value calculation purposes a boundary of 50% of men in a given city council has been used to gauge local gender inequality. For this indicator, after the final index value calculation the index value has been multiplied by a factor of two, in order to adequately reflect the intensity of the gender inequality problematic in Croatia on the doughnut visual.

	x	**IV**	**2*IV**
Gospić	65	0.294	0.588
Slavonski Brod	52	0.040	0.080
Zadar	65	0.290	0.581
Zagreb	67	0.333	0.667
Croatia	73	0.458	0.916

Availability of Inpatient Services. The number of hospital beds per 1000 inhabitants serves as a proxy indicator for assessing the health care capacities of existing public health infrastructures of specified localities. This number refers to all hospital beds stationed in clinical hospital centres, clinical hospitals, clinics and general hospitals of analysed cities, and has been derived from the annual Operations of Hospitals in Croatia report for 2018, issued by the Croatian Institute of Public Health. One of the main worries for governments around the world during the coronavirus pandemic is having enough hospital beds to accommodate potentially infected patients while ensuring and maintaining proper inpatient hospital care for treating other types of diseases and illnesses. For some countries, and the same logic would apply for cities, high density of hospital beds has proved to be a big advantage in the crisis. For other countries, expanding hospital bed capacities has been a key part of the strategy for mitigating the crisis, with some countries like Croatia urgently installing hospital beds outside of existing health infrastructures at one point. Regardless of the COVID-19 crisis, hospital bed capacity is an important aspect of the proper functioning of health institutions, as, for example, a shortfall in this regard may cause difficulties in admitting patients in need of emergency care (Mayor 2007). To calculate the values to be mapped in the graph, a threshold of 8 hospital beds per 1000 residents has been selected. However, according to the WHO, there is no global norm for the density of hospital beds in a population. The boundary of 8 was, thus, selected as Eurostat based calculations for Germany, one of the top performer countries during the peak of the crisis of April and May of 2020, display approximately 8 hospital beds per 1000 capita.

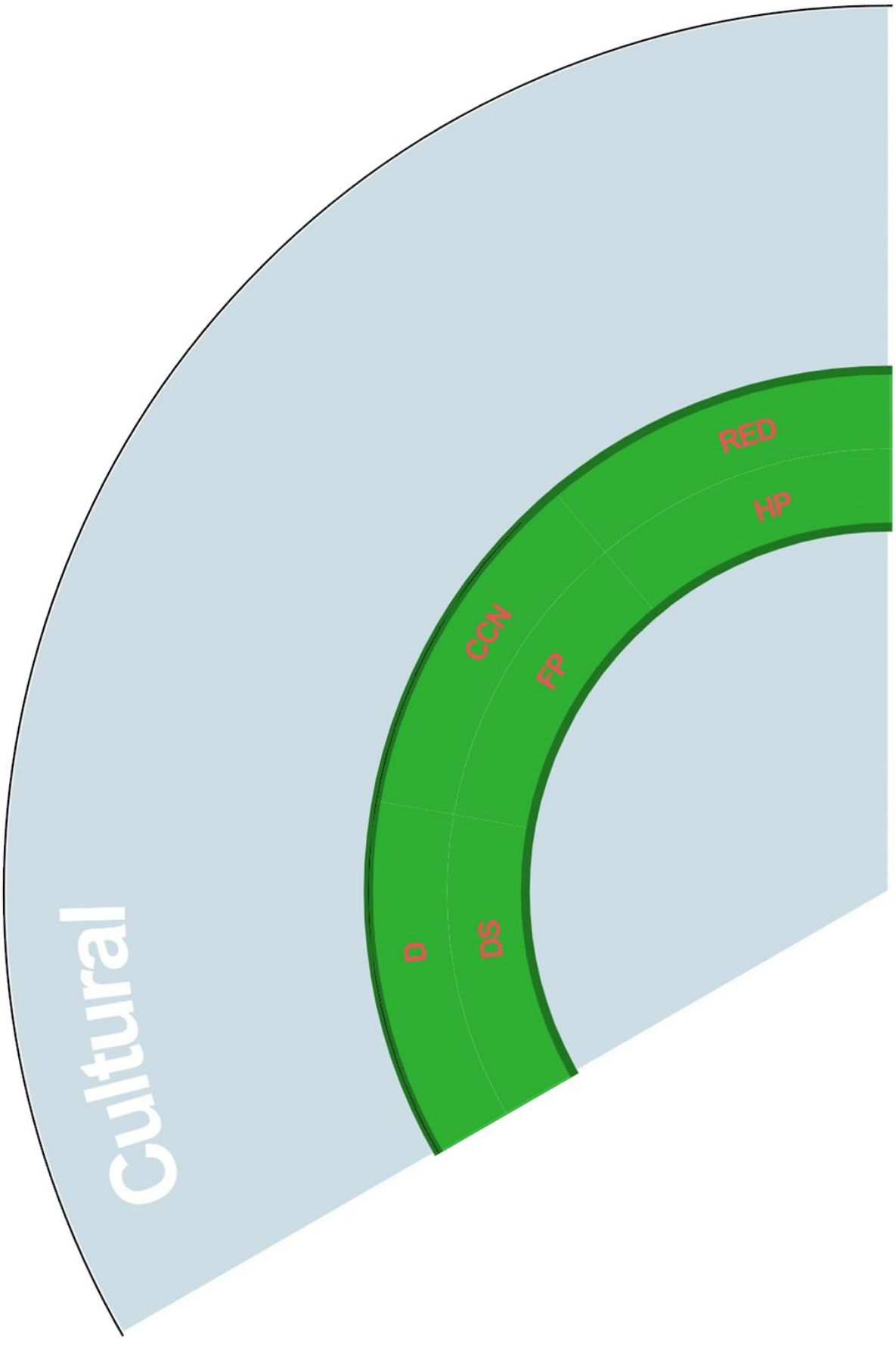
	x	**IV**
Gospić	6	-0.255
Slavonski Brod	7	-0.081
Zadar	6	-0.302
Zagreb	6	-0.238
Croatia	3	-0.569

Educational Attainment. The share of residents holding third-level degrees in a given city. The data has been extracted from the 2011 Census, published online by CBS online. This relates to all non-university degrees (faculty levels and professional studies under the Bologna Process), art academies, university studies in accordance with the Bologna Process, master scientific, professional and art degrees, and doctorates of science. This indicator accounts for the following age groups: 20-24; 25-29; 30-34. These age groups have been selected as those individuals are old enough to hold tertiary education degrees. Furthermore, individuals from those age groups are the ones we can expect to be important catalysts for the necessary transformative action in the 21st century. Education is a crucial component of an individual's development and it is vital for people to be able to participate in a democratic society and have the ability to support themselves. Higher levels of education contribute to greater horizontal and vertical social mobility, increased health, reduced crime and improved democracy. Even though ultimately there should be an upper limit to tertiary-level education, some minimum levels of higher education in society are necessary to spearhead the sheer magnitude and complexity of the transition to come. Thus, the threshold of 40% has been applied, as 40% of young Europeans with a higher education qualification is a sufficiently ambitious and realistic target set by EU's Europe 2020 strategy.

	x	**IV**
Gospić	20	-0.608
Slavonski Brod	18	-0.670
Zadar	28	-0.450
Zagreb	33	-0.343
Croatia	21	-0.590

Voter Turnout. Voter turnout is the percentage of voters who cast a vote in the most recent local elections in Croatia, in this case, in 2017. This analysis considers this indicator as a proxy for the "political voice" category in Raworth's (2012) "social foundations" framework. In terms of social sustainability, it is important that citizens feel that they can have an impact on their society in order for them to feel like they belong. Although citizens usually perceive national elections to more important than the local ones (Morlan, 1984), in this research, voter turnout can be regarded as representative of the feeling of the positive impact on the structure and dynamics of society. This is because turning up to vote displays the belief of citizens that their action has a palpable impact on the local government. All voter turnout data has been derived from publicly accessible databases published by the State Electoral Commission of the Republic of Croatia. An ambitious threshold of 80% of turnout has been set for all localities, for maximum realistic legitimacy of elected executives. Although this figure may appear more appropriate for national elections of Western European countries, it has been selected because of the scale of democratization necessary to carry out a just transition on all levels of political decision-making.

	x	**IV**
Gospić	51.96	-0.510
Slavonski Brod	29.49	-0.918
Zadar	28	-0.945
Zagreb	34.23	-0.832
Croatia	35.20	-0.815


Cultural
D
DS
FP
CCN
HP
RED

Distrust. This indicator represents the mean value of region-specific responses to the following two survey questions: "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?" (1-you can't be too careful; 5-most people can be trusted); "Generally speaking, do you think that most people would try to take advantage of you if they got the chance, or would they try to be fair?" (1-most people would try to take advantage; 5-most people would try to be fair). In this additive index, both input variables had to be re-coded to reflect distrust, so that the higher score on the additive scale (range 2 - 10) represent higher levels of distrust. As it is the basic component of social capital, greater levels of trust are often linked to greater levels of subjective well-being. Because cities, especially large metropolitan areas, are often places of vast differences among the population, trust is a necessary component for a broad and inclusive democratic action. This seems especially valid for the large-scale crisis of global proportions that demand collective solutions, like climate change. The boundary of 6 was selected to signify acceptable levels of distrustful opinions and attitudes among the surveyed population. Thus, the selected value represents the middle of the range of the additive scale that is not to be crossed. Similarly as was the case with Gender Inequality, the original IV has been multiplied with the factor of two, in order to visually display the magnitude of the problem of distrust.

	x	**IV**	**2*IV**
Gospić	6.48	0.120	0.340
Slavonski Brod	7.17	0.293	0.293
Zadar	6.74	0.185	0.370
Zagreb	6.30	0.075	0.150
Croatia	6.68	0.170	0.340

Climate Change Nonchalance. Mean value of region-specific answers to the following survey question: "In general, do you think that a rise in the world's temperature caused by climate change is…" (1-extremely dangerous for the environment – 5-not dangerous at all for the environment). In order to adequately address unprecedented levels of environmental degradation taking place, people must first recognize that climate change is a dangerous phenomenon. It is no longer enough to admit that (anthropogenic) climate change is real and already affecting major Earth's processes. If any collective mitigation and adaptation measures are to be successfully implemented, we must realize the great and imminent danger of the business-as-usual scenario causing climate change. The boundary was set to 3 as all values below this mid-range value represent sufficient concern to expect the respondents to recognize the scale of the crisis and potentially take part in efforts towards mitigating climate change.

	x	**IV**
Gospić	1.97	0
Slavonski Brod	1.90	0
Zadar	1.98	0
Zagreb	1.84	0
Croatia	1.99	0

Renewable Energy Dismissal. Share of urban respondents rejecting the prioritizing of non-renewable sources of energy. In other words, this indicator has been applied to assess the (lack of) priority which a particular city gives to renewable energy for meeting Croatia's future energy needs. More precisely, this indicator measures the percentage of respondents supporting non-renewable sources of energy as a national priority in energy policy. It is the sum of percentages of respondents from a particular region which answered to the question "To which of the following should Croatia give priority in order to meet its future energy need?" with "coal, oil, natural gas, nuclear power, fuels made from crops or none of those.", as opposed with "Solar, wind, or water power". Civic support for a transition to a net-zero carbon energy production is a crucial component for successfully transitioning to an ecologically sustainable future. Such transition is necessary not only because of the finite nature of fossilized energy sources but because of the destructive impact of fossil-based energy systems on the environment. This appears particularly important when globally cities account for more than two-thirds of the world's primary energy demand. The boundary of 33.3% of respondents selecting non-renewables was selected as this represents 66.6% of respondents directly or indirectly supporting renewable sources of energy. In this case, a two-thirds majority was applied as this percentage more accurately represents the urgency of achieving net-zero carbon emissions by 2040, in accordance with the Paris climate goals.

	x	**IV**
Gospić	23.3	0
Slavonski Brod	41.3	0.240
Zadar	30.1	0
Zagreb	23.3	0
Croatia	31	0

Degrowth Support. Mean value of region-specific responses to the following four survey questions: „Climate change and other environmental problems will sooner or later result in an end to economic growth" (re-coded); "Limited availability of natural resources (e.g. oil, gas) will sooner or later result in an end to economic growth"; "Economic growth always harms the environment"; "To contribute to the fair mitigation of global climate change Croatia must reduce its CO2 emissions" (recoded). Responses were given on a scale from 1-5 (completely disagree-completely agree). This indicator is, thus, an additive index, with lower score levels (min=4) signalling lower levels of degrowth support, and higher scores (max=20) meaning stronger support. This indicator is a reproduction of one factor of the "Degrowth scale", used by Domazet et al. (2020) in broader research of "degrowth potentiality" of socio-political systems. In this study, however, the indicator is mainly used to gauge citizens' understanding of environmental limits to growth. This is especially important because of the impact that urban activity, due to the physical and social infrastructure of cities, has on the affirmation of growth-oriented development models. It is of no surprise that cities have been deemed as economic growth machines (Molotch, 1976), and as such have to be at the centre of necessary large-scale socio-political transformations and throughput reductions. Thus, the fundamental support of values underpinning such strategies is crucial in successfully implementing them. A threshold of 14 expects that respondents, on average, score 3.5 on each item of the scale, to indicate above-average levels of support for degrowth-compliant understandings.

	x	**IV**
Gospić	14.26	-0
Slavonski Brod	13.54	-0.046
Zadar	13.38	-0.062
Zagreb	13.76	-0.024
Croatia	13.79	-0.021

Flourishing perception. Mean value of region-specific responses to survey questions measuring "flourishing" perception, a concept introduced by Huppert and So (2013) in their psychometric analysis of multiple aspects of positive well-being. The index contains 9 questions, with responses ranging on a scale from 1-5 (totally agree – totally disagree). Thus, this indicator is an additive index, with lower score levels referring to higher levels of flourishing perception, and vice-versa. In degrowth theory, repositioning well-being at the centre of economic activity is at least as equally important as quantitative downscaling of economic growth. In social sciences, different methodologies for measuring well-being have been well researched and applied. Huppert and So (2013) identify well-being as "positive mental health", and define it as opposite states to some of the most common mental health disorders, like depression or anxiety. In their work, an operational definition of flourishing is derived from ten aspects of opposite psychological states to internationally acknowledged symptoms of depression and anxiety in order to combine feeling and functioning, hedonic and eudaimonic aspects of well-being. Due to its multi-dimensional character "flourishing" provides superior insights for policy interventions than the more commonly used "life satisfaction" measure (Huppert and So, 2013). For the purpose of this analysis, regional-level data containing "flourishing index" scores have been provided by the Institute for Social Sciences in Zagreb. A threshold of 31.5 shows that respondents, on average, score 3.5 on each item of the scale, which displays acceptable average levels of positive well-being self-assessment, with any value above the average 31.5 for all nine items combined mapped as unacceptable shortfalls.

	x	**IV**
Gospić	35.05	-0.263
Slavonski Brod	35.55	-0.300
Zadar	35.19	-0.273
Zagreb	34.14	-0.196
Croatia	34.86	-0.249

Health Perception. Mean value of region-specific responses to the following survey question: "In general, would you say your health is…". Responses were given on a scale from 1-5 (excellent-poor). For the purpose of the analysis, the original input variable has been re-coded, so that the higher levels of the index reflect a more positive assessment of one's health (poor-excellent). Although the best method for measuring the health of the local population would be to rely on official medical data, it is important to include personal health self-assessments in our model as a way of approximating adequate levels of another dimension of the overall well-being of citizens. According to the WHO's Healthy Cities approach, a healthy city is "conscious of health and striving to improve it. Thus any city can be a healthy city, regardless of its current health status." In this regards, subjective health assessments become even more important. In fact, some studies (Monden, 2014 - Encyclopedia) have discovered positive correlations between subjective health, measured as self-assessments of general or physical health, and subjective well-being, which in turn positively contributes to health and longevity (Deiner and Chan, 2011). Without a doubt, a generally healthy population, as well as a population that regards itself to be in good health, is what any model of attainment of sustainability should strive for and achieve if humanity is to thrive in vibrant and resilient communities in the 21st century.

	x	**IV**
Gospić	3.35	-0
Slavonski Brod	3.28	-0
Zadar	3.25	-0
Zagreb	3.27	-0
Croatia	3.30	-0

3. RESULTS

This section presents the results of the applied model, as described in previous sections, on the selected sample of Croatian localities. Additionally, the analysis includes a national-level doughnut visualization of the Republic of Croatia. As was already explained in the introductory remarks, this degrowth doughnut model has been developed with a specific set of themes and indicators, that in some cases significantly differ from those originally developed by Domazet et al. (2020). However, it is worth mentioning that in some rare instances the results of this research almost entirely correspond with the results of the above-mentioned model when applied for the Republic of Croatia. For example, such is the case with organic farming, as this research discovers 5.99% of total Croatian farmland to be organic, whereas the original national model finds this to be 6.15%, rendering the visualized shortfalls almost identical in both instances. This is due to the identical methodology applied for visualizing this indicator in both models.

In other cases, the values of some indicators are expressed in the same units between the two different models, and use different datasets and methodologies to define these values but still display somewhat similar results. In the case of "CO2 Emissions", used in the original model, and "Carbon Footprint", utilised in this research, the units of both indicators remain in annual tons per capita of CO2. However, because of the already mentioned methodological steps undertook in approximating the levels of CO2 emissions (3.72) in this analysis, the data differs somewhat from that included in the original model for Croatia (4.17). As in this example, this difference is not one that could render the approximation efforts of this research useless, the national model used in this research could be regarded as a point of reference when gauging the validity of derived indicator values, by comparing the manually calculated proxy input values with the automated Degrowth Doughnut values that rely on extracting these input variables from established international databases while conducting much simpler operations. It is worth mentioning that the strength of the national visualization in this research lays partially in providing quantifications that were not accessible in the original national model, as is the case, for example, with the quantification of the level of distrust in Croatian society.

For almost all other cases of corresponding indicators, however, this analysis yields significantly different results, mainly due to the differences in applied methodologies. These differences are sometimes caused by the nature of the data utilised as input parameters for

doughnut index value calculations. This refers not only to the incompatible temporal characters of the data collected by the two models but also to their differing "spatial" characters, in terms of the level at which the data is being analysed. For instance, the voter turnout data (55.52%) in the original model differs significantly from the results of this model (35.20%) because this research analyses the national voter turnout for the local elections in Croatia in 2017, while the original national model focuses on the most recent national elections. Additionally, although some indicators do retain the same nomenclature, for instance as is the case with "Gender Inequality", this research relies on qualitatively different data. Whereas the original national model collects UNDP GI index data to obtain national scores, this research relies on the percentage of men in city councils to approximate gender inequality on a national level. At the same time, in the case of gender inequality, it is important to point out that this research relies on the data on the gender distribution at the level of city councils, rather than the data on gender distribution at the level of the national parliament, as one might expect. This logic has been retained and applied throughout the entire process of data collection and analysis.

This way, the national model used in this research retains its main purpose of presenting a sensible macro-level perspective while at the same time focusing on lower subnational units central to this analysis. Although it is important to discuss in-depth the topics presented here from a national, or even transnational perspective, the visualized doughnut model for Croatia has been presented here primarily to gain a level of comparison for Croatian municipalities which are at the main focus of the following sections.

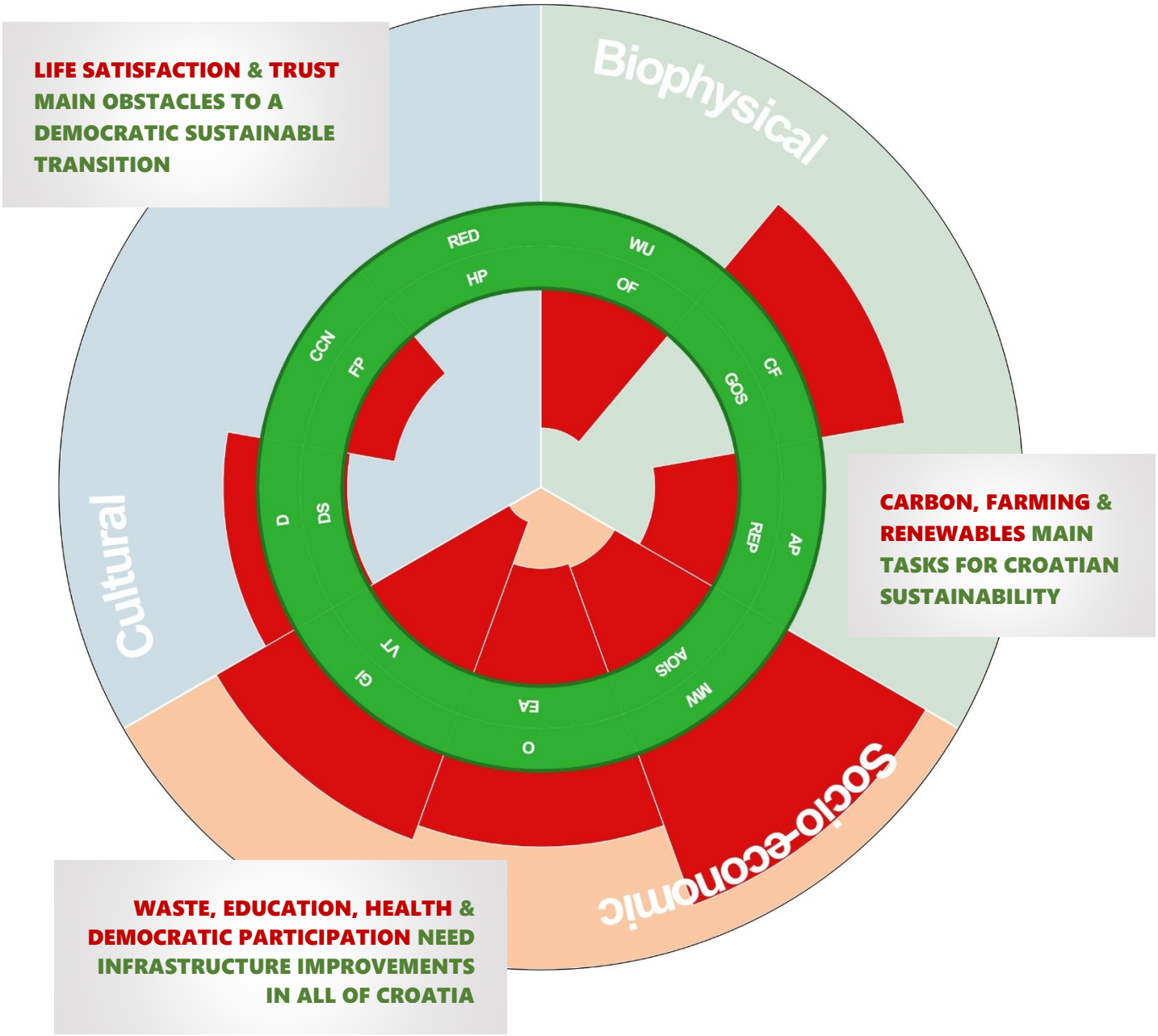


Fig. 3 Degrowth Doughnut visualization with 18 applied indicators for the **Republic of Croatia**.

Legend: *BIOPHYSICAL:* Water Use (WU); Carbon Footprint (CF); Air Pollution (AP); Organic Farming (OF); Green Open Space (GOS); Renewable Energy Production (REP); *SOCIO-ECONOMIC*: Municipal Waste (MW); Overwork (O); Gender Inequality (GI); Availability of Inpatient Services (AOIS); Educational Attainment (EA); Voter Turnout (VT); *CULTURAL:* Distrust (D); Climate Change Nonchalance (CCN); Renewable Energy Dismissal (RED); Degrowth Support (DS); Flourishing Perception (FP); Health Perception (HP)

When it comes to the biophysical segment of Croatia's social metabolism, the doughnut presented in Figure 3 presents overshoots and shortfalls on every indicator for which data has been collected, except in the case of per capita abstracted volume of water from Croatia's renewable water resources (WU). The largest shortfall of this segment is visible in the area of organic farming (OF), which points to a need for much greater efforts for the conversion of land to sustainable farming practices in order to develop food production practices fit for the 21st century. In terms of drivers of climate change, like carbon consumption via carbon-intensive economic activities and the lack of renewable energy production, excesses and inadequacies are visible on both proxy indicators. On the one hand, according to this research Croatian citizens annually emit almost double the amount of what is considered sustainable levels of CO2 emissions (CF). On the other hand, it is clear that Croatia is not doing enough to achieve complete carbon neutrality by 2040, as only slightly more than a half of the total energy production is coming from renewable energy powerplants (REP).

Visually largest and most worrying overshoots and shortfalls, however, are visible in the socio-economic segment of the graph. This is especially true when analysing the levels of material use efficiency (MW) and accessibility to relevant public health infrastructure (AOIS). Even though reported statistics on annually generated municipal waste is merly indicative of the underlying issues of waste management and appropriate infrastructure, according to the presented image it is clear that major interventions are needed in restructuring Croatia's waste management systems as the country annually produces more than two and a half times the total amount of kilograms of municipal waste than in this research exemplary city of Bern. Similarly, it is obvious that large scale projects are necessary for Croatia's overall health system, as with only one hospital bed per thousand inhabitants Croatia falls way below the set standard accentuated by the growing pandemic. Relatively high levels of overwork (O) are accompanied by a significant shortfall of adequately educated (EA) young Croatian citizens. Gender inequality (GI) remains a big issue for an inclusive and balanced model of democracy we want to promote at all levels of political representation as almost 73% of representatives in city councils are men. In this regard, a staggering shortfall is identified in the voter turnout (VT) section of the doughnut, with only slightly above a third (35.2%) of Croatian voters casting a vote in previous local elections, which is a poor performance in established democratic systems aspiring for maximum legitimacy of political representatives.

However, despite the identified deficiencies in democratic functioning, the cultural segment of the doughnut visualization for Croatia does display noteworthy potential for transformative action. Only slight boundary and threshold transgressions are visible in the average popular support of some opinions and attitudes oriented towards a degrowth vision of the future (DS). Despite the visible overshoot, this potential is complemented by relatively low levels of distrust (DT) in society. This result is partially enhanced by the recognized need for a transition to renewable energy sources (RED), along with a recognition of the danger that climate change poses for the environment (CCN), and thus for achieving just and sustainable levels of social reproduction. The overall purpose of the necessary transition to come is to guarantee adequate levels of wellbeing for all, within the physical means of the planet and outside the dominant models of extractivist socio-economic relations. In this regard, it is interesting to note that while Croatian citizens do report sufficient levels of physical wellbeing (HP), the largest noticeable shortfall in the cultural segment is visible when analysing the more personal aspects of their mental health self-assessment (FP).

3.1. Zagreb

In the first instance, it is noticeable that the doughnut visualization for the Croatian metropolis does not overall differ significantly from the visualization for Croatia, as is the case with other cities in the sample. However, the first major difference can be seen at the biophysical level, as this visualization introduces the "Air Pollution" (AP) and "Green Open Space" (GOS) indicator values. With adequate levels of water use and a significant shortfall in the area of organic farming, Zagreb displays a drastic shortfall of green open spaces with an indicator value (3.18 m²) almost three times lower than the aspired 9 m² of green public space per capita. In terms of climate change and pollution, citizens of Zagreb display above-average levels of CO2 emissions, along with unacceptable levels of polluting particles contained in the city's ambient air. One of the biggest shortfalls in the entire section relates to the production of renewable energy, with minimal levels of less than 5% of energy coming from renewables.

In regards to the socio-economic infrastructure, this city displays similar patterns of overshoots and shortfalls as the national model, with, surprisingly, somewhat lower levels of municipal waste generation. It is of no surprise, however, that Zagreb performs better on the AOIS indicator, as the Croatian metropolis could be regarded as the centre of medical infrastructure and service in the country and, on the other hand, would be hard-pressed to perform much worse than the national average. In terms of work and education, inadequate but significantly above-average of educational attainment is identified in Zagreb's working population, while its citizens work approximately an hour longer than the national average. Gender inequality remains a big issue in Zagreb, as two-thirds of local representatives are men, with voter turnout also falling slightly below the national average levels. Most certainly, Zagreb benefits from the concentration of national infrastructure (health, education), but according to this research fails to spearhead as a progressive national leadership in equity and democracy.

On the bright side, Zagreb retains similar levels of potential for a democratic transformation as the national model, with only slight shortfalls and overshoots on indicators of distrust and support for degrowth. Additionally, these attitudes are supplemented with a strong rejection of anti-environmentalist beliefs and values. Finally, the doughnut shows that citizens of Zagreb find themselves to be in physically good health, with some room for improvement in regards to their personal feeling of flourishing. The cultural segment for Zagreb, thus, shows that the biggest obstacle to achieving sustainability in the 21st century are not its citizens.

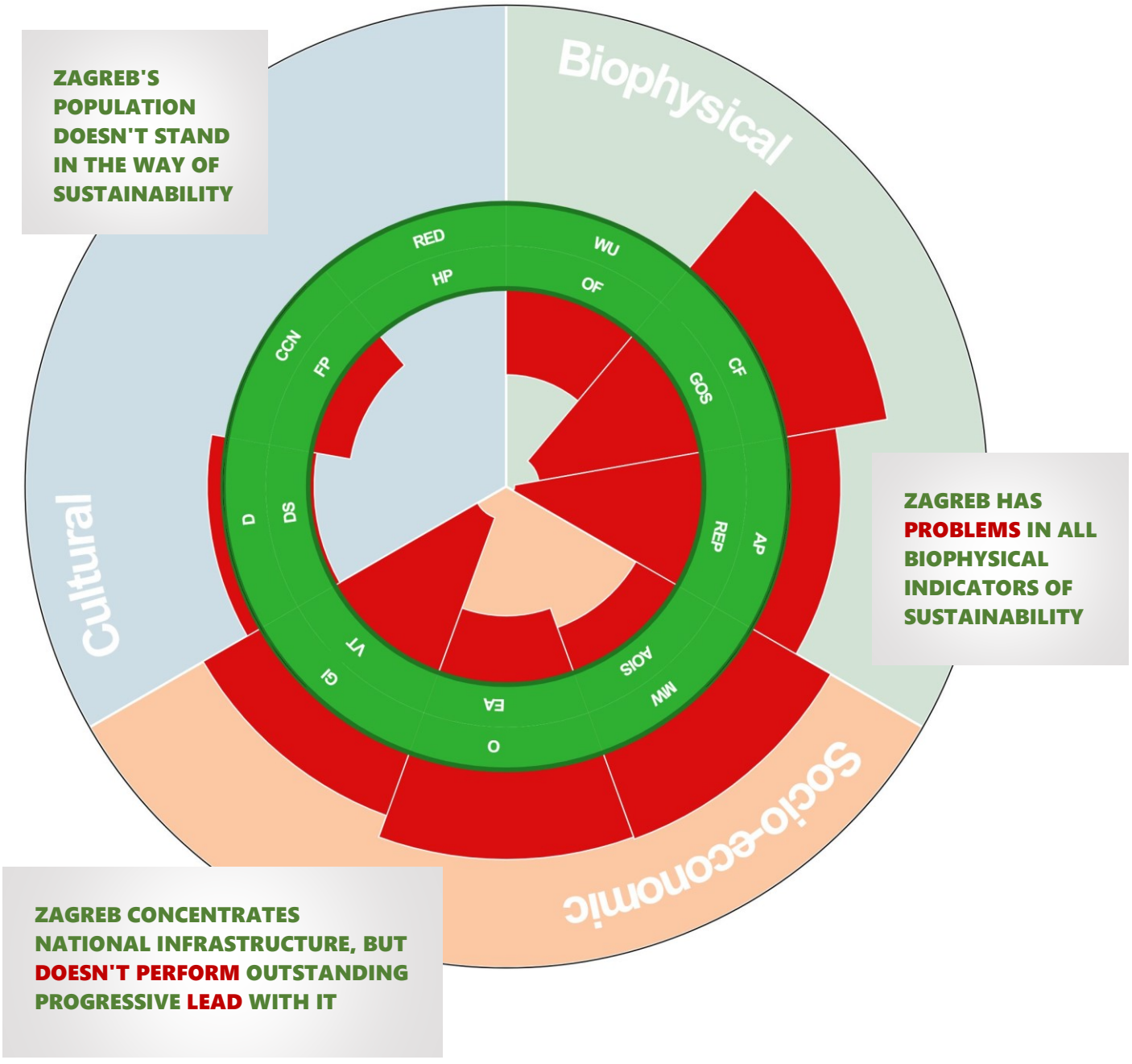


Fig. 4 Degrowth Doughnut visualization for **Zagreb.**

3.2. Slavonski Brod

For the continental town of Slavonski Brod indicate major inadequacies are identified in all areas of its biophysical performance. Although the doughnut displays above-average levels of organic farming, in regards to the access to other natural goods the citizens of Slavonski Brod enjoy the least available area of green open spaces in the sample, with less than 3 m² of public greenery per citizen. With the carbon footprint value almost identical to the national average, the town could be regarded as representative in terms of its carbon consumption patterns. Less than a third of energy coming from renewables in the town's total energy mix resulted in a significant shortfall being mapped on the doughnut in the area of renewable energy production. The most striking overshoot, however, in the biophysical segment can be attributed to the indicator monitoring air quality. Cumulatively, in 2019 citizens of Slavonski Brod have been breathing in low-quality air for more than one month.

On the other hand, Slavonski Brod is the best performer within the selected sample in regard to municipal waste generation, with slightly above 50 kg of municipal waste generated annually above the set limit of 165 kg/cap/yr. At the same time, with 7 hospital beds per 1000 capita, Slavonski Brod is also the best performer in regards to the indicator approximating sufficient levels of medical infrastructure by almost reaching the desired target of 8 beds per 1000 inhabitants. Furthermore, citizens of Slavonski Brod are no more overworked than the citizens of other analysed cities, but with less than one-fifth of their young population acquiring higher education degrees perform the worst in the entire sample when it comes to educational attainment. Additionally, while a barely visible overshoot of gender inequality points to highest performance within the sample, this result is somewhat overshadowed by the worst voter turnout among all analysed units, with less than a third of registered voters in Slavonski Brod casting a vote in the most recent local elections.

In the cultural segment, Slavonski Brod is also the worst performer with overshoots and shortfalls on four out of six indicators. Lowest levels of trust in the sample could partially account for previously detected deficiencies in voter turnout, while average levels of support of degrowth is a sign of optimism when it comes to the democratic potential of citizens of Slavonski Brod. This, however, is not supported by the finding that over 40% of citizens reject renewable energy sources by prioritizing non-renewables for meeting Croatia's future energy needs.

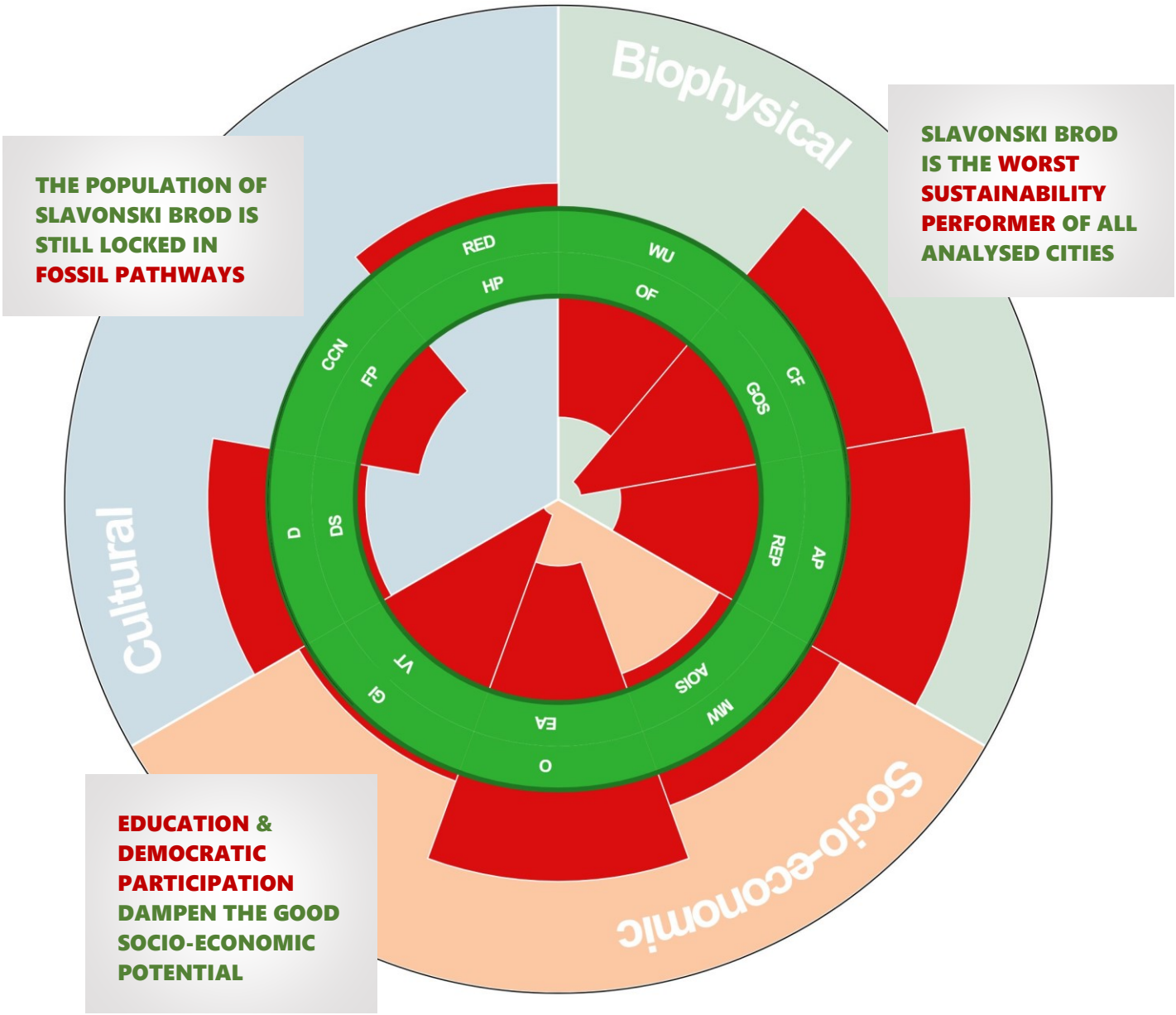


Fig. 5 Degrowth Doughnut visualization for the town of **Slavonski Brod**.

3.3. Gospić

In the terms of the biophysical pressure of Gospić, fewer overshoots and shortfalls and of smaller magnitude are visible than is the case with the two previously analysed cities. Starting with the topic of access to nature, Gospić displays the best performance in regards to organic farming, approaching the sustainable levels of agriculture (20%) with approximately 16% of the utilised agricultural area certified as organic. Green open spaces are also nearing the green ring of safe and just operating space, with around 8 m² of urban greenery per citizen. In regards to climate change and pollution processes, Gospić only displays an overshoot in carbon consumption, with slightly below-average levels of national CO2 emissions per capita annually. Moreover, according to our findings, Gospić is achieving sustainable levels of air quality which can be in part due to sustainable levels of renewable energy production.

Average performance in most aspects of socio-economic functioning of the town of Gospić is also visible from the doughnut visualization. Municipal waste generation is naturally higher than the best performer Slavonski Brod, but slightly lower than the Croatian metropolis Zagreb. A shortfall is visible in the AOIS section of the graph, but with 6 bed per 1000 capita still relatively close to the set standard. Poor performance is recorded in terms of educational attainment with only a fifth of the population holding tertiary-level degrees. Almost two-thirds of male representatives in city councils point to a deficiency in the democratic functioning of Gospić, while a reason for optimism is certainly the highest voter turnout (above 50%) within the selected sample.

This optimism can be further expanded by findings regarding the democratic potential of Gospić, as citizens display adequate levels of degrowth-oriented attitudes and only a minimal, but average overshoot on the distrust indicator. According to the doughnut, Gospić doesn't have a problem with citizens fostering anti-environmentalist views, which further strengthens the city's cultural potential for a democratic transformation. The only shortfall is visible in the area of citizens' mental wellbeing with only average levels of transgression. This, coupled with acceptable levels of physical health, points to overall good performance in terms of the wellbeing of citizens of Gospić.

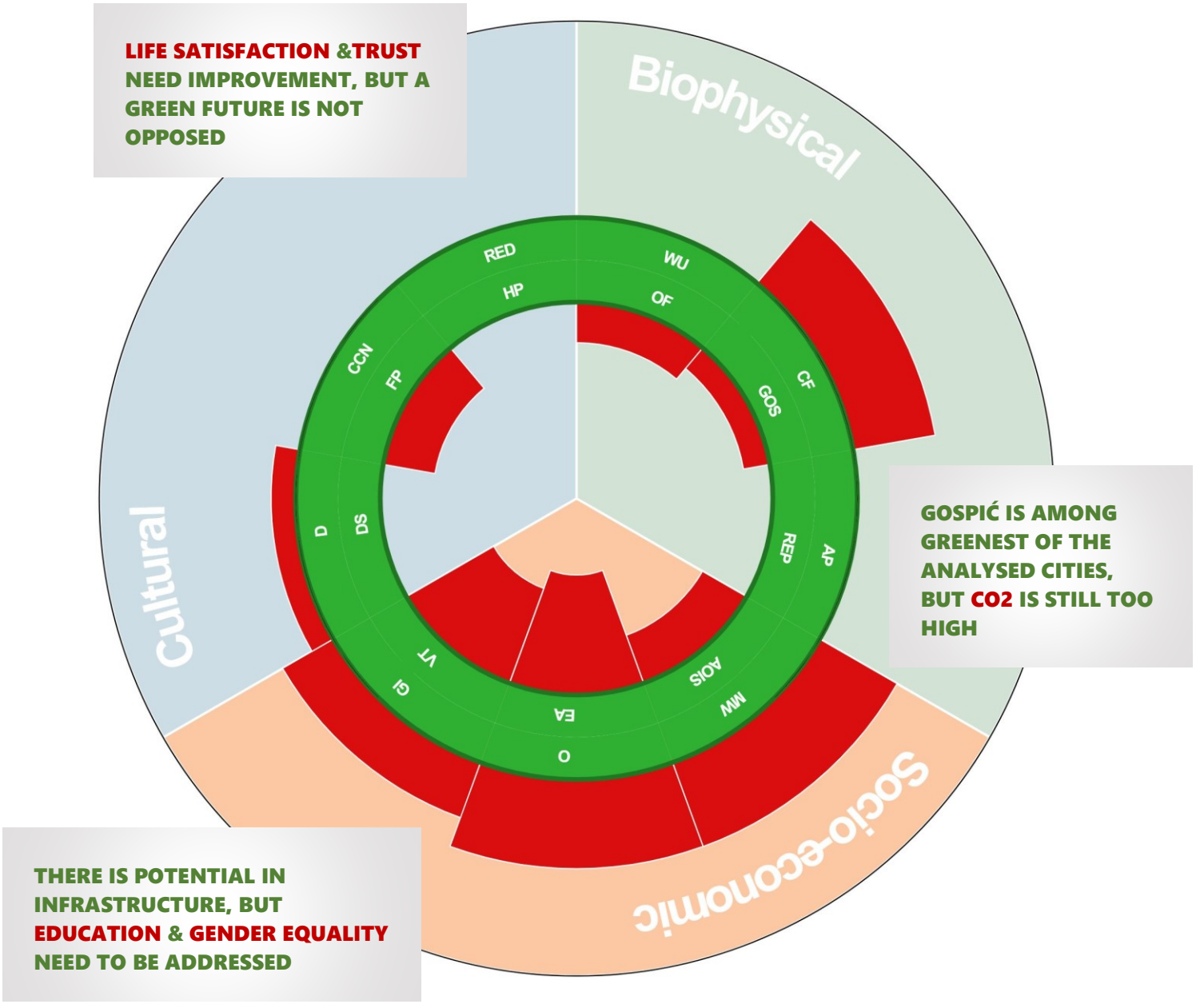


Fig. 6 Degrowth Doughnut visualization for the town of **Gospić**.

3.4. Zadar

Unlike Gospić, Zadar has the lowest levels of organic farming in the sample, achieving even lower results than the national average. However, in other regards, it seems like Zadar is accessing its natural resources sustainably, with no issues with water usage and availability of green open spaces. From a perspective of pollution and climate change, Zadar is the best performer, with no air quality issues and with the lowest carbon footprint within the selected sample. With almost a whole metric ton less carbon produced in its economic activities, in comparison to the national average of this research, Zadar's economy is seemingly least carbon-intensive among all analysed cities. On the other hand, it is of no surprise that Zadar meets the set target for renewable energy production as almost a fifth of Croatia's renewable energy is produced in power plants stationed in the County of Zadar.

Somewhat less encouraging results are visible in the socio-economic segment, where Zadar is producing the largest overshoot in municipal waste production recorded in this research, exceeding the specified limit almost three times over. In regards to infrastructure, Zadar displays the usual levels of AOIS shortfall. Similarly, usual levels of overwork are detected, as is the case with the rest of the sample. The results are encouraging, but not sustainable in regards to the educational attainment of Zadar's young citizens, as only over a fourth of them acquired academic degrees. In regards to democracy, Zadar is experiencing similar levels of gender inequality as the majority of the sampled cities. At the same time, the lowest voter turnout and, thus, visually the largest shortfall is noticeable.

Almost identical pattern to Gospić's is visible in the cultural segment, with an added shortfall of popular support of specified degrowth statements by Zadar's citizens. This democratic potential is also slightly hindered by unacceptable levels of distrust among the population. However, no overshoots have been detected in regards to citizens' professing anti-environmental attitudes, with acceptable levels of support being displayed for renewable energy prioritizing and concern about the dangers of climate change. As was the case with all units of analysis, while the citizens of Zadar are assessing their overall health as good, a shortfall in the assessment of their more personal, mental aspect of wellbeing is recognized by the model.

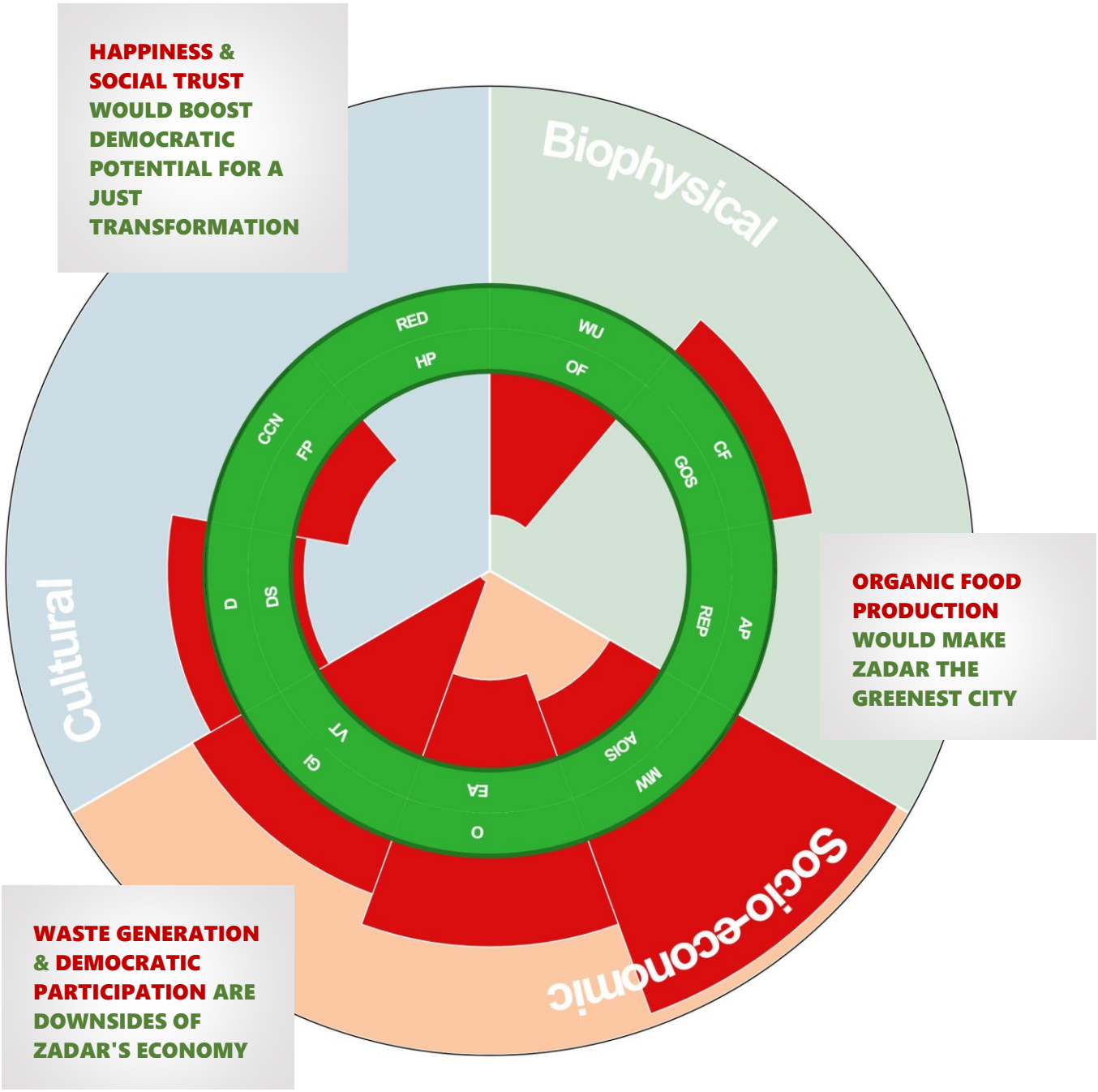


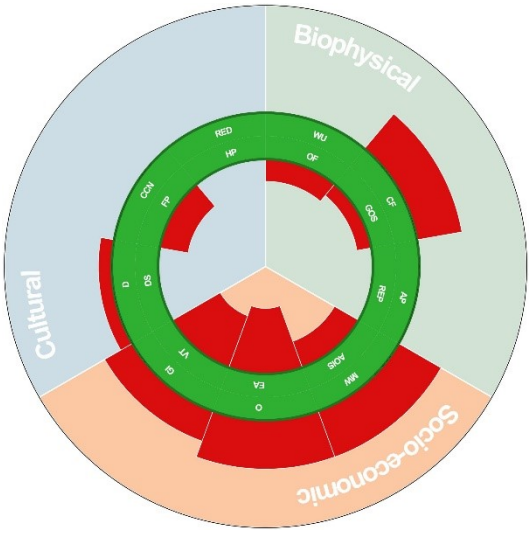
Fig. 7 Degrowth Doughnut visualization for the town of **Zadar.**

4. DISCUSSION

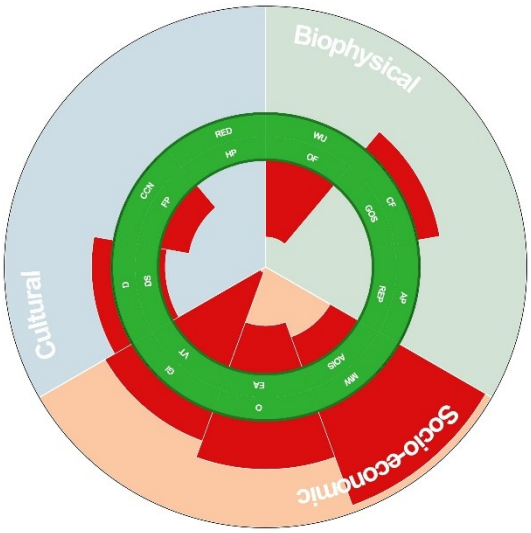
This section analyses the above-presented results of the selected sample of local doughnuts, along with a national representation for Croatia. One of the most obvious results is that none of the analysed units reaches the green ring of safe and just operating space. Although they do meet sustainability standards in certain aspects of their social metabolisms, no units display exemplary performance by satisfying the standards defined by the model. Not only do local social metabolisms fail to function sustainably but they all also fail to reach the sustainable area of SJOS in any of the three defined segments. This points to a need for policy interventions on both national and local levels of political decision-making to address the identified shortcomings. However, the analysis does reveal differences within the sample in regard to their overall sustainability performance. The grouped, comparative "mosaic" of presented doughnut visualizations offered below (Fig. 8) renders this insight more obvious. If we are to simultaneously compare the doughnut visualizations against each other it does seem that some cities are more (un)sustainable than others and, thus, form relatively distinct patterns of sustainability performance. Although the visualized overshoots and shortfalls in the socio-economic and cultural segments are relatively uniform across the sample, with the exclusion of minor, but relevant exceptions that need to be adequately addressed, it is noticeable that the cities of Zadar and Gospić perform significantly better on the biophysical set of indicators, especially when compared to the cities of Zagreb and Slavonski Brod. In this sense, the national model provided in this research is not fully representative of the selected sample, as the pattern of the sustainability performance of Croatia's social metabolism more resembles that of Zagreb and Slavonski Brod than of Zadar and Gospić.

In order to better inform policy measures for the transition to come, an in-depth discussion on certain aspects of these discrepancies is provided in the following sections. This includes not only an analysis of identified shortcoming but an examination of existing potentials upon which strategies for achieving a just and sustainable future can be built. Uniquely, because of the conceptual foundations and operational mechanics of boundary, threshold, and range determination and justification, a certain level of discussion about what is and what ought to be done is presented by the visualizations themselves, additionally strengthened by the previous sections concerning indicator selection overview. This, in turn, perhaps allows for a more localized narrative aimed at further embedding the discussion in the context of natural processes and social dynamics specific to Croatia and some of its localities.

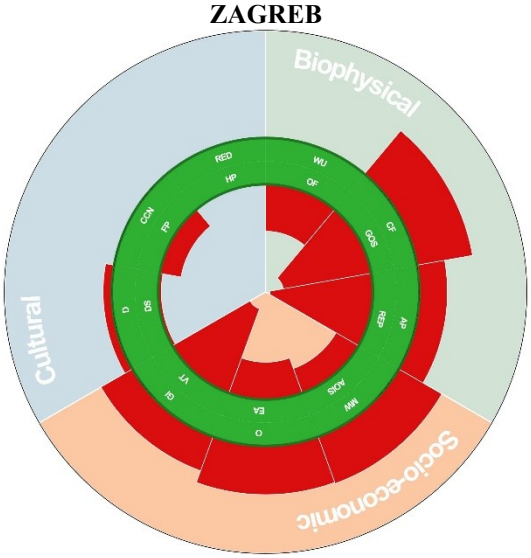
GOSPIĆ



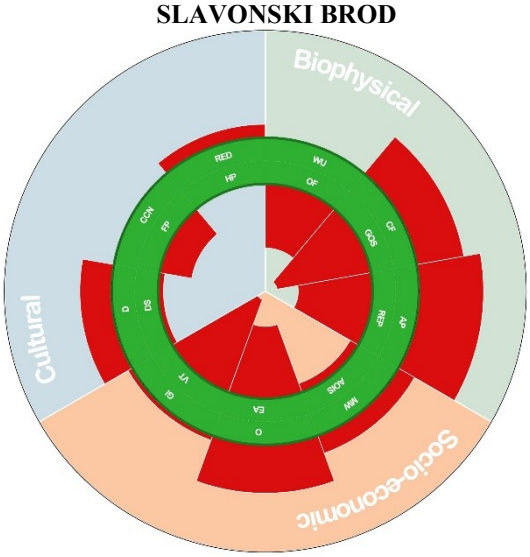
ZADAR



ZAGREB



SLAVONSKI BROD



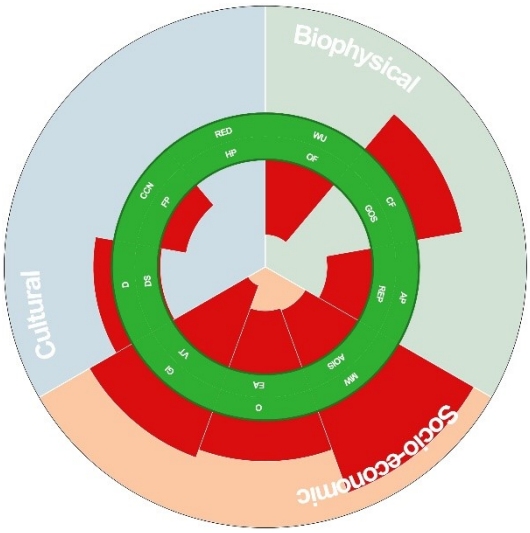


Fig. 8 Mosaic representation of the Degrowth Doughnut visualizations for the selected Croatian municipalities, with the Republic of Croatia for comparison (bottom doughnut)

4.1. Biophysical performance

As stated previously, one of the most interesting results of this research refers to the differences in the biophysical performances of Gospić and Zadar, compared to Zagreb and Slavonski Brod, with former cities displaying better indicator values than the latter, rendering their social metabolisms closer to the aspired SJOS. It is difficult to attribute these differences to a certain set of specific characteristics of these localities, as the only obvious difference refers to their geographical positioning within the territory of Croatia, with Zadar positioned more closely to the Adriatic Sea, and Gospić being in its relative proximity, while Zagreb and Slavonski Brod are landlocked cities under continental climate and connected to fossil fuel infrastructure. Indeed, it is to be expected that geographical positioning will have an impact on indicators gauging biophysical performance related to access to natural resources, climate change and pollution. However, this relationship is insufficient in explaining the dynamics of differing sustainability performance in biophysical aspects of their social metabolism, and should, in future research, be controlled for a more comprehensive set of variables in order to establish these determining factors. Furthermore, it is also obvious that Zagreb and Slavonski Brod represent more industry-oriented economies, while it can be stated that Zadar, and to a minor extent Gospić, perhaps precisely because of their geographical features, focus more on service-based and biomass processing activities that are usually considered less resource-intensive. Except for Zagreb, at the county level, all three cities show similar levels of development in terms of their county-level HDI scores. An extremely low population density in the case of Gospić could to an extent explain the good performance on biophysical indicators, as most of the methodological assumptions of the model's biophysical segment in their essence rely on per-capita estimations.

In this research, the topic of access to nature is measured by the indicators of water use, organic farming and green open spaces. In the case of water use, the doughnut visualized for Croatia is representative, as all cities remain within the SJOS regarding this indicator. Croatia's richness in renewable water resources is a well-known phenomenon and is certainly one of Croatia's largest potentials for future transformation efforts. However, we should be careful in

considering this as the ultimate proof of sustainable water extraction practices across Croatia's territory. The often publicly cited data referring to approximately 32,000 m^3 of total renewable water resources per capita annually in Croatia is the one used in this research, which may seem like practically unlimited amounts of water are accessible to Croatia's citizens for utilization at any given time. However, a detailed analysis of public policies of water extraction practices in Croatia states that it would be more appropriate to refer to the data on underground renewable water resources of 2000 m^3 per capita annually, as this is the water being used for human consumption purposes. Around 5% of renewable underground water was extracted in 2015, which is a lot considering the unequal temporal and spatial distribution of these waters across Croatia, and considering the overall unavailability of water for extraction, due to technical and ecological reasons (Tomašević, 2016). In this light, although according to this research Croatia's accessibility to water resources may seem unlimited, we should be careful when determining sustainable levels of water use, along with defining clear criteria for granting concessions related to water use extraction. This is partly because the effects of water extraction by private companies for commercial purposes has greater overall negative effects on the environment when compared to the delivery of water by public water supply institutions to realize the basic human right of access to water (Tomašević, 2016).

In any case, a fundamental reconceptualization of current modes of water supply and utilization practices will have cascading effects throughout Croatia's economy. Because of the role that water plays on all levels of Croatia's production and consumption processes, changes in water distribution and utilization practices may be inevitable in all major sectors of the economy. One such sector is agriculture. Along these lines, when analysing the standards set for organic farming, none of the analysed cities reaches sustainable levels. The best performer in the sample is Gopić, whose results could partially be attributed to the fact that Gospić is the only city for which county-level data hasn't been applied and, thus, presents the most realistic state of affairs. Nevertheless, poor performance on this indicator across the rest of the sample, with Zadar displaying the worst results, should raise some concern. A transformation to sustainable means of food production can refer either to transforming a portion of existing industrial farmlands and/or to rooting organic farming practices on Croatia's unutilised agricultural land. This seems especially necessary when considering the data published by the Institute for Applied Ecology "OIKON", which detects 400,000 ha of unused agricultural land in Croatia that could be used to feed 11 million people annually, at the same time creating numerous, high-quality jobs. The largest share of this unutilised agricultural land is unsurprisingly found

in the County of Zadar, with 43,178 ha of unutilised farmland located in this county. In any case, for the purpose of achieving a sustainable future, all means of sustainable food production should be endorsed by national and local authorities, like agroecology, permaculture, traditional and subsistence farming, along with organic farming methods. One way of supporting these efforts, especially from an urban perspective and in the context of Central and Eastern European countries, could be by advocating already existing food self-provisioning practices in cities' allotment gardens, as some studies show numerous environmental and social benefits of this mode of alternative food production practice for urban sustainability (Sovova, 2015).

As stated in the opening remarks, agriculture is just one of many sectors vulnerable to the negative impacts of climate change. This analysis confirms that Croatia needs to significantly reduce its carbon footprint if it is to meet Paris Agreement goals and contribute to limiting global temperature rise well below 2 degrees Celsius above pre-industrial levels in this century. Following the result of the national carbon footprint indicator, none of the analysed cities reaches sustainable levels of carbon dioxide emissions, with some cities, like Zadar, producing somewhat better results than the above-average levels detected in Slavonski Brod and, especially, Zagreb. This is further exemplified by the poor performance on the Air Pollution indicators for Zagreb and Slavonski Brod, with Slavonski Brod displaying considerable vulnerabilities in this area. Unfortunately, this is a well documented and longlasting problem for citizens of Slavonski Bord, as activists have been warning local and national authorities about these air quality issues caused by the Oil Refinery "Brod" across the Sava river in Bosnia and Herzegovina, along with dangerous levels of exposure to background radiation originating from the thermal power plant in Stanari, Lukavac, Ugljevik, Zenica and Tuzla. Increased levels of air pollution are the result of various factors. Polluting particles are most often formed due to an increased number of domestic and industrial combustion plants on solid fuels (mostly biomass) during the winter months. This, in combination with regular daily activities, such as daily migration patterns using personal transportation, and appropriate weather conditions, causes the retention of these particles in the city's ambient air. PM10 is one of many such particles, and smaller the polluting particles are, the more dangerous they are as they infiltrate people's bodies on a deeper level and can cause numerous health issues.

It is obvious that altering cities' combustion patterns and infrastructure, along with overall downscaling of everyday economic activities, will have a positive effect on the air quality in

our surroundings and, at the same time, alleviate other negative impacts of climate change. In fact, some studies (Kennedy et al., 2012) have attributed significant per capita GHG emissions (0.27 tCO2/cap/yr) reductions in major metropolises (e.g. London, New York, Berlin etc.) to changes in cities' stationary combustion patterns (power plants, industrial combustion plants, heat and power production plants, district heating plants, small plants e.g. stoves and residential boilers etc.). This mainly refers to a switch from oil and coal to renewables and natural gas for fueling heating and electricity generation. Interestingly, although the cities are, in percentage terms and on average, reducing their per capita emissions faster than their nation-states, alterations to electricity generation sourcing are usually the result of higher levels of governments (Kennedy et al., 2012).

As mentioned in the opening sections, the roles that cities play in global climate change and mitigation efforts are well understood. Because cities represent complex and interconnected spaces of social and economic activity, synergies are required on all levels of political decision-making in order to adequately transform our existing infracture, production and consumption practices to sustainable levels of resource use. In order for this to happen, national legislation has a significant effect on the development and implementation of local climate plans for climate change mitigation and adaptation (Reckien et al, 2018). In the year 2020, a first such breakthrough has seemingly been made in Croatia with the "Climate change adaptation strategy in Croatia for the period up to 2040 with a view to 2070". The extensive strategy for the first time explicitly prescribes the necessity for specific measures across eight most vulnerable and following key sectors in Croatia: water resources, agriculture, forestry, fishing, biodiversity, energetics, tourism and health. At the same time, the importance of executive authorities successfully transferring these responsibilities to units of regional and local self-government in regard to planning, implementation and reporting, while at the same time ensuring adequate co-financing, is recognized.

However, in the public space of civic deliberation, a lack of critical discussion about some conceptual cornerstones of the Strategy is noticeable. Although it is out of the scope of this analysis to provide an in-depth analysis of this comprehensive document, generally, it is now clear that any strategy aimed at achieving wellbeing in the 21st century must avoid the trap of defining policy measures in terms of "green growth". It is not clear that the Strategy unambiguously rejects "sustainable" developmental models predicated on the idea of economic growth and the negative impacts of such developmental model on the overall quality of life. A

truly transformative strategy for the 21st century will have to be supported by degrowth-oriented policies centred around downscaling of our consumption patterns through reductions in material output and fundamental transformations of our energy systems from fossil fuels to renewable energy sources, while at the same time prioritizing regenerative practices centred around care to reduce social inequality and increase overall wellbeing. Although embedding these processes in existing global climate networks is to an extent detrimental (Reckien et al., 2015), at the same time, the transition to come must be achieved by cooperation with local stakeholders, enriching the process of co-planning with transparent and openly critical debates to increase the overall inclusiveness of the process (Lehtinen, 2018).

Although there are numerous strategies for cities to achieve necessary levels of GHG emissions reductions, this process is undoubtedly inseparably connected to higher levels of renewable energy production and consumption. This is crucial in reaching net-zero carbon emissions by 2050. In this research, some Croatian cities perform better than others, with Gospić and Zadar completely meeting the aspired for targets set in the doughnut model, while Zagreb and Slavonski Brod are considerably failing to meet the target of 90% of renewable energy production in the total energy mix. In a way, national and local policy measures aiming for higher levels of energy efficiency are important for mitigating negative climate change impacts, along with reducing energy poverty throughout Croatia's regions. Even in Croatia's capital, the city of Zagreb, significant shares of citizens are still living in low-energy efficient households (Grdenić et al, 2020), which causes numerous health and infrastructural issues. At the same time, there is a noticeable lack of adequate measures in existing national and local policy frameworks aimed at addressing the issue of energy poverty related to energy inefficiency of households. Providing energy security to all should be one of the main priorities of any strategy for a just and sustainable future.

However, one should be careful when advocating for greater energy efficiency within the current (green) growth developmental models. As the Jevons paradox in economics teaches us, when the efficiency of resource uses rises, the rate of its consumption usually rises with it, due to increasing demand. This is why when it comes to reducing GHG emissions through transformations of our energy systems, a necessary shift must be aimed at fundamentally transforming collective consumption patterns and infrastructure, rather than further enhancing ecologically destructive productivity capacities of existing modes of extractivist socio-economic (re)production. It is clear, however, that this can not be achieved by existing national

strategies, as exemplified in the "Energy development strategy of the Republic of Croatia until 2030 with a view to 2050", which fails to ambitiously respond to impending threats of climate change by legitimizing investments in new infrastructure projects based on fossil fuels extraction, such as Krk's LNG terminal and the Adriatic-Ionian gas pipeline. This could have the ecologically undesired consequence of rising oil and gas production for as long as until 2040, according to the Strategy's projections, which is far from being in sync with internationally agreed-upon goals and ongoing climate change mitigation and adaptation efforts.

According to a research on Croatia's renewable energy production potentials, there are scenarios according to which a full transition to 100% of domestically produced renewable energy is already attainable (Jerkić et al. 2015), which makes the identified shortfalls in renewable energy production even more alarming. Thus, major and prompt investments are needed in renewable energy technologies and infrastructure across Croatia, if we are to meet the Paris Agreement climate goals. Regarding Croatia's cities, it is interesting to note that it is of no surprise that Zadar and Gospić are within the SJOS ring as their counties combined produce more than a quarter of total renewable energy produced in Croatia. This is important as this implies that the produced renewable energy is not necessarily consumed in these regions and cities, which may point to unsustainable levels of renewable energy consumption. On a national level, a portion of that energy may even end up being exported, while importing energy that may not come from renewable sources. This, however, only additionally strengthens the argument that Croatia has the capacities to develop networks that can produce and distribute adequate amounts of renewable energy across the national territory. At the same time, municipalities should be nationally incentivised (Wu et al., 2018) to develop localized and decentralized modes of renewable energy production and dissemination, in order to aid in strengthening local self-governance for achieving energy self-sufficiency.

Some of the negative impacts of climate change can be combatted by focusing on increasing the size and qualities of green open spaces in Croatia's urban areas. Again, better performance on these biophysical indicators is achieved in Zadar and Gospić, compared by the poor performance of Zagreb and Slavonski Brod. Adequate amounts of quality green spaces accessible to the general public are important for building healthy and more resilient urban communities. Although civic initiatives, like the recent "Plant a Tree" are important, green urban infrastructure development should be given high priority in the very process of urban

planning and systematically documented in the city's official strategies and action plans. In this sense, local governments should be discouraged from unilateral and uncooperative conversions of public spaces for private projects not benefiting the majority of citizens. In Zagreb, local authorities have met such resistance earlier this year, when architects and activists voiced their concerns as the latest general urbanistic plan of Zagreb included conversions of close to 420,000 m² of public green spaces used for sport and recreation to construction sites for residential and other purposes. In contrast, local governments should entice lower levels of local decision-making to proactively incorporate local knowledge and experiences into initiatives of neighbourhood planning and corresponding infrastructure design, while making sure that these processes are aligned with strategic environmental and sustainability standards. At the same time, in the context of green open spaces, it is important that projects designating new green urban spaces, or developing existing ones, do not result in "eco-gentrification", forcefully displacing and negatively impacting long-term, low-income residents living in areas of (new) urban greenery (Black and Richards, 2020).

4.2. Socio-economic performance

For us to achieve sustainable levels of resource use that will ensure a good life for all in the 21st century, biophysical capacities of nation-states and lower spatial units have to be complemented by adequate social dynamics and physical infrastructure. Indicators discussed in this section display relatively uniform performance across the sample of Croatia's cities, with the most significant exceptions refereing to fluctuations in indicators gauging sustainable levels of medical infrastructure and municipal waste production. From the grouped overview of the visual doughnuts, it is noticeable that the socio-economic performance patterns of Zagreb and Gospić are more alike, with the exception for indicators of democracy than the socio-economic dynamics of Slavonski Brod and Zadar. At the same time, we can notice that the doughnuts for Zagreb and Gospić more resemble the national averages presented in the doughnut visualization for Croatia, and are in this regard more representative than the cities of Zadar and Slavonski Brod. From the national doughnut visualization, major shortfalls and significant overshoots are identified. The most significant transgressions are noticeable in the set of indicators contained in the theme of "materials and infrastructure", with the other two

themes displaying relatively similar levels of overshoots and shortfalls when visually compared.

Indicators for material use and infrastructure are approximated with quantifications of per capita municipal waste generated in a year, and hospital beds available per 1000 capita. In the case of waste, similarly as in the case of green open spaces, sustainable waste management in cities has to be adequately regulated by waste management strategies and plans that are in line with positive national guidelines and existing examples of good practice. In the context of EU, targets for recycling, packaging and landfilling are tied to overarching strategies aiming to achieve the circular economy model across the EU. Some degrowth proponents have criticised the circular economy model as being another de-politicizing strategy of growth-driven capitalism, especially relevant for business models based on the cheap flow of energy and materials. Certainly, as the circular economy model tends to give more emphasis on technological improvements in order to achieve sustainability, rather than complementing such infrastructural changes with a necessary cultural shift, as emphasized by degrowth-oriented thinkers, the same caution related to the rebound effect of the Jevons paradox, identified in regards to energy efficiency measures, should be exercised. However, as the circular economy model is currenty a political reality for EU countries, calls for synergies (Schroder et al., 2019) between the two conceptual and political frameworks should not be ignored if we are to successfully move towards sustainable levels of material use.

Although municipal waste contributes to less than 10% of 2.5 billion tonnes of waste annually generated in the EU, the issue of unsustainable waste management is important as it is inextricably tied to our everyday consumption patterns and existing waste management infrastructure supporting them, contributing significantly to climate change. The urgency of changing both our consumption patterns and waste management systems is highlighted by the fact that in 2019 in Croatia only 37% of waste was being sorted for recycling, which is well below the target of 50% for 2019 set out in Croatia's Waste Management Plan, and the target of 60% for 2022 if Croatia is not to pay millions of kunas worth of penalties imposed by the EU. Particularly devastating facts for the health of Croatia's environment are stated in reports of more than 60% of municipal waste being stored underground, with the EU target for 2035 being less than 10%, and only slightly above 20% of municipal waste being recycled and composted, with the EU target for 2020 being more than 50%. In the local context, according to the Ministry of Environment and Energy 2019 Municipal Waste Report, only the city of

Prelog (66.7%) achieves the desired 60% of municipal waste being sorted, with even seven cities not sorting waste at all. In the case of major Croatian cities, Varaždin is the top performer with more than 40% of waste sorted, with Slavonski Brod coming second with 29.23%. These findings are in line with the findings of this research that identifies Slavonski Brod as the top performer when it comes to annual per capita municipal waste generation. On the other hand, Zadar being by-far the worst performer in the sample is compatible with the finding of only 7% waste being sorted in this city in 2019, along with an established (Zorpas et al. 2015) understanding of the negative impact of the tourist sector on waste generation.

While is important to adopt zero waste habits on the individual level, at the same time emphasizing the "refuse" and "reduce" components in the waste generation cycle, it is equally or more important to sustainably manage our waste collection and processing systems. This is especially evident in Zagreb, one of the worst performers on the MW indicator in the sample. In Zagreb, an unsustainable and unjust waste collection system is in place by which mixed municipal waste is charged according to the reserved amount of the volume inside the tank, and not according to the actual disposed waste of each household. This creates problems in apartment buildings with shared containers, as it is not possible to determine, for example, who threw hazardous waste. More importantly, the current system is not financially stimulating citizens to recycle in order to pay less for the waste collection service as the fixed amount of the price represents a significantly larger share (70%) than the variable share (30%) in the overall price of the service. Moreover, the variable part of the price in apartment buildings that share a container is, in case there is no agreement among the tenants, divided into equal parts for each apartment, no matter how much each apartment is recycling. If there is an agreement, it is divided depending on the number of occupants in each apartment, but again regardless of how much each apartment is recycling. This issue goes along with another problem of not having the technology, in the form of chipped containers nor waste bags, to individualize waste collection billing.

All of the above makes it hard to decipher why has the cost of disposing separately collected waste in the City of Zagreb increased almost four times, compared to the price in 2018. The problem is highlighted by a publicly often cited fact that Zagreb, in 2016, because of its poor waste management system has "thrown away" 156 million kunas of valuable resources in the form of biowaste, paper and plastics and glass, metal and textiles. A major part of the issue is also that a significant share of the public waste disposal service in Zagreb is performed by

subcontractors, which negatively affects the quality of the service. Not only that separately collected waste in Zagreb is "privatized" by the city's "Čistoća" who hands over the collected waste to recoveries who further process it. This results, among other things, in the over two-times increase of the collected waste, while the price of handing over waste to recoveries has risen almost fourfold. All of the above stated makes it obvious that the City of Zagreb needs to push for sustainable waste management systems, with adequate technologies and just distribution of costs and benefits that would make the process transparent and just. This would increase the overall quality of the service, stimulate citizens to contribute to achieving sustainability targets by ultimately lowering the price of the service, and improve the overall aesthetic and health of the urban environment.

When it comes to other measured aspects of the socio-economic infrastructure conceptualised in this research, major inadequacies are detected in regard to the performance on Overwork (OW) and Educational Attainment (EA) indicators of all units of analysis. Regarding the OW indicator, of course, there are many ways to conceptualise sustainable levels of work. This can be achieved not just by measuring hours of work per week, but ideally could be conceptualised to reflect the quality of work, in the sense of the absence of many known issues at the workplace, like discrimination, mobbing etc. However, this research focused on overwork in terms of hours of work per week, as this measure is recognized by national and international policies and discussions when defining an ideal workload and when discussing sustainable levels of work. As the society is currently dominantly embedded in fossill technological and institutional infrastructure, it is reasonable to expect that reducing the hours of work would minimize the negative impacts on the environment, social dynamics and individual health, as demonstrated above in the indicator justification section.

However, one of the limitations of this research regarding the operationalization of an indicator displaying sustainable levels of work is the absence of publicly available data on actual hours of work per week, meaning those hours that would account for "unofficial", extra hours spent at the workplace. This is why all units of analysis display similar overshoots, as the method for calculating the input parameter relied on officialy reported hours of work to CBS, which, unsurprisingly, doesn't reach the value above the legally determined maximum of 40 hours per week, defined by Croatia's labour law. However, although even other studies identified the lack of publicly available data on overtime hours in Croatia (Zavalić, 2013), some researchers conclude that a significant portion of the (researched) workforce (25%) spends 10 or more

hours at the workplace in various key professional fields in Croatia (science, education, health services) and that 75% of employers are in breach of the 8-hour workday defined by the provisions of Croatia's labour law (Petričević and Medarić, 2014).

This, in conjunction with lowering the amount of work per week to 32 hours, the so-called 4-hours work week, or potentially lower depending on specific needs and posibilities, could result in even more drastic visual overshoots which would more adequately reflect many issues ingrained in contemporary working environments of Croatia and its cities. That way, some differences are to be expected among units of analysis, as it is to expect that different workforce structures of different cities affect the overall overwork structure if we are to assume that some professions tend to result in more overtime hours than others. In this sense, there are some key recommendations to be extracted, one of which is to improve the process of data collection and availability regarding overtime hours. This could help with creating overall better regulation that will ultimately reduce working hours to improve the health of citizens, increase collective care capacities and positively impact the environment. This is associated with better inspection of existing regulation of the workplace from governing bodies and institutions, at the same time not endangering the autonomy of social partners to regulate this area themselves via collective agreements. At the same time, employers should be encouraged to adhere to all positive regulations and to respect the balance between the personal and private life of their employees by communicating transparently and consulting with relevant workforce representatives.

Of course, the workforce structure, along with all the positive and negative consequences resulting from it, is in many ways affected by the educational structure of society. In this research, education, as one major component of achieving better futures for ourselves and generations to come, is measured in terms of the percentage of young people holding university-level (or equivalent) degrees. In this sense, it is of no great surprise that the more developed cities (in county-level HDI terms) of Zagreb and Zadar achieve better results than Gospić and Slavonski Brod on the EA indicator, which in turn display values more similar to the national average. It would be useful, however, to avoid simplistic interpretations, as the mere number of university graduates does not guarantee a sustainable future if the quality of those educational programmes is not aligned with existing challenges and specific requirements of the 21st century. In any case, there are arguments that the drastic expansion of the system of higher education, more precisely the increase in the number of students by 82% in the period from 1990 to 2005, had negative consequences for Croatia's higher education system in terms

of enrollment and development policy not being clearly defined (Babić et al., 2006). Furthermore, Rodin (2009) sees a discrepancy between the way the Bologna reform is conceived and the way it is implemented, primarily due to the different understanding of its fundamental determinants by key stakeholders, which resulted in negative effects in the overall higher education system and, consequently, educational attainments.

Many existing issues with Croatia's (higher) education system are well-reported and often politically debated. Some analysis identify the impossibility of significantly influencing the government through political participation, which often results in political indifference, as one of the major repressive factors of a society that is encouraging the worryingly intensifying "brain drain" of Croatia's highly-qualified young people (Troskot et al., 2019). There are many driving factors of emigration, one of them being the perceived unfavourable perspective in Croatian society, along with negative employment perspectives. From a perspective of achieving a just and sustainable future, however, at a young, highly-educated population must have a sense of being able to influence political dynamics in society. In this regard, it is necessary to not just keep increasing the share of highly educated people to sustainable levels but making sure that Croatia builds an environment of opportunity and flourishing to retain the highly-skilled workforce fit to drive the much-needed transformation efforts to come. At the same time, Croatia's educational policy should be critically assessed to determine misalignments between the purpose of Croatian higher education and the challenges of the transition to come. This is evident as some analysis (Brajdić Vuković, 2017) demonstrate that researchers in the biotechnical and technical sciences are significantly less worried about climate change, even than the general population, and are more anthropocentric in their worldviews than their colleagues in the social sciences, humanities, biomedical, health and natural sciences. In the context of climate change mitigation and adaptation efforts and the scale of the necessary transition, such insights should find a way into many already existing outcries for a better conceptualisation and functioning of Croatia's higher education system.

The above-identified and shortly discussed political resignation of Croatia's highly-educated population is perhaps somewhat reflected in the poor results on the VT indicator. On a general level, voter turnout is a complex phenomenon that is influenced by many factors, and increased voter turnout may be the result of many differing societal characteristics, such as compulsory voting, the importance of the elections at hand and small population levels (Stockemer, 2016). On a national level, the negative voter turnout trend is a well-established phenomenon in

Croatia and has been steadily dropping since the first parliamentary elections on 1990, with an exception of the elections of 2000. This trend is aligned with an established view that in post-socialist European countries the national voter turnout percentage is lower than Western Europe's, along with the fact that voter turnout percentage drops after the founding elections and continues to drop (Kostadinova and Power, 2007). Moreover, in the case of local elections, the voter turnout is usually lower than those for the national parliament as they are perceived by citizens as less important (Morlan 1984). In this sense, it is of no great surprise that all units of analysis display significant shortfalls in regard to this aspect of democratic functioning as the threshold value of 80% visually accentuates low turnout on the doughnuts for the last local elections of 2017 in Croatia. This low voter turnout could partly be interpreted in the context of the negative trend (Čular and Šalaj, 2019) of increasing dissatisfaction with the functioning of Croatian democracy among Croatia's citizens.

It is beyond the scope of this research to discuss the possible reason for the decreasing satisfaction with democracy in Croatia, as this question could and should be further explored in separate research. Furthermore, although an in-depth analysis on the motivation of Croatian citizens for political participation on all levels of decision-making is lacking, some research do suggest that it could be due to the lack of relevant political competencies among the younger population (Kovačić and Vrbat, 2014). If this is the case, educational content related to human rights and democratic citizenship could be introduced and/or further developed in (existing) educational curriculums to strengthen and empower voters of all ages to actively participate in formal democratic processes, such as voting. On a local level, experts recommend that local communities develop projects, elective and non-teaching civic education activities as an example of good practice and involve students in social community engagement. On the other hand, if we are to accept the assumption that increasing the share of the younger population in (local) elections would result in an increase of the overall voter turnout, political parties should innovate on communication strategies in order to connect with their younger voter base to determine topics important and relevant to them.

One other troubling aspect of Croatia's democracy detected in this research is the prevalence of gender inequality among all researched cities. All units of analysis display better results on the GI indicator than the national average of 27% of women in local representative bodies, ie city councils. One interesting result of the study is that the best result is achieved in the least developed city in the sample, Slavonski Brod (48% of women), while the most developed city

of Zagreb is the worst performer with only a third of local representatives being women. This somewhat goes against the "Investing in Equal Opportunities for All: An Analysis of Gender Equality in Croatia" report by The World Bank, which finds that traditional gender roles and stereotypes associated with work in the household and some professions are prevailing in Croatia's rural environments (mostly Dalmatia and Slavonia), but they are changing for the better in Zagreb and other urban concentrations of modern, educated and younger population. This may point to a need to strengthen the attention of political decision-makers and human rights advocates on political representation as well as on economic opportunities of women, as ultimately it is not reasonable to assume that true widespread gender justice can be achieved without a drastic increase of women representatives in key governing bodies.

In any case, gender equality should not be a politically marginalized topic to be called upon every four years when there are political gains to be had. Political parties striving for true gender equality should be the frontrunners in adopting equal gender distribution across their party's electoral lists via gender quotas. In order to progress from the 97th place in the world's ranking of representation of women in parliaments, and improve the overall conditions and opportunities for women in society, Croatia should strive for creating a new National Gender Equality Policy, which expired in 2015. Generally speaking, along with strenghtening existing governmental bodies and civic organisations focused on gender equality and promoting new ones, specific policies and strategies should be defined, adopted and integrated on all levels of politics and social life in order to achieve complete gender equality and enrich Croatia's democratic institutions and the overall quality of political processes. In this sense, a positive move forward is certainly in the proposed, but not yet adopted European Union Strategy for Gender Equality for the period 2020-2025, which, among other things, states that one of its goals is the political empowerment of women, ie the achievement of gender balance in decision-making and politics.

4.3. Cultural performance

One interesting and most optimistic finding of this study is that all units of analysis display significant potentials for achieving a democratic transition to the desired state of a just and sustainable society in Croatia. As can be seen from the doughnut visualizations, the least overshoots and shortfall of all units of analysis can be observed in the cultural segment of the presented graphs. All analysed cities display sustainability in regard to demonstrating sufficient concern about the dangers of climate change, as operationalized in the CCN indicator. Moreover, all citizens adequately accept the view that renewable energy should be given priority in national policies and strategies, as is visible from the lack of overshoots in all cities, with the exception of Slavonski Brod. It is interesting to note, however, that almost uniform good performance on the cultural set of indicators is not necessarily associated with good biophysical performance, and this is even less the case for the results in the socio-economic segment of the presented doughnuts. Again, an interesting exception is the city of Slavonski Brod, as it displays the worst performance in all three measured segments and the ultimately by this analysis unexplored interconnectedness of these segments could be more easily observed in its case. This also somewhat refers to the least amounts of development, in county-level HDI terms, of this city when compared to the rest of the sample. Furthermore, the results of the cultural segment does not deviate too much from the national average, which means that the researched cities are to an extent representative examples.

The lack of anti-environmentalist attitudes (CCN and RED), which are attitudes and values that could hinder political climate change mitigation and adaptation efforts, is one of the most optimistic findings of this study. However, it is not clear how this relates to other measured aspects of sustainability and this should be further explored in other studies. For example, it is to expect that low levels of educational attainment would negatively impact indicator values of CCN and RED, which is ultimately not the case in this study, with the possible exception of Slavonski Brod, which displays highest shortfalls in educational attainment but does not deviate much from the national doughnut which displays no shortfalls on indicators related to environmentalistic attitudes and opinions. Furthermore, we could assume that these positive attitudes towards the environment and climate change adaptation and mitigation efforts, like prioritizing renewable energy, would positively reflect in environmental-friendly practices, most notably in better results on the REP indicator in the biophysical segment in all cities. However, this is not the case for all units of analysis and could point to either individual

consumption choices or the lack of accessible infrastructure to exercise the identified pro-environmental attitudes.

On the other hand, the perceived lack of political participation, as displayed and briefly discussed in poor VT performance across the sample, could to an extent explain these discrepancies between the relatively poor performances of the biophysical and especially of the socio-economic indicators. Along with the identified democratic shortcomings discussed in relation to the socio-economic segment, this could also somewhat refer to overshoots and shortfalls associated with indicators measuring the potential for a democratic transtion conceptualised in the cultural segment, as visible from the DT and DS indicator values. Although relatively minimal, these transgressions are prevalent across the sample, with only the town of Gospić being completely aligned with sustainable levels of acceptance of degrowth-oriented values and attitudes. This is somewhat a surprising result, as we could expect that less economically developed regions would foster more growth-oriented values and would be less inclined to sacrifice certain aspects of material consumption for the sake of the environment.

However, it should be noted that good overall performance on the DG indicator in this research is not the final proof of Croatian citizens' support for degrowth, as this research included general questions that could be related to degrowth-oriented values and attitudes, for example, if they believe that economic growth always harms the environment, or if they believe that climate change or other environmental problems will result in an end to economic growth. In other words, this research did not inquire about the support for specific degrowth policies and, considering the wider political and socio-cultural context of Croatia, it would be reasonable to expect different results if such questions were included. On the other hand, degrowth support is only one factor in the higher-level construct of degrowth ideology which in recent studies significantly correlates with the need for a social change and the perceived need for a less materialistic-orientation of society (Brajdić Vuković et al., 2020). According to these findings, in Croatia, the degrowth ideology is one that recognizes the need for economic redistribution and provides a good life for all members of society. Furthermore, it is an ideology that promotes non-materialistic values contained in arts and culture and fosters care for the environment and friends (Brajdić Vuković et al. 2020). The study also establishes the potential for developing certain aspects of the inclination for degrowth attitudes regardless of some population demographics, for example, the place of residence (Brajdić Vuković et al., 2020) which could

mean that all cities in Croatia have relatively equal potential to adequately support dimensions of the degrowth oreintation. However, their findings of reduced confidence in individual political power and overall perceived lack of interest in Croatian politics from degrowth supporters could somewhat hinder mobilization efforts to push for specific degrowth-oriented policies.

Another indicator used in the doughnut for gauging the potential for democratic activation of citizens is the indicator of distrust (DT). As previously stated, all cities fail to demonstrate sustainable levels of trust and this could prove to be an obstacle for a desired democratic and just transition to higher levels of sustainability. This is because trust is a central element of democratic political participation and democratic institutions, and is a key element for positive human relations overall (Lenard, 2008). Although social trust is a complex phenomenon and determining causes of distrust in Croatian society is out of the scope of this analysis, some studies find that higher levels of social trust in a country are generally found among citizens of good health, in possession of university degrees and who are gainfully employed (Holmberg and Rothstein, 2017). This would imply that to achieve higher levels of trust in society citizens should strive for improvements in the quality of public services. This, however, presents a sort of a paradox, as it is not obvious how to collectively achieve these changes for the benefits of the majority of citizens through existing democratic institutions, as distrust in itself is harmful to the proper functioning of democratic processes and institutions (Lenard, 2008). This problem affects Croatia, as some studies show that young people in Croatia are characterized by low levels of trust in institutions, especially when it comes to trusting political parties and politicians (Franc and Međugorac, 2015). Although the efforts of achieving higher levels of trust and political engagement should take into account all age groups, this could suggest to a potential for activation of young citizens Croatia in informal political and community engagement through volunteering and collaborations with NGOs and independent local initiatives in order to strengthen Croatia's social capital for the transition to come.

As previously mentioned, trust is an important component of many positive aspects of life. In fact, some studies find that increased institutional trust positively affects subjective well-being (Hudson, 2006). In this research, subjective well-being is measured by the Flourishing Perception indicator, based upon the research of Huppert and So (2013) which identify well-being as "positive mental health". In this study, shortfalls on the FP indicators are detected across the sample, seemingly regardless of the performance of biophysical and socio-economic

indicators. This is worrying, as good mental health is in some sense both the prerequisite and the ultimate consequence of necessary transition efforts to sustainability. Throughout this analysis and discussions, calls for achieving greater levels of well-being have been made evident. However, studying wellbeing in the context of degrowth is challenging, as there is no significant historical example of the intentional reduction in material and energy throughput according to which we could model our expectations of the effects on wellbeing outcomes. Although the majority of growth-critical literature assume that the overall downscaling of our economies would result in increases in subjective well-being, some authors are sceptical in regard to these assumptions. Koch et al. (2017) argue that the empirical evidence does not necessarily agree with this prediction, as they find that although the happiness curve relative to GDP growth does flatten out for one country, comparisons with other countries show that the most environmentally unsustainable and richest countries are also the "happiest". They also argue that setting "happiness" as the ultimate objective for societies is questionable, as doing so promotes economic growth and hides structural dynamics of inequality and domination (Koch et al., 2017). This is why they think that degrowth-policies should focus on satisfying basic human needs, as stipulated in the original Paris declaration, rather than focusing on subjective well-being. As their example of transitioning to vegetarianism demonstrates, the wide-scale nature of changes in almost all aspects of our everyday lives necessary to achieve a degrowth society will inevitably lead to a decrease in short-term subjective well-being. A switch to alternative methods of food production and consumption will not just cause changes in our everyday dietary habits, but also cause negative short-term socio-economic effects, like job loss in the conventional (industrial) food production industry. However, they do recognize that such a transition could result in satisfying other needs in such a way that the negative short-term subjective well-being outcomes are ultimately outweighed (Koch et al., 2017).

It is sometimes argued that it would be better to monitor objective concepts and measures of wellbeing in relation to a degrowth-oriented society, like health and life expectancy (Büch and Koch, 2019). This eudaimonic and needs-based approach to wellbeing argues that "real" needs of the people related to meaningful relationships and work, identity and opportunities to participate in political and communal aspects of public life can be achieved with relatively low levels of input resources utilized (Büch and Koch, 2019). However, as the growth-oriented paradigm has embedded itself not only in our economic system but in our social, cultural, technological and political practices, a successful shift towards degrowth would require successful management of social conflicts that will inevitably arise due to a gradual reduction

of available resources to satisfy people's need in the simultaneous transformations of the above-specified aspects of life. For this purpose, authors propose an establishment of regular deliberative forums that could raise questions and propose answers about the satisfaction of universal needs. These dialogues would not only promote a discussion for the ultimate purpose of consensual decision-making between experts and citizens but also between the rich and the poor (groups and countries), along with between present and future generations (Büch and Koch, 2019).

Having the above-stated limitations of subjective wellbeing measures in mind, the "flourishing" concept used in this research is nevertheless useful as, due to its multi-dimensional character, it combines hedonic and eudaimonic aspects of well-being. This way it can offer greater insights for policy interventions than the more commonly used "life satisfaction" measure (Huppert and So, 2013). As was stated in the indicator justification section, the questions used to derive the necessary calculations are centred around statements that indicate opposite psychological states to major mental health issues, like depression and anxiety. In this sense, the identified shortfalls on the FP indicator are troublesome, especially in the context of influental international organizations already recognizing the threat of the coronavirus outbreak exacerbating mental health issues caused by the cumulative impact of anxiety, stress and grief. The WHO warns that the coronavirus pandemic has caused disruptions or completely halted key mental health services in 93% of countries worldwide while, at the same time, the demand for mental health has been increasing. In Croatia, some major issues related to mental health problems have been increasing for some time, considering the trend of growing rates of hospitalization due to depression, among other mental health illnesses (Štrkalj Ivezić et al. 2018). An extensive epidemiological analysis concluded that the flaw in our system for treating mental health patients is contained in the fact that it is still based on (inpatient) hospital treatment. At the same time, a lack of availability of quality outpatient mental health services is causing barriers in the process of successfully treating eisting mental health patients and recognizing those in the process of seeking help (Štrkalj Ivezić et al. 2018). In this regard, to align the organization of mental health services in Croatia with European and WHO standards, we should strive to transform the model of hospitalization of chronic mental health patients to a system of prevention embedded in the community itself. Furthermore, along with conducting necesssary educational programmes, a national strategy could be developed and implemented by local governments to combat the stigma associated with mental health patients

and illnesses, and to enable quality, easily accessible treatment and fight discrimination against people suffering from mental disorders.

5. CONCLUSION

The results of this explorative analysis demontrates how Croatia and some of its localities fail to reach the defined sustainability standards by functioning outside the safe and just operating space of the doughnut's green ring. Although Croatia and its cities fail to operate sustainably in either of the three defined segments of their social metabolisms, this study reveals some key differences between the units of analysis. One interesting finding of this research is that, to an extent, two different patterns of (un)sustainability performance are observable from the doughnut visualizations. Gospić's and Zadar's pattern of social metabolism performance differs from those identified in Zagreb and Slavonski Brod, whose doughnut images more resemble that of the Republic of Croatia. At the same time, the visualised patterns of Zadar's and Gospić's social metabolism present a more sustainable state of affairs, with Zagreb and Slavonski Brod, and Croatia overall, performing substantially worse. These differences are most visible upon inspection of the biophysical segment. Although all cities fail to achieve sustainable levels of CO2 emissions and food production, Zadar and Gospić perform significantly better on all other indicators of climate change, pollution and access to natural resources. This leads to the conclusion that Zagreb and Slavonski Brod are further away from significantly contributing to climate change mitigation and adaptation efforts by adopting renewable energy production practices, reducing air pollution and increasing the share of green open spaces in their urban environments.

Another important finding of this study is that all units of analysis are especially unsustainable in their socio-economic infrastructure. Unlike their biophysical performance, this segment forms relatively uniform visual patterns accross the sample. None of the analysed units displays complete sustainability in any single aspect (indicator) of the socio-economic segment. This leads to the conclusion that in regard to the socio-economic segment, due to large(est) overshoots and shortfalls, there is no remarkable potential to quickly reach the defined sustainability targets, especially considering the low performance on indicators of democracy. The surprising exception is perhaps the worst overall performer in the sample, Slavonski Brod, which displays only minimal transgressions on indicators of waste generation, hospital beds and gender inequality.

Thus, swift interventions are necessary in order to successfully tackle the challenges that are ahead. Most remarkable potentials in this sense are detected in Croatia's cultural segment,

where least overshoots and shortfalls are detected. In other words, from a cultural perspective, there are no significant barriers for Croatian politics to implement changes that will drive Croatia to a more sustainable future. In addition, this good performance is relatively uniform across the entire sample. This is encouraging, as the analysis concludes that major policy interventions are needed on all levels of political decision-making. In previous sections, some possible trajectories for Croatia's politics are discussed, ranging from interventions in existing national strategies to advocating for strategies based on the presented insights where no coherent and sustainable system is in place. However, for Croatia to achieve sustainability in the 21st century and ensure good quality of life for all within the existing biophysical constraints of its environment, its citizens need to realize that they hold the political power to change the conditions of their existence for the better. As visible from the presented doughnuts, such transition efforts will not come without its cost. However, as demonstrated in the discussion on increasing overall well-being from a degrowth perspective, an inclusive deliberative approach could be essential in overcoming potential costs and challenges that altering our production and consumption practices on a most fundamental level will definitely impose.

The presented application of the Degrowth Doughnut on the case of Croatia and its cities is just one contribution to the dialogues to ensue. Hopefully, insights derived from this research could provide citizens and, ultimately, policy-makers with the tools for understanding the desired transitional pathways towards just and sustainable configurations of Croatia's social metabolisms. Although its holistic nature enables us to progress in understanding the deep and complex interconnectedness of our current modes of existence, the success of the Degrowth Doughnut ultimately relies on social partners of seemingly insurmountable social and cultural backgrounds engaging in meaningful and inclusive conversations about strategies for improving our own lives and providing a safe future for generations to come.

References

Ančić, B., Puđak, J. & Domazet, M. (2016) Do we see climate change in Croatia? Research on attitudes on some aspects of climate change in Croatian society. *Croatian Meteorological Journal.* [Online] 51, 27-45. Available from: https://hrcak.srce.hr/168219 [Accessed 6th October 2020].

Babić Z., Matković, T. & Šišić, V. (2006) Structural Changes in Tertiary Education and Impacts on the Labor Market. *Privredna kretanja i ekonomska politika.* [Online] 16 (108), 28-65. Available from: https://hrcak.srce.hr/18359 [Accessed 6th October 2020].

Black, K.J. & Richards, M. (2020) Eco-gentrification and who benefits from urban green amenities: NYC's high Line. *Landscape and Urban Planning.* [Online] 204, 103900. Available from: https://doi.org/10.1016/j.landurbplan.2020.103900 [Accessed 6th October 2020].

Bonneuil, C. & Fressoz, J-B. (2017) *The Shock of the Anthropocene*. New York, Verso.

Brajdić Vuković, M. (2017) Climate change concern, anthropocentric worldview and the technoscientific context of young researchers. In: Domazet, M. (ed.) *Ecology and Justice: Contributions from the margines*. Zagreb, Croatia, Institute for Political Ecology, pp. 95-117.

Brajdić Vuković, M.., Ančić, B. & Domazet, M. (2020) Values Underpinning a Degrowth Transformation of the Socio-political System. *Traditiones,* 49 (1), 141-58.

Büch, M & Koch, M. (2019) Challenges for the degrowth transition: The debate about wellbeing. *Futures.* [Online] 105, 155-165. Available from: https://doi.org/10.1016/j.futures.2018.09.002 [Accessed 6th October 2020].

Cha, Y. (2013) Overwork and the persistance of gender segragation in occupations. *Gender & Society* [Online] 27 (2), 158-184. Available from: https://doi.org/10.1177/0891243212470510 [Accessed 6th October 2020].

Coote, A. & Franklin, J. (2013) *Time on Our Side: Why we all need a shorter working week*. London: The New Economics Foundation.

Crutzen, P.J. and Stoermer, E.F. (2001) The Anthropocene: An epoch of our making. *Global Change – The IGBP Series* [Online] 78, 12-15. Available from: http://www.igbp.net/news/features/features/anthropoceneanepochofourmaking.5.1081640c135c7c04eb480001082.html [Accessed 6th October 2020].

Čular, G. & Šalaj, B. (2019) Critical citizens or dissatisfied autocrats? Support for democracy in Croatia between 1999 and 2018. *Anali Hrvatskog politološkog društva: časopis za politologiju* [Online] 16 (1), 7-26. Available from: https://doi.org/10.20901/an.16.01 [Accessed 6th October 2020].

Dao, H., Peduzzi, P., Chatenoux, B., De Bono, A., Schwarzer, S. & Friot, D. (2015) *Environmental Limits and Swiss Footprints Based on Planetary Boundaries*. 1st ed. [pdf] Geneva: UNEP/GRID-Geneva & University of Geneva. Available from: https://pb.unepgrid.ch/ [Accessed 6th October 2020].

de Molina, M.G. & Toledo, V.M. (2014) *The Social Metabolism: A Socio-Ecological Theory of Historical Change*. Cham, Springer.

Dearing J.A., Wang, R., Zhang, K., Dyke, J.G., Haberl, H, Hossain, S, Langdon, P.G, Lenton, T.M., Brown, S, Carstensen, J., Cole, M.j., Cornell, S.E., Dawson, T.P., Doncaster, C.P., Eigenbrod, F., Flörke, M. & Jeffers, E. (2014) Safe and just operating spaces for regional social-ecological systems. *Global Environmental Change* [Online] 28, 227-238. Available from: https://www.sciencedirect.com/science/article/pii/S0959378014001174?via%3Dihub [Accessed 6th October 2020].

Diener, E. & Chan, M.Y. (2011) Happy People Live Longer: Subjective Well-Being Contributes to Health and Longevity. *Applied Psychology: Health and Well-Being* [Online] 3 (1), 1-43. Available from: https://doi.org/10.1111/j.1758-0854.2010.01045.x [Accessed 6th October 2020].

Domazet, M., Dolenec, D. & Ančić, B. (2012) *We Need to Change. Mapping Croatia's potential for sustainable development* [Online] Zagreb, Heinrich Böll Stiftung Croatia. Available from: http://ipe.hr/wp-content/uploads/2017/04/HBS_We_Need_to_Change-Web.pdf [Accessed 6th October 2020].

Domazet, M. & Marinović Jerolimov, D. (2014) Sustainability on the semi-periphery: an impossible topic in a non-existent place? In: Domazet, M. & Marinović Jerolimov, D. (eds.) *Sustainability Perspectives from the European Semi-Periphery*. Zagreb, Croatia, Institute for Social Research in Zagreb & Heinrich Böll Stiftung Croatia, pp 19-49.

Domazet, M., Rilović, A., Ančić, B., Andersen, B., Richardson, L., Brajdić Vuković, M., Pungas, L. & Medak, T. (2020) Mental Models of Sustainability: The Degrowth Doughnut Model. In: Goldstein, M. and DellaSalla, D. (eds.) *Enyclopedia of the World's Biomes*. pp 276-286. Amsterdam, Netherlands, Elsevier, pp 276-286.

Franc, R. & Međugorac, V. (2015) Mladi i (ne)povjerenje u institucije: Moguće odrednice i posljedice. In: Ilišin, V., Gvozdanović, A. & Potočnik, D. (eds.) *Demokratski potencijali mladih u Hrvatskoj*. Zagreb, Croatia, Institut za društvena istraživanja u Zagrebu & Centar za demokraciju i pravo Miko Tripalo, pp 47-65.

Franić, R., Jurišić, Ž., Gelo R (2014) Food production and rural development – Croatian perspective within the European context. *Agroeconomica Croatica* [Online] 4 (1), 16-24. Available from: https://hrcak.srce.hr/125550 [Accessed 6th October 2020].

Grdenić G, Delimar M, Robić S (2020) Framing the context of energy poverty in Croatia: A case-study from Zagreb. *Energy Policy* [Online] 147, 111869. Available from: https://doi:10.1016/j.enpol.2020.111869 [Accessed 6th October 2020].

Hickel, J. (2016) The true extent of global poverty and hunger: questioning the good news narrative of the Millennium Development Goals. *Third World Quarterly* [Online] 37 (5), 749-767. Available from: https://doi.org/10.1080/01436597.2015.1109439 [Accessed 6th October 2020].

Holmberg, S. & Rothstein, B. (2017) Trusting other people. *Journal of Public Affairs* [Online] 17 (1-2), 1-8. Available from: https://doi.org/10.1002/pa.1645 [Accessed 6th October 2020].

Hudson, J. (2006) Institutional Trust and Subjective Well-Being across the EU. *KYKLOS* [Online] 59 (1), 43-62. Available from: https://doi.org/10.1111/j.1467-6435.2006.00319.x [Accessed 6th October 2020].

Huppert, F.A. & So T.T.C. (2013) Flourishing Across Europe: Application of a New Conceptual Framework for Defining Well-Being. *Soc Indic Res* [Online] 110 (3), 837-861. Available from: https://link.springer.com/article/10.1007%2Fs11205-011-9966-7 [Accessed 6th October 2020].

Kallis, G., Demaria, F. & D'Alisa, G. (2016) Odrast. In: D'Alisa, G., Demaria, F. & Kallis, G. (eds.) *Odrast: Pojmovnik za novu eru*. Zagreb, Croatia, Fraktura & IPE, pp 1-27.

Kallis, G., Paulson, S., D'Alisa, G. & Demaria, F. (2020) *The Case for Degrowth.* Cambridge, Polity Press.

Ke D.S. (2012) Overwork, stroke, and karoshi-death from overwork. *Acta Neurol Taiwan* 21 (2), 54-9.

Kennedy, C., Demoullin, S. & Mohareb, E. (2012) Cities reducing their greenhouse gas emissions. *Energy Policy* [Online] 49, 774-777. Available from: https://doi.org/10.1016/j.enpol.2012.07.030 [Accessed 6th October 2020].

Koch, M., Buch-Hansen, H. & Fritz, M. (2017) Shifting Priorities in Degrowth Research: An Argument for the Centrality of Human Needs. *Ecological Economics* [Online] 138, 74-81. Available from: https://doi.org/10.1016/j.ecolecon.2017.03.035 [Accessed 6th October 2020].

Kostadinova, T. & Power, T.J. (2007) Does Democratization Depress Participation? Voter Turnout in the Latin American and Eastern European Transitional Democracies. *Political Research Quarterly.* [Online] 60 (3), 363-377. Available from: https://doi.org/10.1177/1065912907304154 [Accessed 6th October 2020].

Kothari, A., Demaria, F. & Acosta, A. (2014) Buen Vivir, Degrowth and Ecological Swaraj: Alternatives to sustainable development and the Green Economy. *Development* [Online] 57 (3-4), 362-375. Available from: https://link.springer.com/article/10.1057%2Fdev.2015.24 [Accessed 6th October 2020].

Kovačić, M. & Vrbat, I. (2014) „Znam da ništa ne znam“: politička kompetencija i politička participacija među mladima u Zagrebu. *Suvremene teme: međunarodni časopis za društvene i humanističke znanosti* [Online] 7(1), 56-76. Available from: https://hrcak.srce.hr/132144 [Accessed 6th October 2020].

Lenard, P.T. (2008) Trust Your Compatriots, but Count Your Change: The Roles of Trust, Mistrust and Distrust in Democracy. *Political Studies* [Online] 56: 312-332. Available from: https://doi.org/10.1111/j.1467-9248.2007.00693.x [Accessed 6th October 2020].

Lethinen, A.A. (2018) Degrowth in city planning. *Fennia – International Journal of Geography* [Online] 196(1), 43-57. Available from: https://fennia.journal.fi/article/view/65443 [Accessed 6th October 2020].

Malm, A. (2016) *Fossil Capital: The Rise of Steam Power and the Roots of Global Warming. New Global Warming*. New York, Verso.

Mayor, S. (2007) Lack of hospital beds causes emergency departments to miss targets. *The British Medical Journal (BMJ)* [Online] 334 (7585), 111-117. Available from: doi: https://doi.org/10.1136/bmj.39098.461968.DB [Accessed 6th October 2020].

Milanović, B. (2011) A short history of global inequality: The past two centuries. *Explorations in Economic History* [Online] 48 (4), 494-506. Available from: https://doi.org/10.1016/j.eeh.2011.05.001 [Accessed 6th October 2020].

Molotch, H. (1976) The City as a Growth Machine: Toward a Political Economy of Place. *American Journal of Sociology* [Online] 82 (2), 309-332. Available from: https://www.jstor.org/stable/2777096 [Accessed 6th October 2020].

Morlan, R.L. (1984) Municipal vs. National Election Voter Turnout: Europe and the United States. *Political Science Quarterly* [Online] 99 (3), 457-470. Available from: https://doi.org/10.2307/2149943 [Accessed 6th October 2020].

Nässén, J. & Larsson, J. (2015) Would shorter working time reduce greenhouse gas emissions? An analysis of time use and consumption in Swedish households. *Environment and Planning C: Government and Policy* [Online] 33, 726–745. Available from: https://doi.org/10.1068/c12239 [Accessed 6th October 2020].

Nykvist, B., Persson, A., Moberg, F., Persson, L., Cornell, S. & Rockstrom, J. (2013) *National Environmental Performance on Planetary Boundaries: A study for the Swedish Environmental Protection Agency*. The Swedish Environmental Protection Agency. Report number: 6576.

O'Neill, D.W., Fanning, A.L., Lamb, W.F. & Steinberger, J.K. (2018) A good life for all within planetary boundaries. *Nature Sustainability,* 1, 88-95.

Prasad, B. & Thakur, C. (2019*)* Chronic Overworking: Cause Extremely Negative Impact on Health and Quality of Life. *International Journal of Advanced Microbiology and Health Research,* 3 (1), 11-15.

Raworth, K. (2017) *Doughnut economics: Seven ways to think like a 21st-century economist.* London, Random House.

Reckien, D., Flacke, J., Olazabal, M. & Heidrich, O. (2015) The Influence of Drivers and Barriers on Urban Adaptation and Mitigation Plans-An Empirical Analysis of European Cities. *PLoS ONE* [Online] 10 (8), e0135597. Available from: https://doi.org/10.1371/journal.pone.0135597 [Accessed 6th October 2020].

Reckien, D., Salvia, M., Heidrich, O., Church, J.M., Pietrapertosa, F., De Gregorio-Hurtado, S., D'Alonzo, V., Foley, A., Simoes, S.G., Krkoška Lorencová, E., Orru, H., Orru, K., Wejs, A., Flacke, J., Olazabal, M., Geneletti, D., Feliu, E., Vasilie, S., Nador, C., Krook-Riekkola, A., Matosović, M., Fokaides, P.A., Ioannou, B.I., Flamos, A., Spyridaki, N.A., Balzan, M.V., Fülöp, O., Paspaldzhiev, I., Grafakos, S. & Dawson, R. (2018) How are cities planning to respond to climate change? Assessment of local climate plans from 885 cities in the EU-28. *Journal of Cleaner Production* [Online] 191: 207-219. Available from: https://doi.org/10.1016/j.jclepro.2018.03.220 [Accessed 6th October 2020].

Rhoads, J.M. (1977) Overwork. *The Journal of the American Medical Association (JAMA),* 237: 2615-2618.

Rockström, J., Steffen, W., Noone, K., Persson, A., Chapin III, F.S., Lambin, E.F., Lenton, T.M., Scheffer, M., Folke, C., Schellnuber, H.J., Nykvist, B., de Wit, C.A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Cruzen, P. & Foley, A.(2009) A safe operating space for humanity. *Nature,* 461, 472-475.

Rodin, S. (2009) Higher Education Reform in search of Bologna. *Politička misao* [Online] 46 (5), 21-38. Available from: https://hrcak.srce.hr/55627 [Accessed 6th October 2020].

Rosnick, D. & Weisbrot, M. (2007) Are Shorter Work Hours Good for the Environment? A Comparison of U.S. and European Energy Consumption. *International Journal of Health Services* [Online] 37 (3), 405-417. Available from: https://doi.org/10.2190/D842-1505-1K86-9882 [Accessed 6th October 2020].

Schröder, E. & Storm, S. (2020) Economic Growth and Carbon Emissions: The Road to "Hothouse Earth" is Paved with Good Intentions. *International Journal of Political Economy* [Online] 49 (2), 153-173. Available from: https://doi.org/10.1080/08911916.2020.1778866 [Accessed 6th October 2020].

Sovova, L. (2015) Self-provisioning, Sustainability and Environmental Consciousness in Brno Allotment Gardens. *Socialni Studia* [Online] 12 (3), 11-26. Available from: https://doi.org/10.5817/SOC2015-3-11 [Accessed 6th October 2020].

Stadtherr, L., Coumou, D., Petoukhov, V., Petri, S. & Rahmstorf, S. (2016) Record Balkan floods of 2014 linked to planetary wave resonance. *Science Advances* [Online] 2 (4), 1-6. Available from: https://advances.sciencemag.org/content/2/4/e1501428 [Accessed 6th October 2020].

Steffen, W., Crutzen, P.J. & McNeill, J.R. (2007) The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature? *AMBIO: A Journal of the Human Environment* [Online] 36(8): 614-621. Available from: https://www.jstor.org/stable/25547826 [Accessed 6th October 2020].

Stern, D.I. (2004) The Rise and Fall of the Environmental Kuznets Curve. *World Development* [Online] 32 (8), 1419-1439. Available from: https://doi.org/10.1016/j.worlddev.2004.03.004 [Accessed 6th October 2020].

Štrkalj Ivezić, S., Jukić, V., Štimac Grbić, D., Ćelić, I., Brečić, P., Silobrčić Radić, M., Bagarić, A. & Ćurković, M. (2018) Organizacija liječenja oboljelih od mentalnih poremećaja u Republici Hrvatskoj.

Acta Med Croatica [Online] 72: 179-188. Available from: https://hrcak.srce.hr/199524 [Accessed 6th October 2020].

Tomašević, T. (2016) *Poruka u boci: Analiza javne politike koncesija za crpljenje vode radi flaširanja i prodaje na tržištu*. 1st ed. [pdf] Zagreb: IPE & Zelena akcija. Available from: http://ipe.hr/wp-content/uploads/2017/08/IPE-Poruka-u-boci-optimized.pdf [Accessed 6th October 2020].

Troskot, Z., Prskalo, M.E. & Banović R.Š. (2019) Ključne odrednice iseljavanja visokokvalificiranog stanovništva: slučaj Hrvatske s komparativnim osvrtom na nove članice EU-a. In: Bačić, A. (ed.) *Zbornik radova Pravnog fakulteta u Splitu*. Split, Pravni fakultet Sveučilišta u Splitu, pp. 877-904.

Waters, C.N., Zalasiewicz, J., Summerhayes, C., Barnosky, A.D., Galuszka, A., Cearreta, A., Edgeworth, M., Ellis, E.C., Ellis, M., Jeandel, C., Leinfelder, R., McNeill, J.R., deb. Richter, D., Syvitski, J., Vidas, D., Wagreich, M., Williams, M., Zhisheng, A., Grinevald, J., Odada, E., Oreskes, N & Wolfe, A.P. (2016) The Anthropocene is functionally and stratigraphically distinct from the Holocene. *Science,* 351 (6269), 137-147.

Wu, J., Zuidema, C. & Gugerell, K. (2018) Experimenting with decentralized energy governance in China: The case o f New Energy Demonstration City program. *Journal of Cleaner Production* [Online] 189: 830-838. Available from: https://doi.org/10.1016/j.jclepro.2018.04.123 [Accessed 6th October 2020].

Zavalić, M. (2013) Utjecaj prekovremenog rada na zdravlje radnika. *Sigurnost: časopis za sigurnost u radnoj i životnoj okolini* [Online] 55 (2), 133-140. Available from: https://hrcak.srce.hr/104719 [Accessed 6th October 2020].

Zorpas, A.A., Voukkali, I. & Loizia, P. (2015) The impact of tourist sector in the waste management plans. *Desalination and Water Treatment* [Online] 56 (5), 1141-1149. Available from: https://doi.org/10.1080/19443994.2014.934721 [Accessed 6th October 2020].

Župarić Iljić D (2017) Environmental Change and Involuntary Migration: Environmental Vulnerability and Displacement Caused by the 2014 Flooding in South-Eastern Europe In: Domazet, M. (ed.) *Ecology and Justice: Contributions from the margines*. Zagreb, Croatia, Institute for Political Ecology, pp. 137-159.

Jerkić, E., Jerkić, L., Kordić, Z., Rajšl, I. & Grozdanić, I. (2015) Prelazak Hrvatske na 100% obnovljivih izvora energije. Analiza mogućnosti korištenja obnovljivih izvora u Republici Hrvatskoj. 1st ed. [pdf] Zagreb: Greenpeace in Zentral- und Osteuropa & Zelena energetska zadruga. Available from: https://www.greenpeace.org/static/planet4-croatia-stateless/2015/11/522c6b30-prelazak-hrvatske-na-obnovljive-izvore-energije.pdf

Annex A: Degrowth Doughnut Indicator Cookbook

BIOPHYSICAL INDICATORS

Carbon Footprint

- *Theme*: Climate Change & Pollution
- *Placement*: Boundary
- *Brief description (w/units):* Annual carbon dioxide emissions per capita for a given unit of analysis, measured in metric tonnes (t/cap/yr). Using the latest (2018) 'biannual energy statistical country datasheet', published by the European Commission, CO2 emissions, measured in millions of tons, was extracted for the following sectors: energy, manufacturing, construction, agriculture, forestry, fishing, transport and residential consumption. These sectors account for 80.03% (14.63 mio ton) of total CO2 national emissions (18.28 mio ton). Next, from Croatian Bureau of Statistics' (2018) Employment and Wages report, the 'Persons Employed in Legal Entities (PELE)' data was extracted for the analysed cities. At the same time, 'PELE' data for the national doughnut was obtained from the CBS' Statistical Yearbook from 2018. In this step, only those sectores that correspond with the sectors provided in the previous step, and for which CO2 emissions data was available, were selected. In order to calculate appropriate weighting factors, by which CO2 emission data for each individual sector (converted from millions of tons to tons) on a national level was multipled, the city-level 'PELE' data was divided by the national 'PELE' for the corresponding sector. However, before calculating the input value for our doughnut (index) value caluclatons, certain data adjustment steps, and in some cases extra calculations were necessary. First, since the EU's emission data for Croatia's manufacturing and construction sectors is published as combined (as 'Manufacturing Industries and Construction'), and since CBS publishes 'PELE' data separately (as 'Manufacturing' and 'Construction'), to obtain the weighting factor for the manufacturing and construction sector, the sum of the local-level 'PELE' of manufacturing and construction sectors were devided by the sum of the national-level 'PELE' of the sectors. Similarly, EC publishes national CO2 emissions data for the sector of 'Road Transportation', while CBS publishes 'PELE' data only for the category of 'Transportation and Storage', which understandably excludes transporation used for purposes outside of those connected with activities of business entities. In line with our selected methodology and in order for our city-level CO2 consumption estimation calculations to reflect a more realistic image and to refer to the original category of 'Road Transportation', along with the factor for the CBS provided category of 'Transportation and Storage' the weighting factor had to be calculated separately for these modes of personal transport. This type of transport emissions data were estimated

using the ‘Registrated Road Motor Vehicles (RMV), by Police Department’ data source, which is county-level data obtained from the CBS’ Statistical Yearbook from 2018. As no city-level ‘RMV’ data was available, to estimate the local ‘RMV’ the total number of ‘RMV’ of a given county was multiplied by the percentage of the local population in the population of the corresponding county. From here, the weighting factor (i.e. the ‘share of registered motor vehicles’) was calculated, by dividing the national total ‘RMV’ with the estimated ‘RMV’ of the city. At the same time, as CBS publishes ‘RMV’ data for the City of Zagreb and Zagreb County combined (501,117), the population of Zagreb Country was added to the population of City of Zagreb to calculate the percentage of the population of City of Zagreb. This percentage was multiplied by the provided total ‘RMV’ for both counties, to estimate the ‘RMV’ for the City of Zagreb. After the above described series of data adjustments and weighting factors calculations, in order to estimate tons of CO2 emissions per sector, these factors were multiplied by the EU-provided national sectoral emissions data. Because of the above described extra caluclation needed for the sector of transportation, both ‘RMV’ and transportation weighting factors were multiplied by the CO2 emissions data for the transportation sector, and divided by two, before ultimatively being summed together. At the same time, for the sector of ‘Energy Industry’ the total estimated CO2 emissions were reduced by the percentage of renewable energy production in the total energy production of a given locality. This percentage was extracted from the calculations for the ‘Renewable Energy Production’ indicator, as this is the main input value for computing the said indicator. For the secotr of agriculture, EC issues the data for ‘Agriculture/Forestry/Fisheries’ and ‘Agriculture’ separately. As CBS issues ‘PELE’ data for ‘Agriculture, forestry and fishing’, the two separate EU source were summed up. After calculating tones of CO2 emissions per each sector, these values are then summed together to represent total tons of CO2 emissions of each city. As stated at the beginning, as the available sectors only account for 80.03% of Croatia’s CO2 emissions, to estimate the local carbon footprint, the final result was optimated to 80.03% of a given total population level. This was done by calculating the said percentage of the total local population and using it as the denominator of our annual per capita CO2 emissions calculations. From here, the IV value has been calculated for each city, using the specified formula.

- *Justification*: Carbon dioxide is a major greenhouse gas whose emissions are causing global warming. Reduction of CO2 emissions is imperative in order to successfully decrease and adapt to the impacts of climate change.
- *Source*: Croatian Bureau of Statistics; European Commission
- *Boundary, range determination and justification*: The boundary for all units of analysis was set to 2 t/cap/yr, with the range inside the donut being 0-2 t/cap/yr (i.e range is equal to 2). These

values represent sustainable levels of carbon dioxide emissions, when globally standardized at current population levels.

- *Formula:* **IV = (b-x)/r**
    - x = annual CO2 per capita emissions for a given unit of analysis
    - b = 2 (universal boundary)
    - r = 2 (range within the doughnut)
    - IV ≥ 0 → IV = 0

Green Open Space

- *Theme*: Access to Nature
- *Placement*: Threshold
- *Brief description (w/units):* Per capita m² of public green spaces calculated for an individual city. This area includes the following surfaces: parks, grassy areas, botanical gardens, park-forests, alleys and public playgrounds, with the exclusion of zoos. Zoos were excluded because they are not considered public, 'open' spaces due to an enterance fee citizens usually pay to access these areas. There are also numerous ethical considerations because of which zoos have been excluded from the analysis of green open spaces we would like to create and preserve in the 21st century.
- *Justification*: In an urban context, green (open) spaces fulfill varoious important functions and improve the quality of the urban environment and overall quality of life for citizens. Among just some benefits that urban green spaces can provide are: increased biodiversity, cleaner air, reduced risks of flooding, reduction of heatwave impacts, improved oportunities for leisure and aesthetic life, and longer and healthier lives of citizens.
- *Source*: Croatian Bureau of Statistics
- *Threshold, range determination and justification*: Threshold of 9, with the range of 2-9 from the center to the doughnut threshold (i.e. the range being 7). The boundary of 9 was selected, as per WHO's recommendations. The minimum of 2 was chosen as according to available data for Croatia's cities, 2 m² is among the lowest values and it is unrealistic to expect much lower values.
- *Formula:* **IV = (t-x)/r**
    - x = per capita m2 of green open space for a given city
    - t = 9 (universal threshold)
    - r = 7 (range from center to doughnut threshold)
    - IV ≤ 0 → IV = -0

Organic Farming

- *Theme*: Access to Nature
- *Placement*: Threshold
- *Brief description (w/units):* Percentage of total farmland of a city's surrounding countryside that is cultivated using organic farming methods. This indicator includes the following agricultural surfaces: arable land, permanent grassland and permanent crops. Additionally, along with certified organic agricultural holdings, this surface area includes "agricultural holdings in conversion", defined as agricultural holdings during the defined period before the acquirement of the label organic.
- *Justification*: Industrial agriculture is damaging to the soil, water, and even the climate it relies on. Many alternatives to industrial farming are known, one such alternative being organic farming. There are many benefits[2] to organic farming, such as higher levels of product quality, lower production costs, higher profits for farmers, lower energy use in production, fewer GHG emissions, absence of toxic compounds in waterways, etc. In fewer words, organic farming aids in environmental protection, it preserves and improves health of citizens, and it helps create crucial, climate-friendly and quality jobs. Out of all other alternatives to industrial farming, organic farming is at the moment the most widespread option, especially in the EU, and cities should aspire to support as much organic food production and consumption as possible. In fact, there are already such exemplary cities in Croatia, as Poreč is a member of the prestigious "Organic Cities Network Europe" initiative since 2018. In any case, a significant proportion of local food production will need to come from organic farming methods in order to be able to provide quality food for all, at reasonable prices and short supply-chains.
- *Source*: Croatian Bureau of Statistics
- *Threshold, range determination and justification*: The threshold for all cities was set to 20% of a cities's arable land, with the range from the centre to the donut threshold being 0-20 (i.e range is equal to 20). This threshold was reached by looking at the upper level of production for the world's countries (Austria and Estonia above this level) combined with an allowance for a country to provide for the nutritional needs of its people through organic farming. For cities for which there is no publically available data (all except Gospić), the share of organic farmland was estimated using county level data.
- *Formula:* **IV = (t-x)/r**
    - x = 'organic area share of total farmland [%]', for a given city in the latest available year
    - t = 20 (universal threshold)

[2] https://nasaaorganic.org.au/organic-farming/benefits-of-organic-farming/

- r = 20 (range from center to doughnut threshold)
- IV ≤ 0 → IV = -0
- IV > 0 → IV = -1

Air Pollution

- *Theme*: Climate change & Pollution
- *Placement*: Boundary
- *Brief description (w/units):* Number of days (daily validated data) when the PM10 pollutant exceeded the value of 50 μg/m3 in the city's ambient (outdoors) in the latest available calendar year (January 1st to December 31st 2019). PM10 pollutant has been selected as it one of the more commonly measured pollutant across Croatia's measuring stations, and therefore it was convenient for data analysis. For the all cities the sampled year was 2019. For those cities in which there was no active measuring station, the data from the closest active measuring station in the same region (county) has been applied. In the case that there was more than one active measuring station measuring PM10 in the city, the data was extracted from the station that displays highest transgression levels in regards to the said pollutant.
- *Justification*: According to the WHO, ambient (outdoor) air pollution is responsible for an estimated 4.2 million deaths worldwide every year due to stroke, heart disease, lung cancer and chronic respiratory diseases. In an urban context, more than 80% of citizens living in cities that monitor air pollution are being exposed to air quality levels that exceed the limits recommended by the WHO. At the same time, the highest exposures are being recorded in countries with low and middle development levels. Furthermore, there is a close link between air quality, earth's climate and global ecosystems, as many processes causing air pollution (i.e. fossil fuels combustion) are at the same time causing high levels of CO2 emissions. Therefore, strategies and policies aimed at reducing air pollution will reduce many of the negative health implications attributable to air pollution, along with contributing to climate change mitigation efforts. There are many types of air pollutants. One of them is PM10, particulate matter 10 micrometers or less in diameter. Along with the above described and numerous other negative health effects for humans, these are just some of the negative effects this pollutant has on the environmnet: negative health effects on wildlife, negative effects on aesthetic and utility of areas through visibility reduction, possible effects on vegetation and buildings.
- *Source*: Ministry of Environment and Energy of Republic of Croatia
- *Boundary, range determination and justification*: The boundary was set to 35 permitted exceedences in a given year for all cities, with the range to stay within the doughnut 0-35 (i.e. range is equal to 35). The minimum of 0 has been selected as we are striving for 0 instances

when the air we breathe is substandard. The boundary of 35 permitted exceedences each year has been selected as per air quality standards and objectives as defined by EU's legislation (Directive 2008/50/EU).

- *Formula:* **IV = (b-x)/r**
    - x = number of days in a year that PM10 levels exceeded the value of 50 μg/m3
    - b = 35 (universal boundary)
    - r = 35 (range within the doughnut)
    - IV ≥ 0 → IV = 0
    - IV < 0 → IV = 1

Water Use

- *Theme*: Access to Nature
- *Placement*: Boundary
- *Brief description (w/units):* Share of locally abstracted volume of water (m^3) per capita in the national total renewable water resources (TRWR) per capita. Regional (county) data has been applied, as water used in a county supports many vital sociometabolic processes of the city, for example, food production activities.
- *Justification*: Freshwater is an important resource in all modes of production, as well as an essential ingredient of human nutrition. Sufficient access to freshwater is essential for sustainability of any and all societies. Extraction of freshwater for human production activities and nutrition can deny this essential resource to the rest of the biosphere. Freshwater of sufficient environmental quality is not just a biospheric resource, but also provides a living environment for other species. Overall global freshwater is limited and unevenly distributed. Therefore, total withdrawal in one area often affects the access to freshwater of other areas that share a basin.
- *Source*: Croatian Bureau of Statistics
- *Boundary, range determination and justification*: The boundary of 40, with the range to stay within the doughnut 0-40 (i.e. range is equal to 40). 40% as the freshwater use planetary boundary was first developed on the finding that a critical threshold is often crossed if withdrawals of renewable resources in a watershed exceed 40% (Röckstrom et al., 2009).
- *Formula:* **IV = (b-x)/r**
    - x = share [%] of locally abstracted volume of water per capita in the national TRWR per capita
    - b = 40 (universal boundary)
    - r = 40 (range within the doughnut)

- IV ≥ 0 → IV = 0

Renewable Energy Production

- *Theme*: Climate Change & Pollution
- *Placement*: Threshold
- *Brief description (w/units):* Estimated share (%) of locally produced renewable energy (MWh) in the total estimated energy produced in a given city. For the purpose of calculations, regional (county) data has been applied. Using the *EU energy in figures statistical pocektbook* data has been obtained on total energy production in Croatia and energy production coming from enewables and biofules. Since these figures are expressed in millions of tonnes of oil equivalent (Mtoe), multiplying these figures by the standard conversion coefficient of 11.63 converted the unit to megawatt hours (MWh). In the second step, using the "Integral report" source (see below), shares of production of energy from renewable energy sources power plants in the national total, by counties, were obtained. The next step was to multiply this percentage for each county with the previously obtained (EU source) total energy production in Croatia coming from enewables and biofules, to obtain the total renewable energy production (REP) for each county. In order to to finally estimate the share of locally produced renewable energy in the total estimated energy produced in a given city, we needed to estimate the total energy production (TEP) for each county. This was done in two steps. First, we calculated the national per capita for the total energy produced, as extracted from the original EU source. Then, to estimate the total energy production for each county, we multiplied this value by the population of the county. From here, the IV value has been calculated for each city, using the specified formula.
- *Justification*: All energy will need to come from renewable sources by 2040, according to the Paris climate agreement, if we are to decarbonize our energy systems and avoid dangerous runaway global warming. However, although energy systems of core urban centers are in fact the ones driving unsustainable fossil-fuel-based energy consumption, because of the scale of the issue at hand the necessary infrastructure for the transition to the production of renewable energy will have to be, as it often is, placed outside densly populated urban centers. Even in the case of absence of major power plants in urban surrounding areas, we should still, and perhaps especially then, aspire to implement decentralized modes of renewable energy production. Moreover, this production should be aimed at satisfying the energy needs of the local/regional population. We should avoid profit-motivated exports to areas with access to their own renewable energy resources, to avoid the unnecessary cost of transport and energy loss due to technological reasons.

- *Source(s)*: EU energy in figures statistical pocektbook (2019); Integralna analiza dosadašnjih učinaka razvoja i izgradnje obnovljivih izvora energije u Hrvatskoj u razdoblju od 2007. do 2016. godine
- *Boundary, range determination and justification*: A threshold of 90, with the range from the centre of the doughnut to the doughnut threshold being 0-90 (i.e. range is equal to 90). With the end goal of 100% of energy coming from renewables by the year 2040, 90% is a suitable indicator to establish those that don't need to make significant changes in the next 20 years, with all others on track to miss the Paris climate agreement goal.
- *Formula:* **IV = (t-x)/r**
    - x = share [%] of renewable energy produced in total energy produced, in a given region
    - t = 90 (universal threshold)
    - r = 90 (range from center to doughnut threshold)
    - IV ≤ 0 → IV = -0
    - IV > 0 → IV = -1

SOCIO-ECONOMIC INDICATORS

Gender Inequality

- *Theme*: Democracy
- *Placement*: Boundary
- *Brief description (w/units):* Percentage of male representatives in city councils serves as a proxy indicator for measuring gender (in)justice within local politics, as one of the prerequisites for reaching and maintaining a just distribution of genders throughout all spheres of public life.
- *Justification*: Gender equality is a necessary prerequisite for a socially and ecologically stable and just society. At the same time, it is hard to imagine a democratic transformation to a such a state without a larger share of women positioned at places of political decision-making. According to the Constitution of Republic of Croatia, gender equality is a fundamental value, according to which men and women should be equally represented in all areas of public and private life. However, underrepresentation of women in Croatia's politics is present, and especially visible at local levels of political decision-making, according to the Croatian Bureau of Statistics' report *Women and Men in Croatia in 2018*. There are many mechanism and methods aimed at achieving gender balance in political institutions. One such mechanism is the quota system, aimed at increasing the presence of women in governmental institutions. Although there are many iterations of the method, in their essence, gender quotas in the world of politics rely on pre-defining a certain share (%) of women to participate political structures

and processes. According to IDEA, quotas have proved to be a relatively efficient method in increasing women's representation in politics.

- *Source*: Publicly available data on the gender composition of a given city council, located on the official website of the selected city.
- *Boundary, range determination and justification:* A boundary of 50, with the range 0-50 (i.e. range is equal to 50) to stay within the doughnut, as we are striving for total gender balance within local representative bodies.
- *Formula:* **IV = (b-x)/r**
    - x = % of men in city/municipal councils
    - t = 50 (universal boudary)
    - r = 50 (range to stay within the doughnut)
    - IV ≥ 0 → IV = 0

Availability of Inpatient Services

- *Theme*: Materials & Infrastructure
- *Placement*: Threshold
- *Brief description (w/units):* Number of hospital beds per 1000 inhabitants serves as a proxy indicator for assessing the health care capacaties of existing public health infrastructures of specified localities. The number refers to all hospital beds stationed in clinical hospital centres, clinical hospitals, clinics (only in Zagreb) and general hospitals.
- *Justification*: One of the main worries for governments around the world during the coronavirus pandemic is having enough hospital beds to accommodate potentially infected patients, while ensuring and maintaining proper inpatient hospital care for treating other types of diseases and illnesses. For some countries, and the same logic would apply for cities, high density of hopital beds has proved to be a big advantage in the crisis. For other countires, expanding hospital bed capacities has been a key part of the startegy for mitigating the crisis, with some countries like Croatia urgently installing hospital beds outside of existing health infrastructures at one point. Regardless of the covid-19 crisis, hospital bed capacity is an important aspect of quality functioning of health institutions, as, for example, shortfall in this regard may cause difficulties in admitting patients in need of emergency care (Mayor 2007).
- *Source*: Croatian Institute of Public Health 2018 Report: Operations of Hospitals in Croatia (beds), Croatian Statistical Bureau: Statistical Yearbook 2018 (population)
- *Threshold, range determination and justification*: A threshold of 8, with the range from the centre to the doughnut threshold being 0-8 (i.e. range is equal to 8). According to the WHO , there is no global norm for the density of hospital beds in relation to total population. The

boundary of 8 was selected as this is the number of beds per 1000 capita that sufficiently reflects the extent of the covid19 threat. Calculations[3] for Germany, one of the top performer countries during the peak of the crisis of April and May of 2020, show 8 hospital beds per 1000 capita.

- *Formula:* **IV = (t-x)/r**
    - x = hospital beds per 1000 capita of a given city/municipality
    - b = 8 (universal threshold)
    - r = 8 (range from centre to the doughnut threshold)
    - IV ≤ 0 → IV = -0

Voter Turnout

- *Theme*: Democracy
- *Placement*: Threshold
- *Brief description (w/units):* Voter turnout is the percentage of voters who cast a vote in the most recent local elections in Croatia, in this case, in 2017. The indicator refers to the percentage of voters who voted for the members of city/municipal coucnils, until 16:30 p.m., as this is the only publically available data, and there is no reason to assume that the number differs significantly to the final turnout of 19:00 p.m.
- *Justification*: This analysis considers this indicator as a proxy for the "political voice" category in Raworth's (2012) "social foundations" framework. In terms of social sustainability, it is important that citizens feel that they can have an impact on their society in order for them to feel like they belong. Although citizens usually perceive national elections to more important than the local ones (Morlan, 1984), in this research, voter turnout can be regarded as representative of the feeling of the positive impact on the structure and dynamics of society. This is because turning up to vote displays the belief of citizens that their action has a palpable impact on the local government.
- *Source*: State Electoral Commission of the Republic of Croatia
- *Threshold, range determination and justification*: The threshold was set to 80% for all localities, with the range 25-80 (i.e range is equal to 55) from the center of the doughnut to the doughnut threshold. 80% turnout was selected for maximum realistic legitimacy of the elected executive, as is the case with he national model. The lower limit of the range was set to 25% turnout because the cities with the lowest voter turnout come in at around 25% (the lowest was Rijeka with 27.7%), making anything significantly lower than that unrealistic to expect.
- *Formula:* **IV = (t-x)/r**
    - x = voter turnout for a given city/municipality in the 2017 local elections in Croatia

[3] https://ec.europa.eu/eurostat/databrowser/view/tps00046/default/table?lang=en

- t = 80 (universal threshold)
- r = 55 (range from centre to the doughnut threshold)
- IV ≤ 0 → IV = -0

Municipal Waste

- *Theme*: Materials & Infrastructure
- *Placement*: Boundary
- *Brief description (w/units):* Per capita annual kilograms of total municipal waste generated in a city serves as a proxy indicator for material usage efectiveness. Municipal waste is waste generated in the household and waste that is similar in nature and composition to household waste, except for production waste and waste from agriculture and forestry.
- *Justification*: Municipal waste is an important indicator for approximating material-use efficiency, because it informs how many resources are only used once and very temporary. This is especially true for Zagreb, as it is referred to as the "EU Capital of trash". According to the World Bank, on a global level 2.01 billion tonnes of solid municipal waste is generated anually, with at least a third of that amount not being managed in according to enivronmental safety standards. Although it can be regarded that the success of any sustainable waste management system depends on the socio-economic and physical infrastructure governing such efforts, households are still primary units of consumption and "end-of-pipe delivery and/or collection points" for almost all types of waste (Bulkeley, 2007). As such, households need to be addressed equally by theoretical considerations, along with political strategies for a safe and just transition in the 21st century.
- *Source(s)*: Ministry of Environment and Energy of Republic of Croatia: 2018. Municipal Waste Report; What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050 (The World Bank – city level data)
- *Boundary, range determination and justification*: The boundary is set to 165 kg/cap/yr, which is the lowest appropriate empirical value calculated for a city based on the *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050* report by the The World Bank, a report including total municipal waste generation data for more than 360 cities around the world. 165 kg/cap/yr has been selected as this is approximately (164.80) the lowest empirical value for a city with relatively comparable levels of development and population as Croatian cities – the city of Bern. The range to stay within the doughnut is thus 165, as the minimum is 0 kg/cap/yr of municipal waste, the main goal being a zero-waste society. In other words, the currently

realistic target is 165 kg/cap annaully, while we are ultimatively striving for a zero waste society.

- *Formula:* **IV = (b-x)/165**
    - x = per capita annual kilograms of total municipal waste generated
    - b = 165 (universal boundary)
    - r = 165 (range to stay within the doughnut)
    - IV ≥ 0 → IV = 0

Overwork

- *Theme*: Work & Education
- *Placement*: Boundary
- *Brief description (w/units):* This proxy indicator is used to give an indication of overworked the workers of a given city are. It provides a (weighted) mean usual hours worked per week by people employed in legal entities in a city.
- *Justification*: This indicator helps to better define the nature of "decent work" as initially proposed in Raworth's social foundations. Hours worked takes the "decent work" indicator a step further towards more of a degrowth perspective. The weekly hours worked should be reduced since they damage care potential and other creative contributions to society (Coote & Franklin, 2013). Moreover, a shorter workweek has the potential to reduce emissions of greenhouse gases (Nässén & Larsson, 2015) and other environmental pressures (Rosnick & Weisbrot, 2007).
- *Source(s)*: Croatian Bureau of Statistics: Yearbook (2018) and Employment and Wages (2018)
- *Boundary, range determination and justification*: The boundary of 32, as proposed by literature. The range to stay within the doughnut used for index value computations was set to eight. Although some literature proposes 21 hours work week (Coote et al., 2010), the lower limit has been set to 24 hours work week as this, at the moment, seems a more realistic approximation. Although this is not an observed empirical reality on a larger scale and thus not a standard labour practice, 24 hours workweek has recently been publically discussed in the media[4] as an attainable future goal by the members of the Finnish Government. Even though thorough research on the justification why this value is a goal to strive for, theoretically, the same arguments that make 32 hours work week a desireable gol could apply to advocate for a 24 hours work week. This is so primarily because of the scale of the transformation needed to improve the quality of life infringed by the nature of our social and economic relations, and the

[4] https://www.helsinkitimes.fi/finland/finland-news/domestic/16663-marin-floats-idea-of-a-four-day-24-hour-work-week.html

associated harmful environmental feedback. For the purpouses of index values calculations, however, this is an adequate value that could be modified in accordance with future research.

- *Formula:* **IV = (x-b)/r**
    - x = mean weekly hours worked per employed person for a given city in the last available year
    - b = 32 (universal boundary)
    - r = 8 (range to stay within the doughnut)
    - IV ≤ 0 → IV = 0

Educational Attainment

- *Theme*: Work & Education
- *Placement*: Threshold
- *Brief description (w/units):* The share of residents holding third-level degrees in a given city. This relates to all non-university degres (faculty levels and professional studies in accordance with the Bolonga Process), art academies, university studies in accordance with the Bolonga Process, master scientific, professional and art degrees, and doctorates of science. This indicator accounts only for age groups: 20-24; 25-29; 30-34. These agre groups were selected as those individuals are old enough to already hold tertiary education degrees, and because individuals from those age groups are the ones we can expect to be important catalysts for the necessary transformative action in 21st century.
- *Justification*: Education is a crucial component of an individual's development and it is vital in order for people to be able to participate in a democratic society and have the ability to support themselves. Higher levels of education contribute to greater horizontal and vertical social mobility, increased health, reduced crime and improved democracy.
- *Source*: Croatian Bureau of Statistics: Census 2011 (Table 10. *Population aged 15 and over by educational attainment, age, sex, by towns/municipalities*)
- *Threshold, range determination and justification*: The threshold of 40% with the range from the center to the donut threshold 0-40 (i.e. range is 40), as 40% of young Europeans with a higher education qualification is a target set in EU's Europe 2020 strategy.
- *Formula:* **IV = (t-x)/r**
    - x = share of individuals holding third-level degrees
    - t = 40 (universal threshold)
    - r = 40 (from the center to doughnut threshold)
    - IV ≥ 0 → IV = -0

CULTURAL INDICATORS

Renewable Energy Dismissal

- *Theme*: Anti-environmentalism
- *Placement*: Boundary
- *Brief description (w/units)*: Share of urban respondents that reject non-renewable sources of energy, in order to asses the prioirty which a particular city gives to renewable energy for future energy needs. More precisely, this indicator measures the percentage of respondents supporting non-renewable sources of energy as a national priority in energy policy. It is the percentage of all respondents from a corresponding region in an international survey which answered to the question "To which of the following should Croatia give priority in order to meet its future energy need?" with "coal, oil, natural gas, nuclear power, fuels made from crops or none of those."
- *Justification:* Civic support for a transition to a net zero-carbon energy production is a crucial component for successfully transitioning to a sustainable future. Such a tranisition is necessary not only because of the finite nature of fossilized energy sources, but also because of the negative impact of fossil-based energy systems on the environment. This seems pericularly important when cities globally account for more than two thirds of the world's primary energy demand.
- *Source:* ISSP module: Environment III – Croatia (2010)
- *Boundary, range determination and justification:* Boundary of 33.3%, with the range to stay within the doughnut 0-33.3 (i.e. range is equal to 33.3). The boundary of 33.3 was selected as this represents 66.6% of respondents directly or indirectly supporting renewable sources of energy. Two thirds majority was selected because the massive transition necessary to switch to majority renewable energy will require more than 50% majority support.
- *Formula:* **IV = (b-x)/r**
    - x = percentage (sum of percentages) of responses of "coal, oil, natural gas, nuclear power, fuels made from crops or none of those"
    - t = 33.3 (universal boundary)
    - r = 33.3 (range inside the doughnut)
    - IV $\geq 0 \rightarrow$ IV = 0

Climate Change Nonchalance

- *Theme*: Anti-environmentalism
- *Placement*: Boundary

- *Brief description (w/units)*: Mean value of region-specific responses to the following question in ISSP's 2010 Environment III module for Croatia (2011): "In general, do you think that a rise in the world's temperature caused by climate change is…" (1-extremely dangerous for the environment – 5-not dangerous at all for the environment).
- *Justification:* In order for us to stop the unprecedented levels of environmental degradation taking place, people must first recognize that climate change is a dangerous phenomenon. It is no longer enough to admit that (anthropogenic) climate change is real and already affecting major Earth's processess. If any collective mitigation and adaptation measures are to be successfully implemented, we must realize the great and imminent danger of the bussines-as-usual scenario.
- *Source:* ISSP module: Environment III – Croatia (2010)
- *Boundary, range determination and justification:* Boundary of 3, with a range to stay within the doughnut 1-3 (i.e. range is equal to 2). The boundary was set to 3 as all values below this mean value represent sufficient concern to expect the respondent to potentially take part in efforts towards mitigating climate change.
- *Formula:* **IV = (b-x)/r**
    - x = mean value of region-specific answers to the survey question
    - b = 3 (universal boundary)
    - r = 2 (range inside the doughnut)
    - IV ≥ 0 → IV = 0

Distrust

- *Theme*: Democratic potential
- *Placement*: Boundary
- *Brief description (w/units):* Mean value of region-specific responses to the following two questions in ISSP's 2010 Environment III module for Croatia (2011): (q4a) "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?" (1-you can't be too careful; 5-most people can be trusted); (q4b) "Generally speaking, do you think that most people would try to take advantage of you if they got the chance, or would they try to be fair?" (1-most people would try to take advantage; 5-most people would try to be fair). In this additive index, q4a and q4b had to be recoded in order to reflect distrust, so that the higher score on the additive scale (range 2 - 10) represent higher levels of distrust. Cronbach α = 0.80.

- *Justification:* Trust is a crucial component of an organized transformation that is striving for more sustainability and resilience. As it is the basic component of social capital, greater levels of trust are often linked to greater levels of subjective well-being. Because cities, especially large metropolitan areas, are often places of vast differences among the population, trust is a necessary component for a broad and inclusive democratic action. This seems especially valid for large-scale crisis that demand collective solutions, like climate change.
- *Source:* ISSP module: Environment III – Croatia (2010)
- *Boundary, range determination and justification:* Boundary of 6 was selected to signify acceptable levels of distrustful opinions and attitudes among the surveyed population. The range to stay within the doughnut is 2-6, which means that the effective range used for calculation is 4.
- *Formula:* **IV = (b-x)/r**
    - x = mean value of "distrust" additive index, composed of recoded SPSS variables v11 and v12
    - b = 6 (universal boundary)
    - r = 4 (range inside the doughnut)
    - IV ≥ 0 → IV = 0

Degrowth Support

- *Theme*: Democratic potential
- *Placement*: Threshold
- *Brief description (w/units):* Mean value of region-specific responses to the following four questions in ISSP's 2017 Role of Government and Networks module for Croatia: „Climate change and other environmental problems will sooner or later result in an end to economic growth" (recoded); "Limited availability of natural resources (e.g. oil, gas) will sooner or later result in an end to economic growth"; "Economic growth always harms the environment"; "To contribute to the fair mitigation of global climate change Croatia must reduce its CO2 emissions" (recoded). Responses were given on a scale from 1-5 (completely disagree-completely agree). This indicator is, thus, an additive index, with lower score levels (min=4) signaling lower levels of degrowth support, and higher scores (max=20) meaning stronger support. Cronbach α = 0.63 (Domazet et al., 2020).
- *Justification:* This indicator is a reproduction of a factor of the "Degrowth scale", used by Domazet et al. (2020) in a larger research of "degrowth potentiality" of socio-political systems. In this study, however, the indicator is mainly used to gauge citizens' understanding of environmental limits to growth. This is especially important because of the impact that urban

activity, due to the physical and social infrastructure of cities, has on the affirmation of growth-oriented development models. It is of no surprise that cities have been deemed as economic growth machines (Molotch, 1976), and as such are at the center of necessary socio-political transformations and throughput reductions. Thus, a fundamental support of values underpinning such strategies are crucial in successfully implementing them.

- *Source:* ISSP module: Role of Government and Networks – Croatia (2017)
- *Threshold, range determination and justification:* Threshold is set to 14, with a range of 4-14 from the centre to the doughnut threshold, which means an effective range of 10. A threshold of 14 shows that respondents, on average, score 3.5 on each item of the scale, with the purpose of indicating above average levels of support for degrowth-compliant understandings.
- *Formula:* **IV = (t-x)/r**
    - x = region-specific mean value of "degrowth support" additive index
    - t = 14 (universal threshold)
    - r = 10 (range from centre to donut threshold)
    - IV ≤ 0 → IV = -0

Health Percpection

- *Theme:* Well-being
- *Placement:* Threshold
- *Brief description (w/units):* Mean value of region-specific responses to the following question in ISSP's 2010 Health module for Croatia: "In general, would you say your health is…". Responses were given on a scale from 1-5 (excellent-poor). For the purpouse of the analysis, q26 (V59 in SPSS) has been recoded, so that the higher levels of the index reflect more positive assesment of one's health.
- *Justification:* Although the best method for measuring health of the local population would be to rely on official medical data, it is important to include personal health self-assessments in our model as a way of approximating adequate levels of another dimension of overall well-being of citizens. According to the WHO's Healthy Cities approach, a healthy city is "is conscious of health and striving to improve it. Thus any city can be a healthy city, regardless of its current health status." In this regards, subjective health assessments become even more important. In fact, some studies (Monden, 2014 - Encyclopedia) have discovered positive correlation between subjective health, measured as self-assessments of general or physical health, and subjective well-being, which in turn positively contributes to health and longevity (Deiner and Chan, 2011). In dense, urban environments, a generally healthy population is a

crucial aspect of bulding vibrant and resilient communities, especially when facing infectious diseases of pandemic proportions.

- *Source:* ISSP module: Health – Croatia (2010)
- *Threshold, range determination and justification:* Threshold of 3, with a range of 1-3 from the centre to the doughnut threshold (i.e. range is equal to 2). Threshold has been set to 3, meaning that the average respondents reports their general state of health at least as *"*good".
- *Formula:* **IV = (t-x)/r**
    - x = mean value, for a given region, of SPSS variable
    - b = 3 (universal threshold)
    - r = 2 (range from centre to donut threshold)
    - IV ≤ 0 → IV = -0

Flourishing Percpection

- *Theme:* Well-being
- *Placement:* Threshold
- *Brief description (w/units):* Mean value of region-specific responses of the additive index measuring "flourishing" perception, a concept introduced by Huppert and So (2013) in their psychometric analysis of multiple aspects of positive well-being. The index contains 9 questions, with responses ranging on a scale from 1-5 (totally agree – totally disagree). Thus, this indicator is an additive index, with lower score levels (minimum = 9) refering to higher levels of flourishing perception, and higher scores (maximum = 45) signaling lower levels.
- *Justification:* In degrowth theory, repositioning well-being at the center of economic activity is at least as equally important as quantitative downscaling of economic growth. In social sciences, there have been many approaches to measuring well-being. Huppert and So (2013) identify well-being as "positive mental health", which is to be considered as the oppposite to some of the most common mental health disorders, like depression or anxiety. By identifying internationally acknowledged symptoms of depression and anxiety, they establish their opposites and from there derive ten aspects of positive well-being. Based on psychometric analysis of these ten aspects, they derive an operational definition of flourishing. In this sense, flourishing combines feeling and functioning, hedonic and eudaimonic aspects of well-being. Due to its multi-dimensional character "flourishing" offers greater insights for policy interventions than the more commonly used "life satisfaction" measure (Huppert and So, 2013).
- *Source:*
- *Threshold, range determination and justification:* Threshold is set to 31.5, with the range from the centre of the doughnut to the doughnut threshold being 31.5-45 (i.e. range is equal to 13.5).

A threshold of 31.5 shows that respondents, on average, score 3.5 on each item of the scale, which displays acceptable average levels of positive well-being self-assesment, with any value above 3.5 (or the averaged 31.5 for all nine items) marked as unacceptable shortfalls.

- *Formula:* **IV = (t-x)/r**
    - x = index mean value for a given region
    - t = 31.5 (universal threshold)
    - r = 13.5 (range from centre to doughnut threshold)
    - IV ≥ 0 → IV = -0