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Green zoning: an effective policy tool to tackle the Covid-19 pandemic

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Green zoning: an effective policy tool to tackle the Covid-19 pandemic

Abstract. Green zoning has emerged as a widely used policy response to tackle the Covid-19 pandemic. 'Green zones'—areas where the virus is under control based on a uniform set of conditions—can progressively return to normal economic and social activity levels, and mobility between them is permitted. By contrast, stricter public health measures are in place in 'red zones', and mobility between red and green zones is restricted. France and Spain were among the first countries to introduce green zoning in April 2020. Subsequently, more and more countries followed suit and the European Commission advocated for the implementation of a European green zoning strategy, which has been supported by the EU member states. While there remain coordination problems, green zoning has proven to be an effective strategy for containing the spread of the virus and limiting its negative economic and social impact. This strategy should provide important lessons and prove useful in future outbreaks. Research in epidemiology indicates that thoroughly implemented and operationalised green zoning can prevent the spread of a transmittable disease that is poorly understood, highly virulent and potentially highly lethal. Finally, there is strong evidence that green zoning can reduce economic and societal damage as it avoids worst-in-class measures.

Keywords: Green zoning, Covid-19 pandemic, European Union, Public Health

Purpose of the policy

The Covid-19 pandemic has put the global community to a generation-defining challenge. As policy makers and researchers struggle to identify adequate responses, more and more countries have introduced national or international mobility restrictions. These restrictions range from prohibiting unessential travel to closing borders or requiring a negative test or quarantine for visitors. Furthermore, most countries have introduced coloured maps to illustrate the varying epidemiological situations of their territories: green zones indicate areas where the virus is under control while red zones are places where this is not the case. Different public health measures apply to green and red zones. Hence, 'green zoning' refers to a policy that relies on mobility restrictions and public health measures that are solely based on the epidemiological status of well identified zones. Green zoning aims at reducing the spread of an infectious disease and, at the same time, allowing zones where the virus is under control to levy restrictions and return to normal economic and social activity.

Political and economic background. The antecedents of green zoning can be found in the centuries-old notion of 'cordon sanitaire', which resurfaced during the 2014 Ebola outbreak (Heymann 2014). Cordon sanitaire denotes a barrier used to stop the spread of infectious diseases. Green zoning differs in that it preemptively separates a region, country or continent into smaller zones in order to increase the understanding of the virus while preventing the further intensification of the situation. Green zoning thus consists of building up a network of green zones rather than only isolating zones where the situation is identified as severe—the latter often turns out to be too late to control the spread of a virus. Despite this difference, green zoning builds on the concept of cordon sanitaire, which is often viewed critically due to its medieval and colonial origins, often targeting deprived communities.

At the beginning of the Covid-19 pandemic, several western countries criticised China for fencing off some cities and regions, with Boris Johnson and others proclaiming, ‘we are all in this together’ (Grant 2020). To people who held liberal and individual-focused worldviews, it was unimaginable that different measures could be applied in different parts of a country, and that travel restrictions within a country would be recommended or even enforced. Nevertheless, as the economic and social impact of blanket lockdowns across countries—the closing down of schools, shops and workplaces—became insurmountable, there was increasing support for more targeted measures. Regions, such as the Spanish island Mallorca that was particularly hit by the restrictions due to its reliance on tourism, became early supporters of an international green zoning strategy (Govern Illes Balears 2020). Indeed, Mallorca succeeded, allowing German tourists to travel to the island, while travelling from mainland Spain remained prohibited due to the more severe epidemiological situation there (Jones 2020).

Outline. In the following section we introduce the main principles of green zoning. We then review how green zoning was increasingly adopted across Europe during the Covid-19 pandemic. In the following sections, we survey the mounting scientific evidence for its epidemiological and socioeconomic advantages and discuss its operationalization and remaining criticisms. Finally, we provide an outlook on how green zoning should be implemented to control the Covid-19 pandemic as well as future outbreaks of transmittable diseases.

Content of the green zoning policy

Green zoning consists of four key steps which can be applied to a single country (Oliu-Barton et al. 2020) or a group of countries (Pradelski and Oliu-Barton 2020):

- (1) Divide each country into smaller zones (for example, regions or provinces);
- (2) Use common objective epidemiological criteria to label zones as green or red, depending on whether the virus is under control or not;
- (3) Adopt public health measures depending on the colour of the zones;
- (4) Allow travelling between green zones, but limit other travel as much as possible (e.g., require individuals to have a negative test, a seven-day quarantine and/or a vaccination certificate when travelling from a red to a green zone).

Note that the binary distinction between green and red zones could be replaced by a more gradual scale. Nevertheless, in order to operationalize and effectively communicate green zoning a small number of tiers is preferable.

Rationale behind green zoning. The policy is designed to halt the spread of the virus and minimize economic and societal damage. Disconnecting zones as much as possible breaks transmission chains and thus, decreases the likelihood of reintroductions of the virus. The differentiation between zones and avoiding blanket measures is a powerful tool, as different geographic areas are not equally affected by the epidemic at a given point in time or over time.

This distinction is fair as long as the criteria for red and green zones are objective and agreed upon in advance. Furthermore, green zoning is politically acceptable and enforceable, as many countries have succeeded in its implementation during the pandemic. The acceptability and enforceability of green zoning have been proven during the first year of the Covid-19 pandemic.

The evolution of zones. The spread of the virus combines predictable and unpredictable aspects. Thus, the status of zones will evolve over time. As strict measures are adopted, red zones will tend to become green and join the progressively growing network of green zones, where mobility is allowed. On the other hand, some green zones might see a resurgence of the virus and, as a consequence, cease to be green. As the reimportation of the virus from other zones plays an important role in this process, it is crucial to implement strict and timely, localised measures whenever a green zone turns red: restrict the mobility to and from these zones as soon as possible and reexamine zones which have shared high connectivity through intensified testing and tracing campaigns.

Green zoning during the Covid-19 pandemic in Europe

Green zoning was proposed in a policy article during the first European lockdown resulting from the Covid-19 pandemic (Oliu-Barton et al. 2020). It was initially developed for single countries, building on the idea that green zones, where the virus is under control, could restart economic and social activity among themselves (Monràs 2020). This progressive, regional strategy to resume activity was communicated to the French Council of Economic Analysis and subsequently, to the prime minister and other decision makers. Similarly, it was communicated to several ministries of the Spanish government. On the 28th of April, both France and Spain announced their resumption strategies, which both included the key elements of green zoning (French Prime Minister 2020, Spanish Government 2020). Notably, France fell short in implementing travel restrictions between its zones (départements) but rather opted for perimetral mobility restriction (100km).

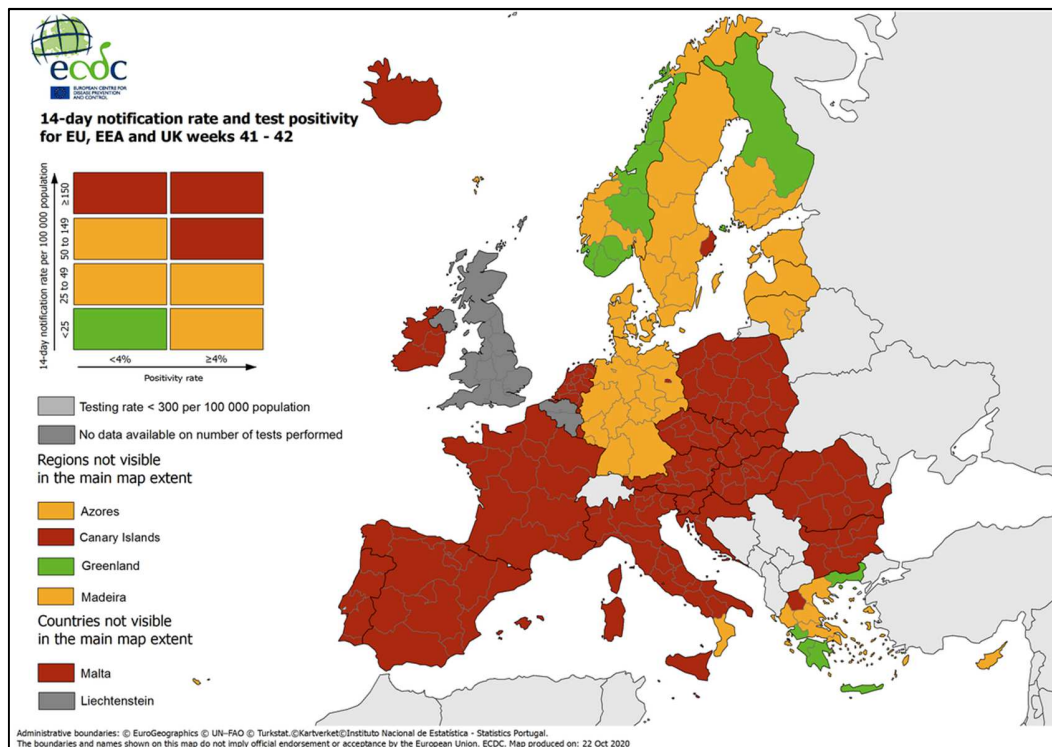
Elevating green zoning to the international level was proposed soon after (Pradelski and Oliu-Barton 2020). Concurrently, alternative policies, such as travel corridors between two countries or travel bubbles containing a few countries, emerged (Editorial Board FT 2020). Green zoning is distinguished by the idea of allowing travel between green zones (regions or provinces) of different countries but not between red and green zones of the same country. In addition, the green zoning policy builds on objective epidemiological criteria and calls for nondiscriminatory rules, in particular, within the European Union. Notably, the Baltic countries created a travel bubble before allowing other European countries to join (Mzezewa 2020).

Due to the national implementations in France and Spain green zoning garnered international media attention and, because of its feature of disregarding national borders, was often portrayed as daring, impossible, or revolutionary (e.g., [Frankfurter Allgemeine Zeitung](#), DE; [Le Monde](#), FR; [El Confidencial](#), ES; [Corriere della Sera](#), IT; [Financial Times](#), UK; [New York Times](#), USA). The travel and tourism industry stood out among the economically motivated proponents

of green zoning, as it feared losing out on the crucial summer months (World Travel & Tourism Council 2020).

Green zoning subsequently became part of the policy considerations of several European countries and the European Commission (EC). Despite including elements of the strategy in their guidelines on how to restore tourism and transport on the 13th of May (EC 2020a), the EC then opted to voice support for the complete restoration of free mobility across Europe. This decision, which in hindsight was faulty, was based on the observation that the pandemic was slowing. As the epidemiological situation worsened across Europe during the late summer period of 2020, Germany joined France, Spain, and Italy in supporting a joint green zoning strategy, and the EC, on the 4th of September, under its new German presidency, issued a new recommendation calling for member states to work closely together on four key points: '1. Common criteria and thresholds for Member States when deciding whether to introduce travel restrictions; 2. Mapping of common criteria using an agreed colour code; 3. A common framework for measures applied to travellers from high-risk areas; 4. Clear and timely information to the public about any restrictions' (EC 2020b). Member states pledged to adopt this green zoning strategy on the 13th of October in a joint memorandum (Council of the European Union 2020). Figure 1 depicts the first, weekly updated, map indicating the epidemiological status across Europe, published by the European Centre for Disease Prevention and Control (ECDC).





Figure 1. The [ECDC coloured map](#), the basis of the EU's green zoning strategy, indicating the varying epidemiological situation of European regions (first map on the 16th of October, 2020).



More and more European countries have followed the examples of France and Spain in adopting elements of green zoning within their territories. For example, the United Kingdom introduced a four-tier system, in which the highest tier resembles a red zone, where strict health measures are in place and travel is discouraged (United Kingdom Government 2020). Similarly, Italy adopted green zoning on the 4th of November 2020. The country was divided into regions that are coloured on a three-tier scale, and travel between the regions is only allowed for essential family or work visits (Ministro della Salute 2020). The legal procedures in each country varied, but many declared states of emergency to bypass parliamentary processes. Notably, federal states struggled to find consensus; for example, Germany often found itself in a deadlock as prime ministers of the Länder could not agree on measures.

Regarding international travel, several countries have adopted the EU recommendations for travel restrictions on incoming EU travellers, which are solely based on the epidemiological status indicated by the ECDC. Other countries, however, have opted to use their own classification of zones and often enforce unilateral travel restrictions that apply to entire countries rather than regions. This bouquet of classifications may lead to confusion among travellers and political rifts, as has been the case since the summer of 2020. Figure 2 provides a classification of European countries according to whether they adopted elements of green zoning within their territory and for travel across Europe. Notably, whether a country has central or federal structure does not seem to be a determinant factor regarding the choice for and operationalisation of green zoning.

Figure 2. *Classification of EU countries, EFTA countries and the UK according to whether they adopted elements of green zoning nationally and/or for international travel and whether the European travel restrictions were based on the ECDC classification of zones or on alternative ones. (Information retrieved on the 21st of December, 2020 from [Re-open EU](#), the EU's portal for tracking the coronavirus situation and restrictions.)*

Elements of green zoning for international travel  	<i>international</i> Belgium Estonia Lichtenstein Malta Norway Romania Slovakia Switzerland	<i>national and international</i> Austria Cyprus Denmark Germany Italy Slovenia Based on ECDC classification: Croatia Czech Republic Finland Ireland Lithuania Netherlands Spain
	<i>none</i> Bulgaria Hungary Iceland Latvia Luxembourg Sweden	<i>national</i> France Greece Poland Portugal United Kingdom
	 Elements of green zoning within country 	

Evidence for the epidemiological and economic benefits of green zoning

There is growing evidence that green zoning can halt the spread of the virus as well as reduce economic hardship by avoiding blanket measures.

Epidemiological benefits. Early work on China's response to the outbreak suggests that the containment of the spread of the virus can be achieved by implementing green zoning at a regional and city level. The key appears to be the fact that there are few sources of the virus at an early stage of the pandemic, and thus, disease importations to virus-free zones are effectively delayed (Kraemer et al. 2020, Tian et al. 2020). Similarly, work in Italy shows that stringent mobility restrictions are needed to reverse an outbreak of Covid-19 (Vinceti et al. 2020). This is in line with the finding that isolation strategies, that is, identifying and immediately isolating infected individuals, is highly effective during the early stages of an outbreak (Hellewell et al. 2020). Nevertheless, scientific consensus is not yet reached, with some studies presenting opposing evidence (Chinazzi et al. 2020).

As our understanding of SARS-CoV-2 increased, it became clear that overdispersion played an important role in its spread, that is, a few infected individuals were responsible for a high number of transmissions (Endo et al. 2020). Thus, public health measures should be aimed at reducing the likelihood of superspreading events (du Plessis et al. 2020). Overdispersion contributes to highly desynchronised spreading in zones which have similar initial conditions but are disconnected from each other. Green zoning diminishes the overall impact of the outbreak by achieving two complementary effects: extinction and desynchronisation. Bittihn and Golestanian (2020) and Schlosser et al. (2020) show that these effects are sizable, even when the virus transmission is widespread and the basic reproduction number is not affected by the

subdivision into zones. This is the case as reintroductions can alter the course of the spread in a zone: overdispersion renders the spread highly stochastic, with a potentially large impact. In particular, intercity, interregional and international spread are essential for sustaining the pandemic even when long-distance transmission events are rare compared to household and local transmissions (Lee et al. 2020).

On a macroscopic level, Rothert et al. (2020) conclude that the lack of travel restrictions between U.S. states contributed to the spread of the virus across the country and substantially increased the total number of infections. Conversely, Eckardt et al. (2020) show how border controls in European countries reduced the spread of the virus, especially in regions with a substantial number of cross-border commuters prior to the crisis. This highlights the importance of understanding mobility flows when assessing a zone's epidemiological situation.

Socioeconomic benefits. Identifying green zones is critical to reducing economic and social restrictions, as this avoids the application of a 'worst in class' logic, i.e., applying measures to the entire country that are only necessary for the most affected zones (Monràs 2020). The progressive lifting of restrictions would avoid an even graver recession, as this would restart activity within economically relevant 'commuting zones', that is, geographic areas that share a common market and thus high local economic activity (Monte et al. 2018).¹ For example, consider the service sector, which is among the sectors that are the most affected by the lockdown. Opening shops, bars, restaurants and cafés in green zones would have a significant impact on the local economy, regardless of the situation across the country (Davis et al. 2019). Further, the social and psychological benefits of reopening green zones should not be underestimated. Finally, to ensure social cohesion it is important to support the population and business in zones that are not green and thus most severely impacted by the restrictions.

Fajgelbaum et al. (2020) study optimal dynamic lockdowns in a network of zones and find that targeted lockdowns achieve substantially smaller income losses than uniform lockdowns. Moreover, it is not sufficient to enforce stricter rules in the most central zones of the network, often identified by densely populated cities. In a related study, Giannone et al. (2020) investigate the effect of targeted lockdowns and travel restrictions when individuals internalize how their actions impact their own probability of getting infected. This leads to an endogenous change in consumption and labour supply even in the absence of mitigation policies. The authors find that the optimal policy would reduce the death toll caused by Covid-19 by more than 130,000 in the U.S. while increasing consumption by 3% compared to the baseline.

Creating an international network of green zones would further contribute to economic growth. The formation of the Baltic travel bubble is an early attempt, as well as the Spanish initiative to allow tourism to the Balearic and Canary Islands from selected European regions where the epidemiological situation was more favourable than in mainland Spain. This increases the gains from international trade, stemming from economies of scale (Krugman 1979), fragmentation of production and comparative advantages (Krugman 1980). With regards to comparative

¹ The European Union mapped commuting zones to support zoning policies during the Covid-19 pandemic (Iacus et al. 2020).

advantages, the economies of Mediterranean countries disproportionately depend on tourism, especially during the summer season. For example, tourism accounts for 13% of employment and 12% of the GDP in Spain (Instituto Nacional de Estadística 2019, OECD 2020). Thus, restoring international travel and tourism would be a major contributing factor in reducing economic shock and restoring civil liberties (Pradelski and Oliu-Barton 2020).

Operationalisation of green zoning

To render the strategy successful, several implementation considerations have turned out to be critical.

Division into zones. From an epidemiological point of view, zones should match areas where the population mixes homogeneously (Clauset et al. 2008). To be politically and socially acceptable, they should also coincide with administrative units (e.g., cities or regions). Further, the division should be aligned with economic activity and logistical constraints to enforce zoning (e.g., as checkpoints for negative tests or immunity certificates should be taken into account). Therefore, countries may choose different granularities for their delimitation. The more countries that jointly implement green zoning, the larger the benefits for their economies and their population's civil liberties.

Definition of labels. Labels should be based on epidemiological indicators such as the basic reproduction number, the number of new infections, the occurrence of undetected community transmission, and the pressure on the health care system (e.g., ICU occupancy). There is increasing evidence that a very low incidence should be targeted with regard to SARS-CoV-2 to protect health, the economy, and civil liberties (Oliu-Barton et al. 2021). Further, the labels must be reliable and consistent across zones. Otherwise, local and national political actors may have incentives to label their zones erroneously. Coordination and surveillance of the labelling could either be achieved by a centralised authority (for example the ECDC in Europe, the Centers for Disease Control and Prevention for the United States, or even the World Health Organization) or by round-robin, that is, a chain of controls where each zone is controlled by one or several other zones.

Enforcement of measures. Varying pandemic responses have spurred much controversy. For example, some countries, including Australia and Singapore, required any incoming travellers to stay in government-controlled quarantine hotels for two weeks. Others, including European countries, took a laissez-faire approach at the beginning of the pandemic but are now introducing a European green pass to control travel. To summarise, the enforcement needs to be aligned to a country's operational capacity as well population acceptance for given measures.

Communication. Finally, the importance of clear and timely communication cannot be overstated (Forman et al. 2020). Being frank about unknowns, setting a timeline for implementation, and explaining the decision-making process and the frequency of policy reviews are all critical for public adherence and support.

Criticisms of green zoning

Critics of green zoning often point to the limitation of civil liberties through mobility restrictions (Meier et al. 2020), and the creation of inequalities and discrimination as a consequence of differentiated measures dependent on a zone's epidemiological situation (Yamin et al. 2020). Nevertheless, representative surveys of 480,000 respondents from 15 countries show that citizens demonstrate a clear willingness to trade off civil liberties for improved public health conditions during the Covid-19 pandemic (Alsan et al. 2020). To mitigate any discriminatory policies and inequalities, it is important that the labelling is based on scientific indicators, is easily communicable and of limited duration, and that the most affected zones are compensated for their non-recoverable losses. A notable example is Australia who opted for green zoning after its first wave of infections, by dividing itself into its six States, labelled as red or green, paired with strict mobility restrictions. The State of Victoria managed to control a resurgence of the virus during August and September 2020, after which it reconnected with the other states and focused on quickly identifying and stopping localised outbreaks (Zhang et al. 2020).

Another criticism of green zoning may be that it leads to fluctuating restrictions that makes it difficult for businesses to plan ahead and creates a psychological burden on the population. To mitigate this uncertainty, it is important that once a zone is labelled green it is effectively protected from a resurgence of the virus by enforcing travel restrictions, implementing test-and-trace, and upholding public health measures (Oliu-Barton et al. 2020).

Outlook

Green zoning is an effective strategy to contain the spread of an infectious disease and to reduce its negative economic and social impacts. This is exemplified by the policy's growing success during the Covid-19 pandemic, providing important lessons for the current and future health crises. Research indicates that when implemented and operationalised thoroughly, green zoning could prevent the spread of a transmittable disease, both during an initial outbreak and the subsequent waves. Green zoning is a useful measure to manage a virus that is poorly understood, highly virulent and potentially highly lethal. Importantly, green zoning should not be permanent as to avoid creating social rifts and inequality between zones. For example, as soon as widespread testing, treatment, or vaccines become available, a reevaluation of the need of zoning should be carried out.

Cross-disciplinary efforts between researchers in the fields of epidemiology, economics, mathematics and sociology have proven to be fruitful. Nevertheless, more research is required to better understand the spread of the virus and the economic impact of the pandemic in light of behavioural responses such as the propensity towards self-protection. While most initial research on green zoning suggests clear benefits, as more data becomes available, primary and secondary effects on population health as well as economic and societal trade-offs should be analysed.

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