

A composite index to promote sustainable development with Zero Net Artificialisation (ZNA) in France

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Since the Brundtland et al. report (Brundtland et al., 1987) and the adoption of Agenda 21 at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, sustainability has been a key priority for European governments, which have adapted their policies accordingly. The new 2030 Agenda, with its Sustainable Development Goals (SDGs), was then adopted by all the member states of the United Nations at the Paris climate summit in September 2015 (Sachs et al., 2019; Secundo et al., 2020). In accordance with the Law on the New Territorial Organisation of the French Republic (Law NOTRe), the regions have become the leading administrative unit in the design and implementation of sustainable development policies (Davidescu et al., 2020) through the development of the *Schéma Régional d'Aménagement, de Développement Durable et d'Égalité des Territoires* (SRADDET).

One of the main problems of sustainable development is to reduce the consumption of natural lands. Environmental consequences are multiple: ecological (with the erosion of biodiversity, the increased risk of flooding due to run-off, the limited carbon storage) and socio-economic consequences (cost of public services, increased travel times and household energy bills, devitalisation of deprived areas, reduced potential for agricultural production, etc.). New models of sustainable development need to be reinvented, combining sobriety and urban quality. The priority is to transform the existing city, by revitalising the core areas of small and medium-sized town centres, recycling the 170,000 hectares of wasteland in France, making use of the 1.1 million vacant homes, and revealing the potential of derelict urban fringes. Density can be optimised to facilitate access to services and activities, while improving the quality of life for our fellow citizens, in particular by increasing the presence of nature in the city.

The reform of “Zero Net Artificialisation” (ZNA) in France, is the result of a recommendation by the Citizens' Climate Convention and a parliamentary debate, with the adoption of the Climate and Resilience Act on 22 August 2021¹, followed by the almost unanimous adoption of the Act on 20 July 2023. For the period 2021-2031, the law sets the objective of halving the rate of consumption of Natural, Agricultural and Forestry Land (NAFL) compared with the previous decade (2011-2021)². This objective provides a framework for a downward trend in the observed consumption, but which needs to be amplified. The trajectory for reducing the amount of artificial land cover must be set out and adapted in regional and urban planning documents for each territory. It takes into account the needs of each region and the history of the last 10 years³.

In light of this global interest, we would like to develop empirical tools considering a multidimensional approach (Kwatra et al., 2020) to evaluate the sustainable development performances of the business parks of the urban community of Caen la mer. The development

¹ LAW no. 2021-1104 of 22 August 2021 on combating climate change and building resilience to its effects, amended by LAW no. 2023-630 of 20 July 2023 aimed at facilitating the implementation of objectives to combat the artificialisation of land and to strengthen support for local elected representatives.

² In France, for example, an average of 24,000 hectares of Natural, Agricultural and Forestry Land (NAFL) has been urbanised each year over the last decade. 63% of this land was used for housing, 23% for economic activities, 7% for road infrastructure, 1% for rail infrastructure and the rest for mixed uses. Developments with less than 8 dwellings per hectare accounted for 51% of the land used, while housing production was limited (19% of the total).

³ Regional plans (SRADDET, SDRIF, SAR, PADDUC) must integrate and localise this objective before 22 November 2024, and the SCoTs and PLUs/Cartes communales must be made compatible respectively before 22 February 2027 and 22 February 2028 respectively.

of sustainable development indicators considering its associated dimensions has become a crucial issue for the evaluation of public policies and the assessment of the performance of territories in the sustainability domain (Bonnet et al., 2021).

"Zero Net Artificialisation" refers to the objective of not increasing the total surface area of artificial land, ie land which has been transformed by human activities such as urbanisation, infrastructure, etc. The aim of ZNA is to compensate for any new artificialisation by measures to restore, renature or enhance other areas.

As far as business parks are concerned, we want to define several sub-indexes to promote the densification of areas and more sustainable businesses, with buildings that respect environmental criteria, better governance and equality between employees.

- The *Land Sobriety* dimension takes into account the need to reduce land use. For example, we are encouraging companies to make an effort to build taller buildings. Yet, two other dimensions must be taken into account,
- The *Energy Sobriety* (Cîrstea et al., 2018, Rosenow et al., 2017) and the *Circular* dimension, that refer to all the incentives and constraints that exist regarding new buildings that must be environmentally performant.
- The *Employ and Societal* dimension that refer to all dimensions that new installations must comply, regarding density of employs but also diversity, minimum wage, access to education etc.

The construction of aggregate composite indexes for each of the three selected dimensions of sustainable development in the ZNA can be described in several stages.

Several stages

- 1 Choice of variables
- 2 Normalisation method (Min-Max, Desirability)
- 3 Aggregation method (arithmetic)
4. Choice of weighting

For this last stage, the calibration is important. Like any index, it must be properly calibrated (do not give too much weight to certain variables, but consider that they form part of the same sub-index, e.g., ground floor car parks and first floor for work, for example). Nor should the Index be seen as a totem, but rather as a means to help progress towards sustainability. There is also the question of the social acceptability of entrepreneurs.

Benefits

1. *Multi-factor*, the index provides flexibility (in particular, some companies will find it easier to meet one criterion than another, and some form of compensation can be accepted). It is good for negotiations to provide alternatives.
2. *Adaptable*, while maintaining the general principle, certain variables may be weighted differently or even may be different, depending on the branch of activity. Within a business park, there may even be a characterisation of a specific sector (e.g. large retail areas or key car parks).
3. *Self-improvement*: by taking into account the total size of the plot and not just the floor area ratio, existing businesses can be encouraged to release surplus land - land reserve - (which can then be used to densify the zone).

92 business parks exist in the urban community of Caen la mer which gathers 48 communes, 270 000 inhabitants and 143 000 employs. Of course, we will not examine all these business parks but we will consider the several types of business parks like:

- 1.1 Business services, R&D, health & digital | BTOB customers
- 1.2 Personal services, commerce, (Companies open to the public) | BTOC customers
- 1.3. Higher education sector - Private training
- 1.4. Manufacturing and construction - TPE (Very Small Enterprises)
- 1.5. Production activities | Compatible or not with housing
- 1.6. Transport activities (courier services)

By choosing a business park for each category, we can refine our index according to the specific nature of the business. Of course, all these new constraints are costly, but we will try to offer the best way for a company to gain in sustainability according to the specifics of its activities.

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