»Kopatz zeigt, wohin sich eine moderne Gesellschaft bewegen muss, wenn sie Nachhaltigkeit als selbstverständliche Routine etablieren möchte.«
Harald Welzer (Vorwort)

Damit Geräte weniger oft kaputtgehen, Tierhaltung artgerechter wird oder Zusatzstoffe aus Lebensmitteln verschwinden, brauchen wir neue Standards und Limits. Das Buch enthält eine Vielzahl konkreter Ideen, eine To-do-List für Politiker, Wirtschaft und Bürger.

Michael Kopatz
Ökoroutine
Damit wir tun, was wir für richtig halten

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DIE GUTEN SEITEN DER ZUKUNFT

Wuppertaler Schriften
zur Forschung für eine nachhaltige Entwicklung

GAiA
ECOLOGICAL PERSPECTIVES FOR SCIENCE AND SOCIETY
ÖKOLOGISCHE PERSPEKTIVEN FÜR WISSENSCHAFT UND GESELLSCHAFT

CULTURAL VALUES AND CLIMATE CHANGE
ECONOMIC VALUATION OF ECOSYSTEM SERVICES
EXEMPLARY TRANSDISCIPLINARY PROJECTS
The **GREEN DENSITY** transdisciplinary research and teaching project focuses on the Waldstadt sector, a strip of forest bordering the city of Bern. This strategic site, likely to host new inhabitants and jobs close to public transport, is particularly adapted to explore urban densification issues. The objective is to experiment, compare and evaluate diverse possible urban forms for the development of such a site.

The process includes the elaboration of six urban and architectural visions from students’ projects developed within Rey’s studio at Ecole polytechnique fédérale de Lausanne (EPFL) and their transdisciplinary multi-criteria assessment.

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**Keywords:** multi-criteria assessment, sustainable architectural design, sustainable design education, transdisciplinary approaches

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To achieve a more efficient use of resources and to strengthen the attractiveness of future urban territories, inventing appropriate design strategies to reclaim urban spaces has become a top priority (Rey and Lufkin 2015). As a genuine tool for exploring spatial, typological and technical alternatives, the architectural and urban design is called to play an essential role and is likely to promote the evolution of the built environment towards increased sustainability (Rey 2014). The inherent holistic nature of sustainability, based on the simultaneous and optimal consideration of a wide range of environmental, sociocultural and economic parameters, induces an increased complexity, which enforces the need to develop new transdisciplinary approaches, both in the architectural practice and in the built environment academic world.

The **GREEN DENSITY** transdisciplinary research and teaching project provides an innovative framing of these complex issues. It aims to design, optimise and assess urban and architectural visions by exploring novel ways to integrate transdisciplinary and evaluative approaches into the project’s process. This paper presents an application of the **GREEN DENSITY** experience to six original visions developed for Waldstadt sector. Located in close proximity to the city centre of Bern (Switzerland), this emblematic site is particularly adapted to explore urban densification strategies aiming at increasing inhabitants’ global quality of life in a holistic sustainability perspective.

### Need for Innovative Transdisciplinary Approaches

Indeed, in a context of reconsideration of urban sprawl, there is certain consensus on the necessity to promote densification processes in European urban territories (Newman and Kenworthy 1999, Williams et al. 2000). Sites such as Waldstadt sector, likely to host new inhabitants and jobs close to public transport, are becoming highly strategic to promote qualitative densification processes. Their development can potentially allow for the construction of new dense and mixed neighbourhoods (Rogers 1998), which fit in with broader sustainability perspectives targeting more efficient use of resources and increasing attractiveness of the entire urban region.

These sustainability perspectives involve finding a long-term balance between environmental, sociocultural and economic objectives. On an operational level, the main challenge is to imagine concrete actions that foster the simultaneous emergence of positive effects in more than one of these dimensions. Regarding the urban and architectural design, it is a question of implementing coherent strategies that are technically appropriate, environmentally friendly, economically viable and value-adding on a sociocultural level (Rey 2012).

The complex and significant scope induced by this holistic approach involves integrating an increased number of competencies into the architectural and urban project’s process, which consequently translates into implementing and coordinating transdisciplinary collaborations (Darbellay and Paulsen 2008). In a sustainabl...
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ability perspective, the latter are not limited to traditional practic-
es of technical coordination. Indeed, current design practices are
characterised by a certain disconnection between the design pro-
cess, conducted by the architect, and the specialised inputs, real-
ised by engineers and specialists. Knowledge and know-how thus
tend to remain parallel and partitioned. Iterations between disci-
plines are few, and most responses are limited to minimal coor di-
nation, which fails to truly nourish the design process. However,
the significance and the complexity of the issues encourage built
environment practitioners and researchers to explore new aven-
ues for cooperation, according to the specific issues raised by each
project (Rey 2015 a).

Our transdisciplinary approach goes beyond a simple addition
of sectorial logics: it aims to transcend disciplinary boundaries to
integrate diverse inputs into a common spatial strategy. The proj-
et’s process can thus be nourished by considerations from disci-
plines other than urban planning and architecture, without ignor-
ing spatial coherence and adapted expression of the final realiza-
tion. This suggests increased communication between the various
involved stakeholders and intense coordination between their re-
spective areas of expertise. Therefore, to support the dialogue be-
tween experts from different fields and nonprofessional actors
from the civil society, it is essential to develop simple, efficient and
synthetic visual methods to represent the current complexity of
transformation processes in urban contexts at all stages of the proj-
et: design, realisation, operation and monitoring.

In reaction, built environment researchers and practitioners
are currently developing a wide range of transdisciplinary sustain-
ability assessment tools to aid decision-making at neighbourhood
scale. Generic examples include the One Planet Living and its ten
principles (Bioregional 2015), stemming from Bioregional’s expe-
rience of working on the eco-village of BedZED, UK, or the SPeAR®
methodology (Sustainable Project Appraisal Routine), developed by
Arup (2012), which appraises urban projects based on key themes
such as transport, biodiversity, culture, employment and skills.
More specific approaches can also be mentioned, such as the
SIPRIUS tool, an indicator system for the integration of sustain-
ability into the design process of urban disused areas (Laprise
et al. 2015) or the URBIUS tool, a multi-criteria decision support
methodology for urban renewal strategies at neighbourhood scale
(Gracia Riera Pérez and Rey 2012).

In parallel to these efforts towards the integration of transdis-
ciplinary evaluative approaches into the urban and architectural
project’s process, innovative education methods also have to be
developed to make future architects aware of the multiplicity of
environmental, sociocultural and economic parameters (Roulet
2006). This is precisely the focus of the GREEN DENSITY project
(Rey and Lufkin 2014, Rey 2013), which aims to design, optimise
and assess urban and architectural projects while enriching the
education of future architects.

Development of Six Visions for the Waldstadt Sector

The first application of the GREEN DENSITY approach was car-
ried out on the Waldstadt sector, a strip of forest bordering the city of
Bern and separated from the Bremgarten forest by a highway. Giv-
en the high demographic growth of the Bern urban region, this
strategic sector, which measures 46 hectares, is likely to attract
several thousand new inhabitants and jobs in close proximity to
public transport and a well-preserved natural landscape (Kauf-
mann et al. 2000).

The project’s methodology includes four major steps. The first
one was achieved within the framework of Rey’s architectural de-
sign studio at Ecole polytechnique fédérale de Lausanne (EPFL) in
2010/2011 and 2011/2012. The remarkable commitment of stu-
dents and assistants, as well as the valuable contribution of exter-
nal lecturers, allowed for production of approximately 60 projects,
from urban form to constructive detail. Confronting the students
with representatives from disciplines related to architectural de-
sign during their learning process allowed for simultaneous in-
tegration of architecture and sustainability issues.

The second phase took the form of two summer workshops,
organised in 2011 and 2012. Guided by the studio assistants, a doz-
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En motivated students developed and improved the most promising projects. The results from four design studio semesters were thus optimised and radicalised to elaborate six synthetic visions, respectively titled Transition, Interface, Outposts, Checkerboard, Continuities and Hyperdensities (figure 1).

The Transition project involves the development of a series of medium-sized buildings and systems at the domestic scale. Private balconies, shared terraces (for use by two dwellings) and neutral, sunny designs with open views onto the forest target households of all kinds of people in search of calm, tranquil and secure housing in the heart of the forest.

Interface promotes conviviality and social exchange through its system of passageways, community rooms and collective terraces on each floor, and series of three-sided interior courtyards. These courtyards are easily used, as are the upper floors, with wide-open spaces that are conducive to family life and children’s games.

The Outposts project features more anonymous buildings. Their large size gives them an imposing character, and their layout leaves little possibility for use of outdoor spaces. This project is adapted to singles or couples seeking luxury apartments overlooking the forest, with a guarantee of anonymity.

Checkerboard and Continuities are projects with a maximum of six floors (figure 2). The closed or semi-open island design supports intense neighbourly relations, where exchanges can take place in both the outdoor spaces and the passageways. The projects also allow residents to enjoy their privacy, thanks to private balconies. The inner courtyards can easily be used as play areas or urban vegetable gardens.

Hyperdensities is a very compact project that is strongly geared to households who want to experience a sense of “urbanity”, where one can observe or bump into one’s neighbours without necessarily having exchanges with them. The outdoor areas are very open and only partially connected to the dwellings. The project is more suited to single people or couples without children, who are seeking to live in a lively, trendy urban environment.

Multi-criteria Assessment of the Visions

Subsequently, the third phase consisted of the thematic analysis of the visions. Several experts from diverse disciplinary backgrounds, based at the School of Architecture, Civil and Environmental Engineering (ENAC) of EPFL, were invited to take a critical look at the visions. Their contributions highlight various environmental, energetic, sociological or economic aspects. Thanks to a coordinated work between architecture teachers and different specialists, it was possible to gain some perspective – enriched by manifold dimensions – on the different urban visions. In addition, the organisation of a series of iterative meetings made pos...
sible the emergence of a common language, which continues to enrich exchanges between all GREEN DENSITY project contributors.

The last phase was dedicated to the transdisciplinary multi-criteria assessment of the six visions. As previously mentioned, the creation of a sustainable neighbouring involves searching for global quality and therefore taking into consideration a broad number of environmental, economic and sociocultural parameters, which requires transdisciplinary evaluation.

The assessment methodology is built around five main categories (as shown in table 1, each category includes two relevant indicators):
1. density and mix,
2. energy gains and losses,
3. biodiversity and water,
4. lifestyles,
5. economic return.

Ultimately, a synthetic representation is realised (figure 3): the ten thematic indicators are grouped in a radar diagram, revealing the sustainability profile of each vision. These diagrams enable the direct, graphical multi-criteria evaluation and comparison of the six visions. For each of the ten indicators, the centre of the radar diagram is equivalent to the minimum value while the end of the axis corresponds to the maximum value.

**Table 1**: Transdisciplinary multi-criteria assessment. Five categories, as well as their respective indicators, are used to evaluate environmental, economic and sociocultural parameters of the six urban densification visions of the Waldstadt sector.

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>INDICATOR 1</th>
<th>INDICATOR 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>density and mix</td>
<td>land use index</td>
<td>functional mix</td>
</tr>
<tr>
<td>energy gains and losses</td>
<td>compactness</td>
<td>solar potential</td>
</tr>
<tr>
<td>biodiversity and water</td>
<td>preserved forest</td>
<td>permeable soil</td>
</tr>
<tr>
<td>lifestyles</td>
<td>level of conviviality</td>
<td>family friendliness</td>
</tr>
<tr>
<td>economic return</td>
<td>profit</td>
<td>profitability</td>
</tr>
</tbody>
</table>

Transdisciplinary approaches, both quantitative and qualitative, are crucial to fully grasp the inherent complexity of urban densification processes.

This graphical representation emphasises the strong heterogeneity of the visions, highlighting their respective assets and limitations. It also uncovers several interesting tendencies – in relative terms – among the different projects. Two distinct groups of projects can thus be identified.

The first group consists of projects with a radical profile, which tend to privilege one dimension of sustainability at the expense of others. The Transition, Interface and Outposts projects, for example, systematically emphasise environmental or energy-related aspects. Indicators such as solar potential, preserved forest and permeable soil receive favourable evaluations. On the flip side, the density of these three visions is relatively low, which explains why they remain clearly below the theoretical profitability threshold.

By contrast, the very radical Hyperdensities project, as its name suggests, presents an increased land use index, and therefore better economic performances (profit and profitability indicators) as the previously cited visions. Its environmental evaluation, logically, is significantly less favourable, in particular in terms of permeable soil and preserved forest.

Furthermore, it is interesting to note that even the most dense vision, Hyperdensities (land use index = 2.8), remains almost two times less dense than the historical centre of Bern (land use index = 4.7). This observation is useful to put in perspective several stereotypes about density and highlights the need for sound evaluation methods to assess architectural projects, both quantitatively and qualitatively.

The second group of projects is composed of visions with a more balanced profile, which reconcile different aspects of sustainability in a holistic optimisation process. The Checkerboard and Continuities projects, even if they are not characterised by top performances, receive good evaluations for an important amount of indicators.

**Global Quality through Transdisciplinary Strategies**

As illustrated by the Waldstadt case study, the creation of a sustainable neighborhood involves a search for global quality by implementing transdisciplinary strategies that are technically adapted, environmentally friendly, economically viable and which create added value at the sociocultural level. Synthesising multiple constraints into a unifying spatial concept has always been an essential element of an architectural or urban project. Therefore, from our viewpoint, transdisciplinarity is by no means revolutionising the foundation of architecture or urbanism. Rather, it makes it possible to enrich practices and research in these two fields with new inputs, on environmental, sociocultural or economic levels. In order to tackle the complexity and the multiplicity of these parameters, architects are definitely expected to master transdisciplinarity if they are to assume the role of central coordinator of the project.

Transdisciplinary approaches, both quantitative and qualitative, are crucial to fully grasp the inherent complexity of urban densification processes. By its effectiveness and clarity, the transdisciplinary evaluative approach developed within the framework of the GREEN DENSITY project provides a powerful critical analysis,
decision-making and communication tool. Going beyond traditional educational methods, which maintain the gap between architects and experts from other fields, it explores innovative ways to integrate holistic, transdisciplinary and evaluative approaches in urban and architectural project teaching. By strengthening the links between the often separate worlds of education and research, it heightens the awareness and enriches the education of future architects.

To make sure that the results of the GREEN DENSITY experience found their way into society at large, a book was published in the Architecture Album collection of the Presses polytechniques et universitaires romandes (PPUR). Entitled Green Density, it presents each vision in a specific sequence with numerous colour illustrations (plans, sections, model photographs, 3D visualisations). Texts presenting the thematic insights are intertwined with the six visions. To valorise the outcomes of the GREEN DENSITY project and to increase its societal impact, a public exhibition was also organised from 22nd November to 8th December 2013 at the Forum d’architectures de Lausanne. The opening of the exhibit, which took place on November 19th, included short speeches by Marilyne Andersen, Dean of the ENAC School, Luca Ortelli, Head of the Institute of Architecture and the City (IA), and Emmanuel Rey, Head of the Laboratory of Architecture and Sustainable Technologies (LAST).

Ultimately, in order to apply the GREEN DENSITY experience to other case studies, a methodology named Neighbourhood-scale Evaluation to Benchmark the Integration of Urban Sustainability (NEBIUS) was developed. As an extension of the GREEN DENSITY approach, this methodology represents a baseline from which other sustainable neighbourhoods, located in other urban areas, can be compared and assessed, whether in academic or operational contexts. Other application case studies proving the value of the approach have already been carried out in Yverdon-les-Bains, Canton of Vaud (Rey 2015b), and are currently being conducted in West Lausanne (Rey forthcoming).

1. www.archi-far.ch
The authors would like to thank the td-net award committee for the recognition of their work, which confirms the viability of the approach and validates the relevance of the experience conducted over a four-year period, from architectural design studio to multi-criteria assessment, including summer workshops and thematic analyses by experts. They also express their gratitude to the Ecole polytechnique fédérale de Lausanne, which has provided an appropriate framework for the development of the GREEN DENSITY research and teaching project, as well as to all researchers, lecturers and students who contributed to this innovative transdisciplinary experience.

References


Submitted May 27, 2016; revised version accepted July 26, 2016.

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Nachhaltigkeit A–Z

Die guten Seiten der Zukunft

B wie Bedeutungsvielfalt

Die Bedeutung von Nachhaltigkeit ist: Es geht um die Sicherung der Grundlagen dauerhafter menschlicher Zivilisation auf der Erde. Zur Frage, was nachhaltige Entwicklung konkret bedeutet, gibt es jedoch sehr unterschiedliche Antworten. Dies wird oft nur als Hindernis für Kommunikation und Umsetzung der Idee der Nachhaltigkeit gesehen. Im Gegensatz dazu vertritt der Physiker und Philosoph Armin Grunwald die These, dass diese Vielfalt der Bedeutungen zentral zur Nachhaltigkeit hinzugehört und er zeigt, wie wertvoll diese Bedeutungsvielfalt ist.

A. Grunwald

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GAIA 25/3 (2016): 185–190