



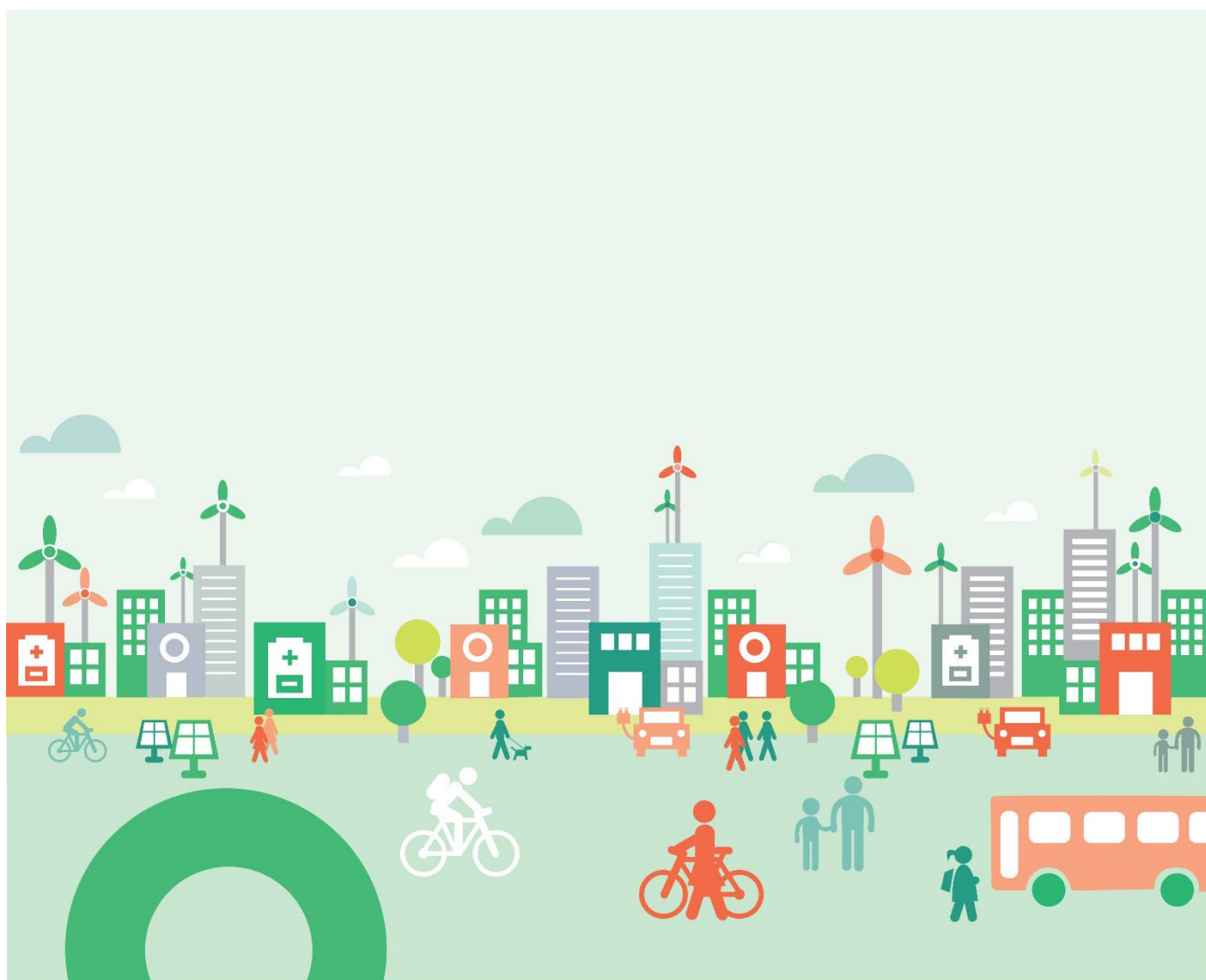
Research Centre on
ZERO EMISSION
NEIGHBOURHOODS
IN SMART CITIES



WHAT DOES IT TAKE TO MEET ZEN GOALS?

A framework to support ZEN realization

ZEN REPORT No. 72 – 2024



Giulia Vergerio, Vegard Knotten | NTNU, SINTEF



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Keywords: ZEN process, success factors, implementation, goals management, collaboration, ZEN organization, stakeholders.

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Preface

Acknowledgements

This report has been written within the Research Centre on Zero Emission Neighbourhoods in Smart Cities (FME ZEN). The authors gratefully acknowledge the support from the Research Council of Norway, the Norwegian University of Science and Technology (NTNU), SINTEF, the municipalities of Oslo, Bergen, Trondheim, Bodø, Bærum, Elverum and Steinkjer, Trøndelag county, Norwegian Directorate for Public Construction and Property Management, Norwegian Water Resources and Energy Directorate, Norwegian Building Authority, ByBo, Elverum Tomteselskap, TOBB, Snøhetta, AFRY, Asplan Viak, Multiconsult, Civitas, FutureBuilt, Heidelberg Materials, Skanska, GK, NTE, Smart Grid Services Cluster, Statkraft Varme, Fornybar Norge and Norsk Fjernvarme.

The Research Centre on Zero Emission Neighbourhoods (ZEN) in Smart Cities

The ZEN Research Centre develops solutions for future buildings and neighbourhoods with no greenhouse gas emissions and thereby contributes to a low carbon society.

Researchers, municipalities, industry and governmental organizations work together in the ZEN Research Centre in order to plan, develop and run neighbourhoods with zero greenhouse gas emissions. The ZEN Centre has nine pilot projects spread over all of Norway that encompass an area of more than 1 million m² and more than 30 000 inhabitants in total.

In order to achieve its high ambitions, the Centre will, together with its partners:

- Develop neighbourhood design and planning instruments while integrating science-based knowledge on greenhouse gas emissions.
- Create new business models, roles, and services that address the lack of flexibility towards markets and catalyse the development of innovations for a broader public use; This includes studies of political instruments and market design.
- Create cost effective and resource and energy efficient buildings by developing low carbon technologies and construction systems based on lifecycle design strategies.
- Develop technologies and solutions for the design and operation of energy flexible neighbourhoods.
- Develop a decision-support tool for optimizing local energy systems and their interaction with the larger system.
- Create and manage a series of neighbourhood-scale living labs, which will act as innovation hubs and a testing ground for the solutions developed in the ZEN Research Centre. The pilot projects are Furuset in Oslo, Fornebu in Bærum, Sluppen and Campus NTNU in Trondheim, Mære agricultural school, Ydalir in Elverum, Campus Evenstad, New city – new airport Bodø, and Zero Village Bergen.

The ZEN Research Centre will last eight years (2017-2024), and the budget is approximately NOK 380 million, funded by the Research Council of Norway, the research partners NTNU and SINTEF, and the user partners from the private and public sector. The Norwegian University of Science and Technology (NTNU) is the host and leads the Centre together with SINTEF.



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FME ZEN (page)

Sammendrag

Denne rapporten ser på hvordan prosessene fra første planlegging til ferdig realisering av ZEN prosjekter kan forbedres. Altså; hvordan når man ZEN-målene som er definert av ZEN-kriteriene og nøkkelindikatorne (KPIer) ved hjelp av effektive prosesser. Rapporten tar utgangspunkt i tidligere forskning og ser på ZEN som et program bestående av flere modulære prosjekter innenfor en kompleks forsyningskjede. Organisasjonen som tar initiativet til ZEN (den ledende organisasjonen) har en utfordrende oppgave med å koordinere innsatsen til de forskjellige eierne og utviklerne. Disse aktørenes beslutninger vil til syvende og sist avgjøre om og hvordan ZEN kan realiseres. Rapporten gir veiledning til å navigere i denne komplekse prosessen, med særlig fokus på de tidlige stadiene av ZEN prosjektet og spesielt rollen til den ledende organisasjonen.

For å sikre at hele ZEN-organisasjonen arbeider mot de samme ZEN-målene, kan vi dra nytte av eksisterende rammeverk som BREEAM og NS3467:2023, gitt at de er knyttet til ZEN-målene. Det er viktig å ha tiltak på plass for å forberede og planlegge utviklingen, vurdere ulike alternativer for å holde prosjektet på rett spor, samt å sikre at beslutninger blir tatt på et solid grunnlag. Ved å tilpasse disse tiltakene og ha en praktisk forståelse av ZEN-kriteriene og KPIene, kan vi støtte en tidlig målstyringstilnærming for ZEN og gi en klar definisjon av prosjektens mandater. I tillegg er det avgjørende at alle aktørene rundt ZEN har en felles forståelse av de faktorene som påvirker samarbeidet, for dermed å kunne bygge et robust rammeverk for prosjektutviklingen.

En klar forpliktelse og forståelse av ZEN, effektiv styring mot ZEN-mål, og tilrettelegging for et godt samarbeid mellom alle involverte aktører er avgjørende for å lykkes med ZEN. Disse faktorene krever fokus allerede fra prosjektets start.

Mål, mandater og rammeverk er "søylene" i strukturen for oppnåelse av ZEN i denne rapporten. Før implementeringen starter, bør den ledende organisasjonen utføre en "forhåndsanalyse" for å sikre at disse elementene er ivaretatt. En ZEN-muliggjører er en veileder som støtter oppbyggingen av disse søylene.

ZEN-muliggjøreren (Engelsk: ZEN Enabler, Z.En), presentert i kapittel 3, fungerer som en veileder for den ledende organisasjonen. Den hjelper til med å etablere nøkkelfaktorer for å realisere ZEN i samarbeid med andre involverte parter. Kjernen i Z.En er en firetrinns prosess kalt 'ASAP-modellen'. Denne modellen består av trinnene: Forutse (Anticipate), Tilpasse (Shape), Evaluere (Assess) og Forankre (Pin). Disse trinnene definerer hvilke handlinger som må være på plass for å sikre en vellykket implementering av ZEN (se Tabell 1). ASAP-modellen støtter en iterativ tilnærming til målstyring og retter fokus mot ZEN-kriteriene og nøkkelindikatorne (KPI-ene) som er angitt i Tabell 2. Disse brukes gjennom hele prosjektets livssyklus. ASAP-modellen fokuserer også på faktorer som påvirker samarbeidet (se Tabell 3), og som bør adresseres tidlig i prosessen.

ASAP-modellen iverksettes først av den ledende organisasjonen. Dette gjøres ved at en dedikert person, kalt en ZEN-champion, tar initiativ til å bruke modellen, og deretter involverer de relevante partene. ZEN-champions er personer som har forståelse for ZEN-visjonene og har kompetanse innen prosessedelse. Det må utpekes en i hver organisasjon som en kontinuerlig koordinerings og grensesnittkontakt så snart organisasjonen er involvert i ZEN prosjektet. ZEN-champions er drivkraften bak implementeringen av Z.En og dermed en viktig suksessfaktor for å lykkes med ZEN.

Verdien av å ha et enkelt, sentralt rammeverk å referere til er anerkjent, spesielt gitt det store antallet prosesser som foregår i forbindelse med en ZEN-utvikling og det påfølgende behovet for koordinering. Z.En har som hovedmål å skape åpenhet og tydelighet i disse prosessene. Det er mange måter å utføre

oppgavene som er foreslått i Z.En , og derfor gir ikke Z.En spesifikke instruksjoner om hvordan de skal utføres. I stedet identifiserer vi de utfordringene som kan ligge skjult bak disse oppgavene, samt diskuterer hvordan de kan håndteres. Dette inkluderer blant annet å ta hensyn til de involverte aktørenes motivasjon for å delta, samt å håndtere usikkerheter i prosjektet og eksterne variabler som kan påvirke utfallet.

I prosessen mot ZEN-realisering oppfordres det til å fokusere på fordelene som ZEN kan gi alle involverte parter. Dette kan fungere som en motivasjon til å engasjere og forplikte seg til programmet og prosjektet. Å skape insentiver, som for eksempel deling av byrder og risiko, å adressere mål som kan øke attraktiviteten i prosjektet, brukerkvaliteter, mm., samt å tydeliggjøre prosesser og utfordringer, er sentrale oppgaver for de ledende organisasjonene og premissgivende aktører. Dette kan inkludere offentlige myndigheter, beslutningstakere, infrastrukturleverandører, mm. Avklarte plattformer og arenaer for kommunikasjon spiller en viktig rolle i å redusere usikkerheten til de forskjellige aktørene. Dette oppnås ved å forstå hverandres mål og strategier fra starten av prosjektet. Videre bidrar dette til å skape en felles forståelse og fremmer samarbeidet mellom de involverte partene.

I konklusjonen av denne rapporten finner de forskjellige målgruppene (ledende organisasjon, eier og utvikler, utførende, mm.) råd om gjennomføringen av fremtidige ZEN prosjekter.

Summary

In this report, we focus on the **process** to increase the chances of ZEN projects' success, meaning the achievement of ZEN-goals, as described by the ZEN criteria and Key Performance Indicators (KPIs). Based on previous research, the report posits that ZEN can be thought as a program of modular projects, with a complex supply chain, where the organization that initiates ZEN (i.e., lead organization) should, not without difficulties, coordinate the efforts of the various owners & developers down the line, whose decisions will eventually define if and how a ZEN can be realized. To give guidance in this direction, the report targets the early project stages and the lead organization, first.

For the whole ZEN organization to work towards ZEN goals, existing frameworks such as BREEAM and NS3467:2023 can be useful, as far as they are connected to ZEN goals. It's essential that actions to prepare (anticipate) and plan the development, assess the alternatives to stay on track, and secure decisions are in place. The adoption of such actions and an operational understanding over ZEN criteria and KPIs can support an early-**goals**-management approach for ZEN and a clear definition of projects' **mandates**. Furthermore, a shared understanding of the elements that affect collaboration is important for the various actors around ZEN to build a better **framework** for the development of the project.

*Understanding and committing to ZEN, managing goals, and facilitating collaboration among actors are important **success factors** for ZEN realization, requiring attention from the early stages.*

Goals, mandates, and frameworks are the Pillars of a structure for ZEN realization proposed in this report. Via a Pre-analysis, the lead organization should check, prior to implementation, if they are addressed. An Enabler for ZEN helps building such pillars.

The **ZEN Enabler (Z.En)**, as a guide (Chapter 3 of this report), helps the lead organization, with the involvement of other parties, to build up success factors for ZEN realization. The core of Z.En is a 4-stage process, called 'ASAP model' (Anticipate – Shape – Assess – Pin), specifying what actions should be in place to be on a good track with ZEN implementation (Table 1). ASAP helps an iterative goals-management and drives the attention to the ZEN criteria and KPIs (Table 2), which should be used throughout the projects' life cycle. ASAP also calls for attention to the elements affecting collaboration (Table 4), which should be addressed early. ASAP model should be deployed by the lead organization first, via an appointed person, so-called ZEN champion, and then involving the relevant parties. The **ZEN champions** are persons with understanding of the ZEN visions and process management competencies, who must be appointed in each organization as continuous coordination interface as soon as such an organization is involved in ZEN. They are the engine running the deployment of the Z.En.

The usefulness of a single framework to come back to has been recognized, especially because of the numerous processes happening around a ZEN development and the need for **coordination**. Z.En aims at bringing some clarity across them. As there are multiple ways to carry out the suggested actions, Z.En does not say how they should be performed. Challenges hidden behind such actions requires more attention, including actors' motivation and project's uncertainties and external variables. We recommend that more attention is given to the benefits of realizing a ZEN for all actors involved, as a motivation to engage and commit. Building **incentives** (e.g., sharing burdens and risks, addressing

enabling goals such as attractiveness, qualities for the users, etc., clarifying processes and variables) is an important activity for the lead organizations and the contextual actors (e.g., regulatory bodies, policy makers, infrastructure providers, etc.). **Communication** platforms and arenas are important to reduce the uncertainty for the various actors by understanding each other's goals and strategies from the beginning. ZEN realization could be supported by the present report, as suggested in the conclusion, depending on the various target groups (lead organizations, developers, executives, etc.).

Definitions

Program: the strategic framework under which a group of projects is developed to achieve a common overall objective.

Project: an individual, focused development effort, which can be reconducted to a single contract with a narrower scope than the one of the overarching program.

Mandate: defined as both the order/requirements and the authority to perform an action, to make something happen in a certain area¹.

ZEN Pillar: A process-related condition that should be in place to increase the chances for a ZEN development to succeed at meeting its performance goals.

ZEN Pre-analysis: The context where the organization initiative a ZEN (lead organization) checks, prior to implementation, that the pillars are properly addressed.

ZEN Enabler (Z.En): A guide for the lead organization to build up, with the involvement of the relevant parties, the success factors for a ZEN development. The core of the Enabler is a 4-stage process, called ‘ASAP’ (Anticipate – Shape – Assess – Pin), which should be the natural starting point for the deployment of the Enabler.

ZEN Organization: The landscape of the various organizations that are involved in the implementation of a ZEN (e.g., local authorities, developers, lead organizations, designers, contractors, suppliers, etc.) and their relationships. A genetic representation of it is presented in Figure 5.

Lead organization: “the organization that initiates the development of a ZEN and then coordinates the development efforts between different subjects and developers.” (Hamdan et al., 2023).

ZEN-Champion: A dedicated person appointed at each organization level to enact a continuous coordination interface among projects and levels. This person must understand the ZEN vision and have process management competencies.

¹ <https://dictionary.cambridge.org/dictionary/english/mandate>

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1. Introduction

1.1. Context

Literature surrounding Architecture, Engineering and Construction (AEC) highlights that weak goal formulation and poor decision-making processes are among the causes for good intentions of projects being lost throughout the process. Also, in ambitious projects, failures in terms or goals achievement are due to lack of stakeholders' engagement and commitment, insufficient organizational processes, and unsupportive development framework (Baer & Haase, 2020).

Good processes for ZEN realization are important to increase the chances of a **ZEN project's success**, which is defined as the achievement of ZEN-related goals in an urban development. Indeed, ZEN developments are, as all projects, potentially affected by the well-known problem of discrepancy between expectations, or goals, and results, or actual delivery. In ZEN, this is particularly problematic because of the scale and of the temporal and contextual uncertainties (Figure 1).

Regarding scale, we know that ZEN consists of multiple buildings and infrastructure projects and requires preparation at both planning and building process levels. As such, ZEN is defined, at least, at the neighborhood level, through a program, usually by hand of contextual stakeholders (i.e., those setting the context, for example local authorities), and at the building/infrastructure level, via projects developed by industry actors (i.e., actors producing or consuming value within the frame defined by contextual stakeholders)². The political and regulatory context also play a role, as well as the market, and these are in constant evolution. All these conditions call for coordination to ensure that goals are preserved and reflected at all levels during implementation. The time uncertainty is not only related to the long duration of such development endeavors, but also to long-lasting processes (planning, provision of complex technological solutions, etc.) and to the fact that the various projects are naturally rolled out at different points in time.

Both scale and time, as well as level of innovation required, are reasons why in developing a ZEN we observe a variety of actors, interests, disciplines, information, instruments, etc., involved, which is also a source of complexity.

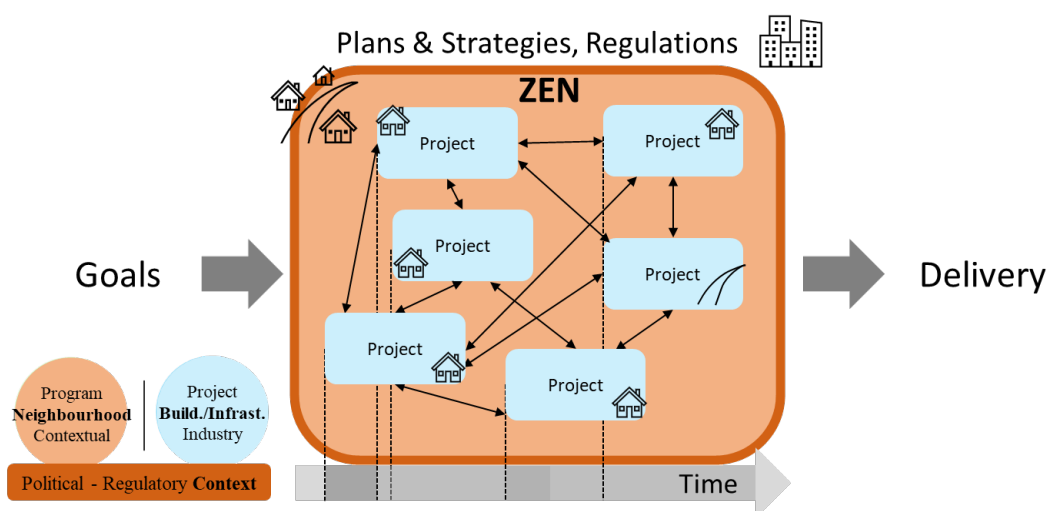


Figure 1 – Complexity in ZEN realization.

² Contextual and industry stakeholders have been defined by (Cheng et al., 2022).

All these elements of complexity call for a plan to make sure that ambitions are not lost, and that we keep an overarching perspective to check for the performance of the whole and to ensure that each project is contributing to the expected result.

So far, a lot of efforts within FME ZEN Research Centre was put in defining what are the **success criteria**, meaning what performance goals a neighborhood should meet to be defined as ZEN. In particular, with the so-called ‘ZEN Definition’, the FME ZEN has characterized a ZEN by saying what it is and what performance criteria it should meet (e.g., energy efficiency in buildings, streets connectivity, ...) to be defined as such (Wiik, Fjellheim, et al., 2022). Performance criteria are divided into 6 categories (i.e., GHG emissions, energy, power, urban form and land use, mobility, and economy). Per each criterion, multiple Key Performance Indicators (KPIs) have been defined to specify what to measure to assess whether projects are adhering to ZEN goals and ambitions and to keep track of it throughout the planning, implementation, and operational stages at both buildings and/or neighbourhood levels. Practical guidance on how to perform such assessment is given in the ZEN definition guideline (Wiik, Homaei, et al., 2022), whose latest version was only recently out (Wiik, Homaei, Lien, Sartori, Karlsson, et al., 2024) together with the ZEN Definition report (Wiik, Homaei, Lien, Sartori, Meland, et al., 2024).

ZEN KPIs are reflecting ZEN performance goals. Less was said, beyond ZEN pilots, about **process goals** and **success factors**, meaning actions that should be put in place to increase the chances of success at meeting performance goals in ZEN developments, which is the focus of this report, as clarified in the next section.

1.2. Target and structure

We support ZEN realization by providing, with this report, guidance in setting up actions to commit to ZEN, to manage goals (iteratively), and to encourage collaboration and integration. We target the early stages of ZEN implementations, and the organizations involved in ZEN development, as clarified in the following.

While a project progresses, uncertainty decreases but potential changes get more and more expensive. Thus, with this report, we are targeting the **early phases** of ZEN implementation (both planning and design levels), visible in Figure 2, as the time when actions (e.g., goals management, commitment, collaboration, and integration) should be put in place or accounted/planned for by the initiators of ZEN. We assume the projects’ implementation perspective, where the NS3467:2023 (*NS 3467:2023 - Steg og leveranser i byggverkets livsløp*, 2023) is the main reference for the definition of process steps. In the figure below we show how the NS3467:2023, with its 10 steps, relates to strategic, implementation, and operational phases as they have been previously defined in ZEN (Wiik, Fjellheim, et al., 2022). Political and regulatory feasibilities are out of our scope. More about the public perspective on the problem of realizing ZEN is discussed in the ZEN process guideline (Rokseth et al., 2024), which can be considered a complementary report to this and, as such, having some thematic overlaps.

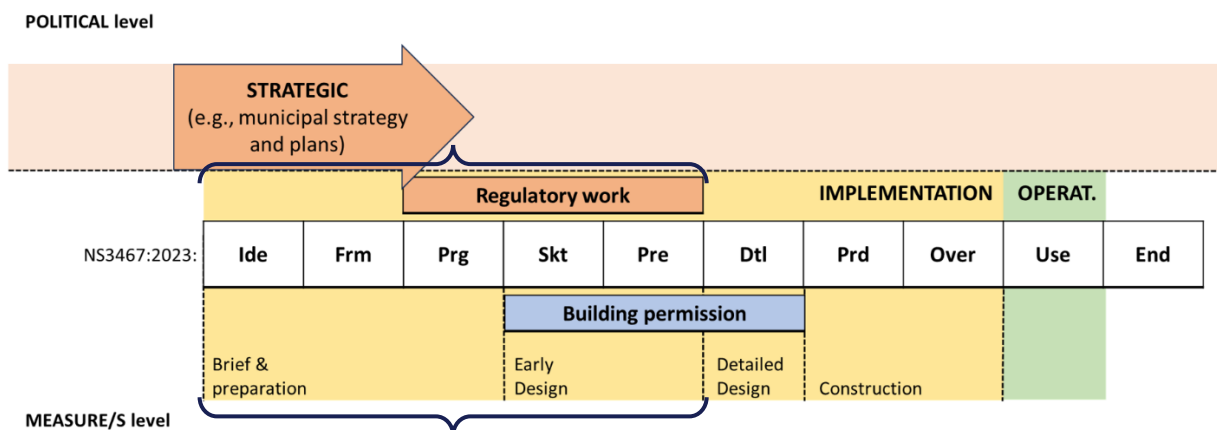


Figure 2 – The focus of this report in the Planning and Building process for ZEN.

The main target of this report is, primarily, the organizations initiating a ZEN development, called **lead organizations**, (Hamdan, De Boer, et al., 2021)) and, secondly, all the organizations involved in ZEN realization, both at authority (in the context of, e.g., urban planning, quality programming) and developers' levels (e.g., projects and design management), as main 'process drivers' in different stages. Their role as **ZEN champions** will be clarified in the report, as well as what is meant by lead organization.

The rest of the report is structured as follows.

In the next chapter (**chapter 2**) we present the background on the topic of a successful process for ZEN realization and what we can learn from them to build a framework supporting ZEN realization, which is introduced in the same chapter (section 2.2). The framework is based on three important conditions (Pillars) a ZEN development should meet, and a Pre-analysis for ZEN, where the lead organization, prior to implementation, checks if the Pillars are addressed.

Then, a so-called ZEN Enabler, i.e., Z.En, is proposed (**chapter 3**), which is a guideline supporting the lead organization in building such Pillars. Z.En aims to bring some clarity across the numerous processes that can happen around a ZEN development by suggesting both success factors and actions that should be accomplished to be on a good track. As there are multiple ways to carry out such actions, Z.En does not say how they should be performed.

More practical aspects about the actual deployment of the Z.En are discussed later in this report, in the form of examples from selected ZEN pilots and feedback collected from stakeholders (**chapter 4**). Open challenges, which require more attention, are discussed in the end (**chapter 5**).

For a practical/hands-on use of this report, we refer the reader to the **Appendixes**.

2. Background

2.1. Learning from literature

ZEN Organization

Previous work in the FME ZEN Research Centre (Hamdan, 2022) has offered a description on how the procurement process for **ZEN** could be **organized**, posing the basis for thinking about ZEN as a program of modular projects. In his work, (Hamdan, 2022) defines a model based on some principles to follow when managing the overall program (program procurement), and a concept that should drive the definition of individual projects mandates (project procurement). While “program procurement is useful for describing how project procurements are organized and managed at the neighborhood level, and for providing direction and setting expectations for all project stakeholders.” (Hamdan, 2022), projects procurement within a Sustainable Neighbourhoods (SNs), like ZENs, should include two types of information: information/decisions that relate to the individual projects (i.e., hidden information), and information/decisions that relate to an overarching program (i.e., visible information). The overall program should be managed embracing modularity, i.e., where individual projects are decomposed but interconnected (or modular), and agreements and coordination are decisive to achieve the goals (Hamdan et al., 2023), especially given the challenges related to multiple ownerships and stakeholders collaboration (Hamdan, Andersen, et al., 2021). The model³ is presented in Figure 3.

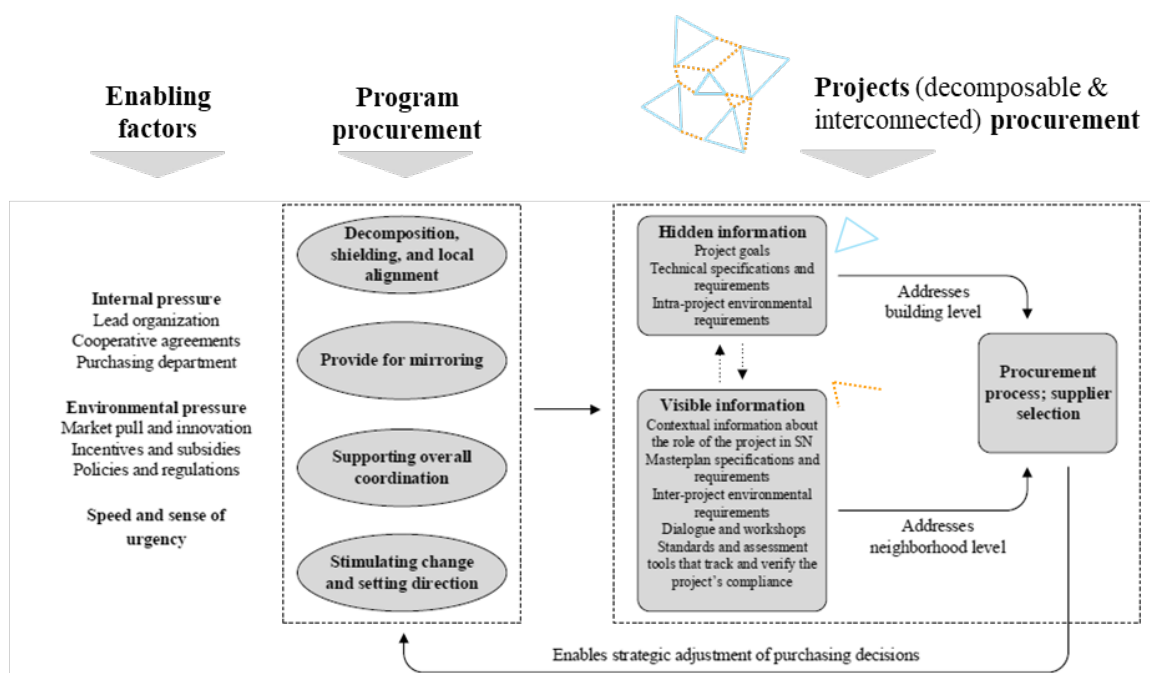


Figure 3 – Neighbourhood-level procurement strategy for SNs projects. Source: (Hamdan, 2022)

The illustrated model/strategy requires some enabling factors to work (Figure 3). Among the enabling factors, the role of the lead organization emerges. It is the organization taking initiative and leading the process of developing a ZEN, working, not without difficulties (Hamdan et al., 2023), for integration, agreements, and goals alignment among projects (Hamdan, De Boer, et al., 2021). Thus, the supply structure for a ZEN project would look like Figure 4, where the relationships among parties are ‘looser’ than expected in order to accommodate for the need of both hidden and visible information, and where the lead organization is at the top.

³ For more information, see PhD thesis: (Hamdan, 2022).

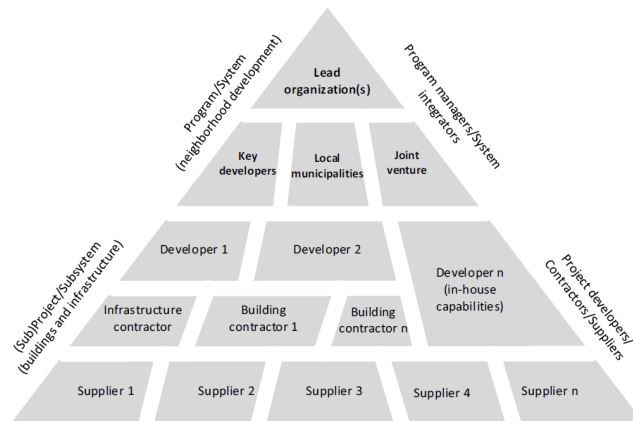


Figure 4 – Procurement pyramid in ZEN projects. Source: (Hamdan et al., 2023).

In practical terms, the lead organization could be the municipality, called here local authority (top-down initiative), but in principle it could also be a group of key developers (bottom-up) having high ambitions for their projects. The lead organization(s) own(s) the overall program. However, the infrastructure and building projects that build up a ZEN are developed through the efforts of various projects' teams (contractors, architects, suppliers, etc.), as contracted by the owners & developers in various forms of contractual arrangements. As owner of the ZEN program, the lead organization should coordinate the efforts of the various owners & developers of the projects that are down the line, whose decisions will eventually define if and how a ZEN can be realized.

A generic schema⁴ of the ZEN organization would most likely appear like in Figure 5.

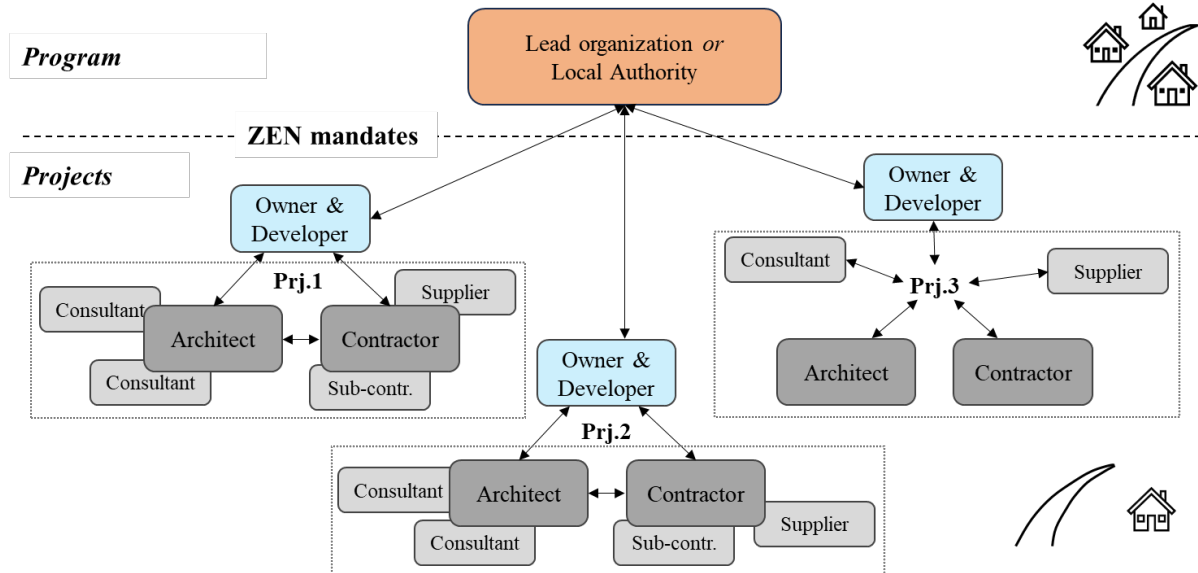


Figure 5 – Probable ZEN developments organization.

Coordination across the different levels of such an organization is a key aspect that a strategy for ZEN realization must take care of.

⁴ NB: the way each ZEN will be organized is dependent on the context, and thus should be clarified at the start, as this report suggests via the Z.En.

ZEN Process

How do we ensure that the ZEN organization (Figure 5) work successfully towards ZEN realization? What are the factors increasing the chances to succeed at meeting the desired performance goals? How can the ZEN organization work with ZEN goals? How do we take care of the process?

To respond to these questions, we investigated frameworks that industry recognizes as a reference when managing a project towards the realization of specified goals in Norway, such as BREEAM and NS3467:2023.

BREEAM-NOR and **BREEAM-Communities** (BREEAM-C) are acknowledged as tools in the ZEN toolkit that can help address process-related aspects for ZEN (Wiik, Fjellheim, et al., 2022). From a comparison between ZEN definition (version publicly available in 2023) and BREEAM-C (Vergerio & Collins, 2024) we have learnt that they have both similarities and differences. With the system of criteria and KPIs, ZEN definition is more concerned about being very specific on what/how to measure and about binding the awarding of points to certain quantitative requirements. Less is said about sequential actions to ensure that projects will perform well against such KPIs. On the other hand, BREEAM-C has a less quantitative approach, and most of the evidence to provide, and criteria to comply with, for a project being awarded credits refer to having certain actions, strategies, documents, and commitment in place. More BREEAM thinking in ZEN would then translate into the definition of practical actions to operationalize the goals advocated by the ZEN criteria and KPIs. The BREEAM-C issues that were found similar to ZEN KPIs entail action that can be grouped into ‘anticipate’, ‘plan’ (including feasibility assessment), ‘manage’ and ‘secure’ actions.

Based on that we argue that a framework supporting ZEN realization should entail four areas of action:

- **Anticipate** – preparatory actions, to be more prepared to face complexity/uncertainty.
- **Plan** – planning actions, to organize the development.
- **Assess** – evaluation⁵ efforts, to hold the development on track.
- **Pin** – securing mechanisms, to make sure nothing is lost among stages and levels.

Previous works in FME ZEN Research Centre have given an insight on how to promote innovation in Sustainable Neighborhoods (SNs) (Hamdan, 2021), by acquiring, engaging, using, and exchanging knowledge/competence in the project⁶. We argue that the four groups of actions identified in the bullet points above reflect this ‘acquisition – engagement – use – exchange’ sequence, as will be clearer when reading the report further (section 3.1).

Another common reference for the construction industry to work with projects is the new **NS3467:2023** (*NS 3467:2023 - Steg og leveranser i byggverkets livsløp*, 2023). The standard “NS3467 Steps and deliverables in the building lifecycle” (merging the two phase-norms “Neste Steg” and “Steg for steg – veien til gode reguleringsplaner ” initiated by Bygg21) aims at giving a common framework to the industry in terms of stages, deliverables, and perspectives to improve communication and timely

⁵ It is worth noticing that, in ambitious and innovative projects, assessment entail uncertainty, which is another source of complexity and risk in ZEN projects.

⁶ The four stages of a project lifecycle as identified by (Hamdan, 2021) are called bridging, engaging, leveraging, and exchanging, where different strategies and practices for innovation are proposed. The focus on acquisition, engagement, use, and exchange is our interpretation/simplification.

decision-making across and within the projects (Knotten et al., 2016). The standard identifies 10 stages of a building project lifecycle, from idea to end of life. It specifies actions and deliverables connected to design/construction, management, and regulatory processes. Particularly relevant in the context of this report is the Standard's recommendation that the project's work on climate and environment should start very early (stage 2-3), including the commitment to certification schemes (for a greater focus on, a more uniformed assessment of, the work on climate and environment).

We can argue that further guidance on when to address ZEN criteria and KPIs in such well-recognized framework would help building an operational knowledge about what ZEN is and to use the ZEN KPIs as a tool to communicate the goals and steer the process towards them, as industry does with BREEAM.

ZEN ambitions

But are existing frameworks, such as the NS3467:2023 or BREEAM, enough for ambitious projects like ZEN to succeed?

A literature analysis on **barriers and good practices in ambitious projects** (Vergerio & Knotten, 2024a), presented elements that should be promoted to increase the chances for an ambitious project to succeed, looking at both building and neighbourhood developments. These elements focus on collaboration, roles and responsibilities, by highlighting the importance of owner and user involvements, early contractor involvement, and aspects of a sound project culture. Secondly, it also highlights the importance of knowledge sharing and communication of experts and the use of champions. For more detail see (Vergerio & Knotten, 2024a)

Based on the findings of the report just quoted, we have identified three conditions to support ZEN development, as important process-related elements to take care of. They are defined as **Goals** (objectives), **Mandates** (requirements/authorities to develop ZEN), and **Framework** (the context).

We argue that an operational knowledge of the ZEN KPIs and the adoption of actions to anticipate, plan, assess, and pin critical decisions (as defined above) would support a clear definition of projects' **mandates** and an early-**goals**-management approach for ZEN. However, this can be done only within a supporting developing **framework** based on collaboration.

ZEN Collaboration

Given the vital importance of collaborative frameworks, in FME ZEN Research Centre, we have looked closer at the topic through the analysis of three case studies located in Trondheim area (Vergerio & Knotten, 2024b) and discussing the findings with the theory. All projects had ambitious goals (e.g. energy, environment, digitalization, ...) and a contractual arrangement based on collaboration elements. The final aim of the study was to learn what the actors recognized as success factors, how projects worked with ambitious goals, and what were the challenges and opportunities for collaboration.

From the study (Vergerio & Knotten, 2024b) we have learnt that there are many elements that affect the collaboration in projects, e.g. clarity of goals, prioritization of goals, ownership of goals/projects, top goals, clustering of actors, owners/clients' involvement, early involvement of relevant parties, economics, requirements, experience with nouveau technical solutions and tools, duration of the project,

tools, needs of involved parties, process management, project environment, trust, attitude, roles and power⁷. Further the elements can be grouped into goals, contracts, organization, and culture of projects.

We further claim that being aware of the effects of collaboration from the early stages is critical for a successful ZEN realization. Recommendations are given for partners and researchers of FME ZEN Research Centre to leverage on good practices/success factors when developing a ZEN and to be aware of challenges/threats in pursuing ambitious goals. Recommendations are also summarized in 10 success factors for ZEN execution and include, but are not limited to the following (quoted from (Vergerio & Knotten, 2024b)):

- “**Clarity** in the project mission is a success factors in literature that is also recognized as such by all parties in the project’s organization. Ownership over goals is also mentioned as such.
- Sometimes **priorities** are unclear, and differences are not only among parties, but also within, which brings more complexity. Aligning the owner’s and project’s goals as well as looking for top management support is crucial.
- The contract must enable **collaboration** and the ability to solve the clients’ goals. Proper economic frameworks and more communication and transparency are needed to alleviate the differences among parties.
- Locking down alternatives for the project too early and without the proper **competences** on board leads to suboptimization. Process management is a success factor; to have the right competency at the right time to solve the issues.
- **Economics** influences the collaboration dynamics, as it should be in balance with ambitions. Letting the project develop with continuous cost control helps the client to make sound decisions and the project develops within the frames.
- Influence in the project, in terms of **roles** and responsibilities, should be both clarified at the contractual level and backed by a culture of trust, which collaboration allows to build.
- It is important that **processes** and **tools** are agreed upon and effectively communicated to all parties in projects, including project plan/schedule, communication, and communication channels. Planning is a success factor in projects. Communication should involve the owner, as they are the main decision-maker.
- The informants mentioned that the collaborative **culture** that they experienced in the projects did not just happen, it was a point of focus and hard work.
- **Trust** is a fundamental element of collaboration, which is built on relationships and transparency” (Vergerio & Knotten, 2024b).

It is important that there is a shared understanding of these and other factors in such a way that the various actors around ZEN can build better conditions for collaboration in ZEN projects.

⁷ Read more in the original report (Vergerio & Knotten, 2024b) and in section 3.3 of this report.

2.2. Toward a framework for ZEN realization

The understanding of both ZEN Definition, the planning and building processes in Norway⁸ and all literature and references reported above, led to the definition of a framework that the lead organization in ZEN could follow, involving the included parties, to work towards ZEN realization.

The framework, visible in Figure 7, is built around the ideas of Pillars, Pre-analysis, and Enabler for ZEN developments, as presented in the following.

Pillars for ZEN

Based on the conditions identified above (section 2.1), a successful ZEN implementation should ensure that:

- **Goals** are ambitious, unambiguous at the start and possible for follow-up,
- **Mandates** are in place, backed by a clear understanding of what ZEN projects entail (i.e., how projects choices can affect ZEN targets).
- **Frameworks** are supporting high ambitions and innovation by promoting collaboration.

They can be considered conditions to increase the opportunity for any project to succeed, but we believe that in the context of ZEN they are particularly important because of the complexity described above (section 1.1) and for the high level of innovation required. They should be considered critical process goals and, as such, they are here defined as Pillars of a ZEN development⁹ (Figure 6).

The three pillars are interconnected, meaning that ‘mandates’ cannot be addressed without addressing ‘goals’, and effective goals management can only happen with supportive ‘frameworks’ in place.

Pre-analysis for ZEN

It is of key importance that ZEN initiatives are able, as early as possible, to study whether these favorable process-related conditions are addressed. This is done as a pre-analysis for ZEN (i.e., **ZEN pre-analysis**). We can say that, with the pre-analysis, one is studying these three elements to eventually improve them and support ZEN development.

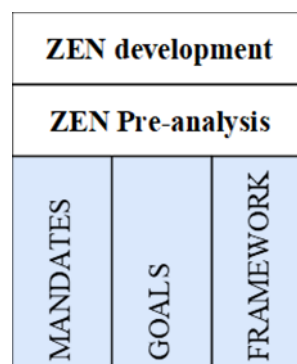


Figure 6 - Pillars for ZEN development addressed in pre-analysis.

⁸ According to the Plan and Building Act. <https://www.regjeringen.no/en/dokumenter/planning-building-act/id570450/>

⁹ They are not the only ones, but those that could be identified by adopting the lenses chosen for this report - those of process managers at the authority (in the context of, e.g., urban planning, quality programming) and development levers (e.g., projects and design management). Political feasibility is not addressed in this report.

We recommend that the responsibility to run such pre-analysis is of organization initiating a ZEN project, i.e., lead organization. Running a ZEN pre-analysis means, for the lead organization of a ZEN, asking the following questions:

- Can we express **goals** clearly, and do we have the processes to follow them up?
- Do we understand what choices ZEN implies, as a basis to define what projects should do (**mandates**)?
- Are there the conditions (**framework**) for collaboration among relevant parties?

Enabler for ZEN

To ensure a positive response to those questions and increase the chances of success, we propose some guidance to the lead organizations via the so-called ‘Zero Emission Neighbourhoods Enabler’, i.e., **ZEN Enabler**, or **Z.En**. In principle, Z.En is a guide represented by Chapter 3 of this report and connected Appendices.

Z.En, in the context of the overall framework for ZEN realization, can be presented as in Figure 7 (blue elements).

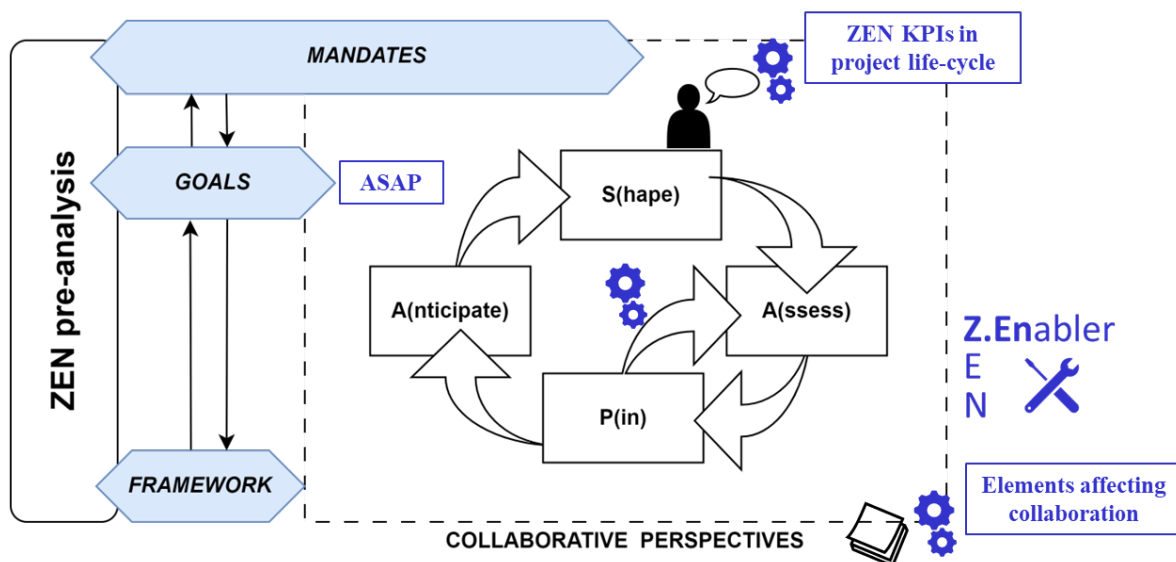


Figure 7 – A framework for ZEN realization – Pillars, Pre-analysis, and Enabler for ZEN.

Figure 7 illustrates that the overall framework includes three interconnected pillars, i.e., mandates, goals, and framework, which are addressed by Z.En. As visible in the same figure, the very core of Z.En is a four stage processes called ‘**ASAP** model’, as discussed further in chapter 3. We are aware that the abbreviation ASAP is commonly known as “as soon as possible”, however we still choose to use the term ASAP – as it is essential to start the process as early as possible. Moving from ‘A’ to ‘P’, ASAP process drives the attention to the use of **ZEN KPIs** throughout the whole project life cycle (to express mandates and assess goals and projects’ choices), and the elements that were found affecting **collaboration** and that, as such, should be addressed.

Z.En is further presented in chapter 3.

Thanks to the adoption of Z.En, the lead organization can set up processes for driving the project in terms of **goals**-compliance and measures' acceptance and durability; gains an operational knowledge of the ZEN definitions as basis to express **mandates** on ZEN; and learns to exploit collaborative perspectives in building up the projects' **framework**. For the organizations included in ZEN (e.g., local authorities, landowners, developers, designers, etc.), who should be informed and involved by the lead organization, Z.En should be a common knowledge basis of the ZEN process and a way for all actors to relate their implementation work to the overall ZEN development.

3. ZEN Enabler (Z.En)

In this chapter we introduce ZEN Enabler (or **Z.En**, Figure 8) at a general level. For a more thorough understanding and a practical use the reader will be referred to relevant Appendixes.

What is Z.En?

Z.En is a guide and is represented by the present chapter and connected Appendixes. It consists of recommendation, conceptual models, etc., addressing and helping the involved actors to realize ZEN.

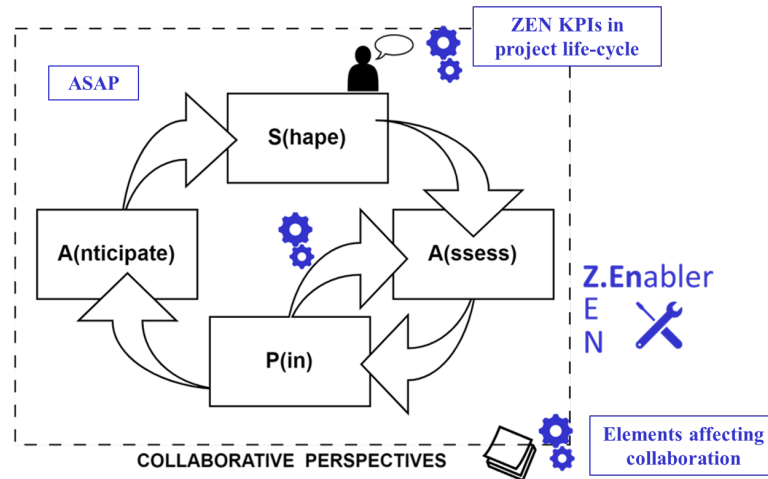


Figure 8 – ZEN Enabler (Z.En).

The core of Z.En is a model in four stages, which are called Anticipate, Shape, Assess, and Pin, in short, ASAP. **ASAP** model (section 3.1) is primarily suggesting action to help working successfully with ZEN goals, which must be done ‘as soon as possible’. While doing that, ASAP also encourages:

- i) To use **ZEN KPIs** throughout the process (section 3.2);
- ii) To work with elements enhancing **collaboration** (section 3.3).

Table-like tools are supporting these aspects, complementing ASAP.

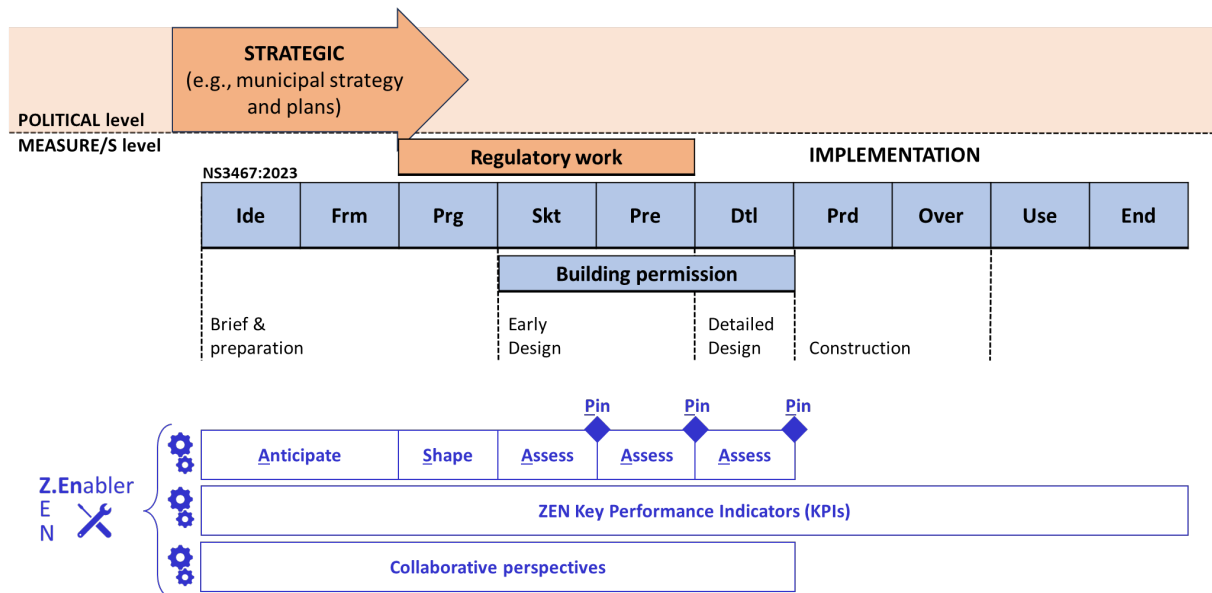
Altogether, if deployed as a practical tool, the elements making up Z.En help to build the three pillars of goals, mandates, and framework (as introduced in section 2.2).

When to use Z.En?

Z.En should be used throughout the whole process of a ZEN development to ensure connection of goals and ambitions between city and neighbourhood programs, on one side, and building and infrastructure projects, on the other. Thus, the **planning and building process lifecycle** is used in Z.En as a timeline to suggest (Figure 9):

- a) When **ASAP** actions should take place to manage goals,
- b) When to pay a special attention to the different **ZEN KPIs**, and
- c) How to address elements enhancing **collaboration** in the early stages of implementation.

The timeline starts with the strategic planning for a ZEN, potentially happening via municipal strategies and plans¹⁰, and it continues with the 10-stages building project's lifecycle as defined by the NS3467:2023. We mostly focus on the early stage of implementation (from idea to preliminary projects) and its interface with the strategic planning level, where regulatory work and building permit processes are important occasions for alignment among the two levels (political versus measure/s).



NS2367:2023 stages are idea (**Ide**), framing (**Frm**), programming (**Prg**), sketch project (**Skt**), preliminary project (**Pre**), detailed project (**Dtl**), production (**Prd**), takeover (**Over**), use phase (**Use**), and end-of-life/disposal (**End**).

Figure 9 – Z.En in the planning and building process lifecycle.

Who should use Z.En?

We propose that the primary responsibility for deploying Z.En should be the lead organization that, as initiator of ZEN and “owner” of the ZEN ambitions (and as such also called **ambitions owner**), is performing a pre-analysis for ZEN. This is done via an appointed person with process management responsibilities and understanding of the ZEN vision, called ZEN champion. The ZEN champion of the lead organization should start the deployment of Z.En by adopting the ASAP model.

For an effective deployment, the lead organization will need to involve other parties (landowners, developers, designers, local authority, etc.) as they are key drivers of the process (i.e., having the ability to change a process to achieve a certain results) in the various stages. To ensure that this is done, the lead organization, via its ZEN champion, should inform about, and involve with, Z.En all relevant and new parties, encouraging, as soon as they are involved, the appointment of **ZEN champions** in their own organizations as continuous coordination interface while the development progresses.

The ZEN champions would be the engine of Z.En, leading its deployment, and they should guarantee coordination throughout ZEN and among projects. Figure 10 illustrates how the ZEN organization looks like with the appointed ZEN champions.

¹⁰ Because we adopt a projects perspective, the capability of municipalities to define ZEN-related provisions in municipal plans (Norwegian: KPA, KDP) and zoning plans (Norwegian: reguleringsplan) is outside our scope. This is a topic under discussion. For more on this see (Junker et al., 2022) and (Rokseth et al., 2024).

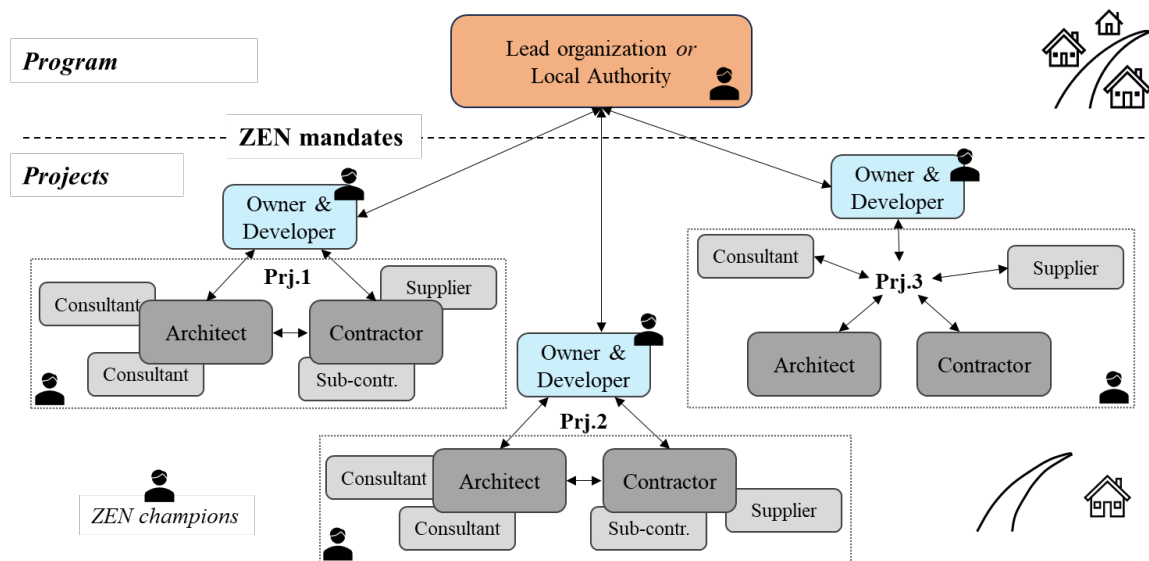


Figure 10 – ZEN champions as coordination interfaces in the ZEN organization.

It would be also possible to imagine a **board** of ZEN champions, if they are given the mandates to represent their organizations and to take decisions on ZEN matters, where interdependences and needs for revisions, sharing, etc., could be discussed at the overall ZEN program level, at the presence of the representative of the lead organization.

Why using Z.En?

It is of interest to the lead organization (i.e., municipality, group of key developers, etc.), owning the ZEN **program**, that Z.En is rolled out with the involvement of the relevant actors to achieve the program goals. For the planning and strategic nature of it, the local authority (which could be the lead organization itself) is seemingly concerned. However, Z.En can be a knowledge basis of the ZEN process for all owners & developers implementing the individual **projects** that are building up a ZEN, as they are affected by the neighbourhood level program.

The two perspectives (i.e., neighbourhood program level versus building/infrastructure projects level) are discussed whenever relevant in the chapter. The role of local authorities (owners of municipal plans and strategies) purely under their regulatory mandates is further discussed whenever relevant. More attention to the public perspectives is given in a complementary report of this – the ZEN process guideline (Rokseth et al., 2024).

How to use Z.En?

Each element of Z.En is presented in the rest of the chapter with reference to the planning and building process to give a general overview. For a practical use of Z.En we refer to Appendix A. Appendixes B and C provides more details on some of the elements of Z.En for those who want to learn more.

3.1. ASAP model.

The core of Z.En is a **conceptual** model, called **ASAP** (‘Anticipate’, ‘Shape’, ‘Assess’, and ‘Pin’), for iterative goals management within ZEN throughout implementation. ASAP is a circular process that should help the lead organization to, primarily, manage goals by suggesting what actions, divided in four stages, should be there to be on track. The first two stages are performed at the neighbourhood (program) level, while the other two should happen at the project level, iteratively. The focus per each stage is illustrated in Figure 11.

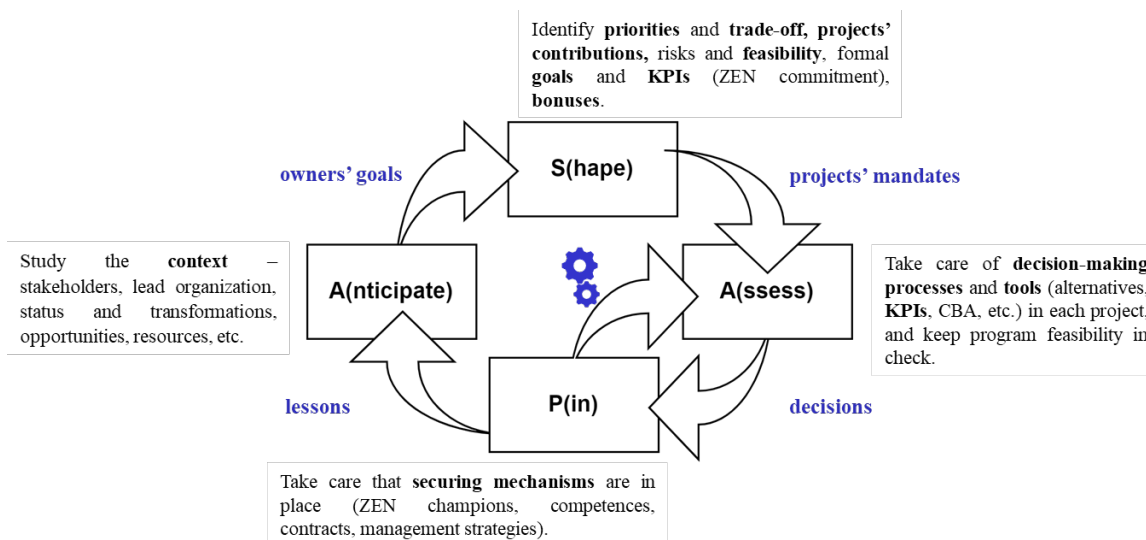


Figure 11 – The core of Z.En – ASAP model and related actions in brief.

The connection of ASAP with existing processes (i.e., NS3567:2023, regulatory work and building permit application in Norway) is specified and illustrated in Figure 12 and actions per each stage are listed in Table 1.

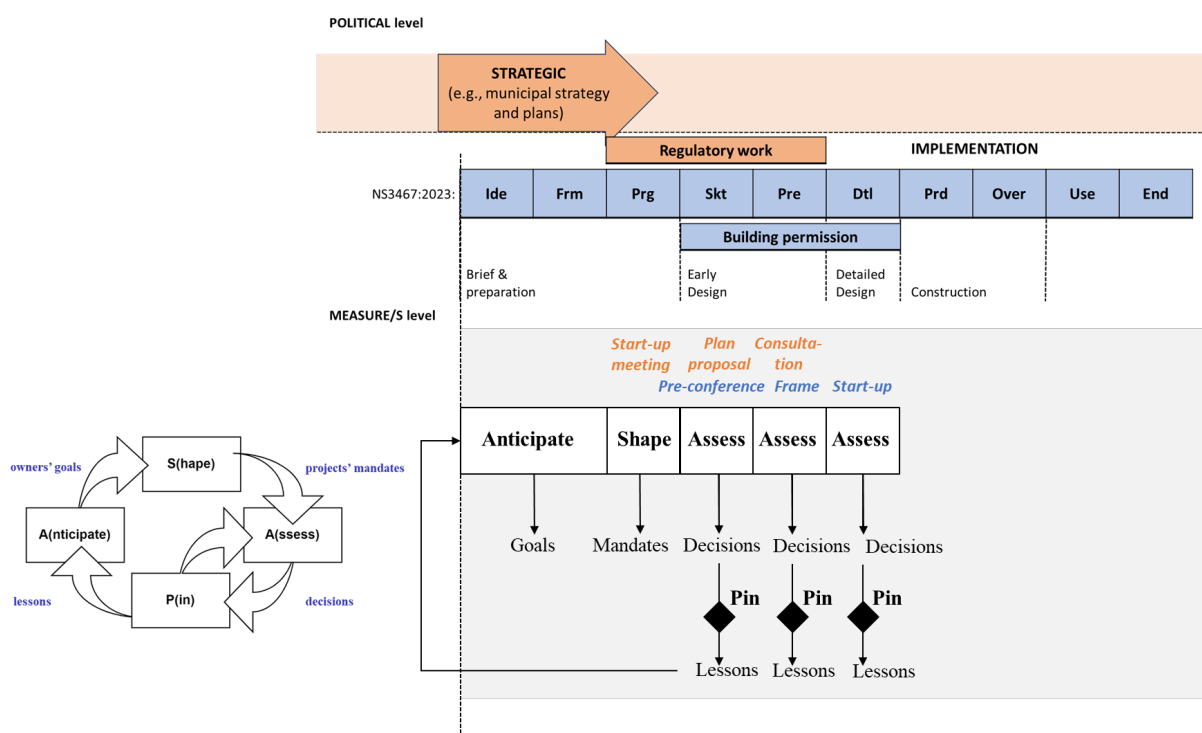


Figure 12 – When to use ASAP. Connection with other processes.

Table 1 - The 4 stages of the conceptual model called ASAP.

A(nticipate)	S(hape)	A(ssess)	P(in)
<p>Perform stakeholder analyses, highlighting networks.</p> <p>Study area's ownership and engage/understand owners.</p> <p>Ensure shared understanding of what is the lead organization.</p> <p>Start selecting competences and implementing parties.</p> <p>Study the planning status, including transformation.</p> <p>Explore opportunities and benefits.</p> <p>Set up dialogues.</p> <p>Encourage innovation.</p> <p>Formulate and communicate idea for financial recourses and levers.</p> <p>Set up preliminary agreements.</p> <p>Anchor decisions not directly connected to ZEN but incentivizing it.</p>	<p>Identify trade-off and priorities at the district level first.</p> <p>Break-down the program into sub-projects.</p> <p>Formulate goals properly (e.g. end state) at both scales.</p> <p>Connect goals of the two scales via study of feasibility and risks (including interdependencies and critical projects) for the program.</p> <p>Commit to ZEN by selecting criteria and KPIs to target at district and building level.</p> <p>Separate ambitions from goals and set up bonuses.</p> <p>Identify tradable goals/ambitions and who are the trading parties.</p> <p>Final agreement in place.</p>	<p>Prefer collaborative models of implementation for 'better' discussion.</p> <p>Favor innovation during design, exploiting firms' capabilities.</p> <p>Ensure that multiple compatible options are formulated.</p> <p>Compute ZEN KPIs at building (developer) and district (lead organization) levels as basis for decisions.</p> <p>Use Choosing by Advantage or similar methods for decision making.</p> <p>Address internal risks in each project and clarify need for revisions.</p> <p>Address uncertainties (e.g., new studies, competences, dialogues, agreements, etc.).</p> <p>Keep program feasibility in check.</p>	<p>Project teams have competences, translate ZEN goals in design solutions, and formalize controllable factors.</p> <p>Binding mechanisms are in place so that decisions are followed up.</p> <p>Critical projects have been contracted and funds allocated (Plan & Cost for execution).</p> <p>Long-term strategies are in place in each project to keep delivering benefits (e.g., management strategy post-occupation).</p> <p>Document adopted strategies as lessons for new projects/phases.</p>
<p>Neighbourhood strategy is shared and aware of owners' goals.</p>	<p>Program is broken down in individual projects' mandates.</p>	<p>Projects progress with sound decisions.</p>	<p>Decisions are followed up, lessons documented.</p>

To **anchor ASAP model to practice** (Figure 13), one should think that 'Anticipate' happens at a very early stage, with a first identification of the area/s. The focus is on the identified area and the surroundings, as drawn in the municipal strategies and plans. Multiple project initiatives might be already there, at an idea/framing stage, and must be mapped, as well as the owners. Preliminary agreements to collaborate in ZEN should be set to have all parties onboard.

At 'Shape' stage, the area has been identified, and the focus is on the respective plot with the start-up of the regulatory work. Individual owners' projects are better outlined via programs' requirements in connection with the overall ZEN program, owned by the lead organization. A clear relationship between projects and owners, on one side, and overall ZEN program and lead organization, on the other, must be set both in terms of goals and contributions and formal mandates and agreement.

At ‘Assess’ stage, the focus is on individual projects at once and on whether they manage decisions in accordance with ZEN goals and ambitions. Here, owners are involving new actors (implementing parties such as contractors, architects, consultants, etc.) to start designing. At sketch design level, negotiation upon projects’ requirements between owners and implementing parties is still ongoing, and this is why it is important that feasibility is kept in check and collaborative contractual models are preferred for a ‘better’ discussion and a decision-making based on the assessment of alternative options.

Assessment after assessment, the projects will be formulated, with related plans and final cost. The decisions taken in this context should be secured and documented to make sure that they are not lost. This is why it is important that all projects under the ZEN umbrella have certain characteristics. Accordingly, in ‘Pin’ stage, the focus is across all the projects who are reporting to the lead organization about the implementation to ensure securing mechanisms are in place.

Spatial and organizational implications of the ASAP model, as described above, are summarised in Figure 13 in a simplified way.

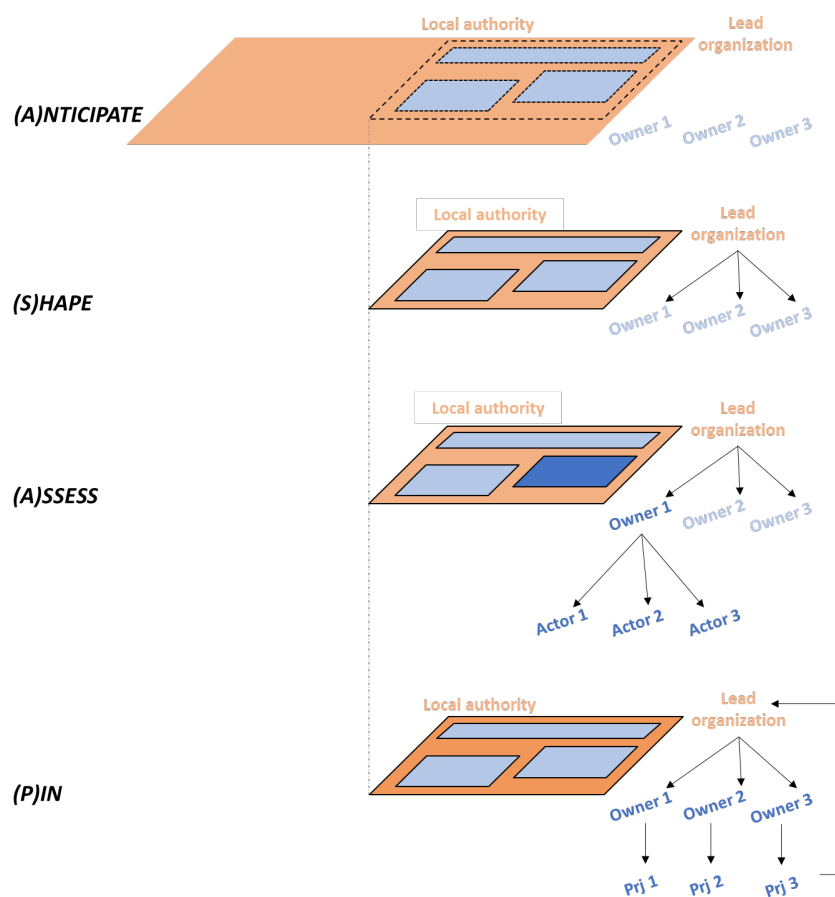


Figure 13 – Spatial and Organizational implications of ASAP model.

The four stages of ASAP are described in more detail in Appendix B for those who wants a more thorough understanding and to use it in practice.

3.2. ZEN KPIs in operation.

It is not only important that ZEN goals are properly formalized and managed, but parties must also **commit** to them. This requires the **awareness** of what ZEN means in an operational sense, and how projects could influence the desired performance of the whole. The **communication** and **reinforcement** of ZEN goals are also important actions to build ownership of them and the project.

We claim that **ZEN criteria and KPIs** could be used for these purposes of building commitment and awareness, and facilitating communication and reinforcement, as the industry typically does with BREEAM and other similar certification protocols.

Thus, we propose here a **table-like tool** (Table 2) where ZEN KPIs ((Wiik, Homaei, et al., 2022), updated to 2024 version before it was out) are displayed by rows and project's phases by columns. At the intersection, cells are colored to suggest whether the KPI might be only partially influenced (yellow), affected by important client's choices (orange), costly to affect (red), or too late to control for (grey) in projects. New windows of opportunities can also open (magenta). Thus, the tool suggests to which extent, when and how one might be able to control a project's output in terms of ZEN criteria and KPIs. Such interplay, which is suggested in the tool via a color code (yellow-orange-red-grey-magenta), must be **discussed and revised** at each project level, as each project has its own specificities. The tool is also included in the ZEN process guideline report (Rokseth et al., 2024) to ensure that KPIs are used with a steering purpose in projects.

The final objective of the tool is to ensure that the set of ZEN performance criteria can be used, across the ZEN organization, as a knowledge basis of the interplay between ZEN targets and design choices to:

- **formalize goals** and **commit** to them (i.e., **projects' mandates**),
- increase **project management** success (i.e., KPIs are addressed timely),
- have a **communication** tool helping everyone relate their work to ZEN and for the **onboarding** of new people. Pointing to ZEN criteria and KPIs build common knowledge and ownership.

The connection of the tool with existing processes (i.e., NS3567:2023, regulatory work and building permit application in Norway) is also specified in Table 2.

Legend of Table 2:






	actions carry out at this stage only partially influence the KPI.
	actions carry out at this stage entrap choices by the client that affect the KPI.
	actions carry out at this stage are possible but costly to control for the KPI.
	actions carry out at this stage are too late to control for the KPI.
	actions carry out at this stage can influence the KPI beyond the project's implementation.

Table 2 – The interplay between design choices and ZEN KPIs.

		NS3467:2023:										
		Ide	Frm	Prg	Skt	Pre	Dtl	Prd	Over	Use	End	
GHG	Emission reduction	GHG1.1 Materials										
		GHG1.2 Construction										
		GHG1.3 Use										
		GHG1.4 Operational energy use										
		GHG1.5 Operational transport										
		GHG1.6 End-of-life										
	Compensation	GHG1.7 Benefits and loads										
Energy	Energy Efficiency in buildings	ENE2.1 Energy need in buildings										
	Energy carrier	ENE2.2 Delivered energy										
		ENE2.3 Self-consumption										
		ENE2.4 Net load profiles										
		ENE2.5 Colour-coded carpet plots										
Power	Power performance	POW3.1 Peak load										
		POW3.2 Peak export										
		POW3.3 Energy stress										
		POW3.4 Representative days										
	Load flexibility	POW3.5 Delivered energy difference										
		POW3.6 Operational cost difference										
		POW3.7 Energy stress difference										
		POW3.8 Peak load difference										
Building Form and Land Use	Density and land use mix	URB4.1 Population density										
		URB4.2 Block density										
		URB4.3 Land use mix										
		URB4.4 Access to diversity of amenities										
	Building layout	URB4.5 Dwelling type										
		URB4.6 Multifunctional building roofs										
		URB4.7 Active frontages										
	Street network	URB4.8 Street connectivity										
		URB4.9 Street intersection density										
		URB4.10 Walkable and bikeable streets										
	Green open space	URB4.11 Share of green open space										
		URB4.12 Share of green permeable area										
		URB4.13 Preserving and planting trees										
Mobility	Access	MOB5.1 Access to public transport										
		MOB5.2 Travel time ratio										
		MOB5.3 Parking facilities										
Economy	Socio-economic	ECO 6.1 Investment cost										
		ECO6.2 Operating cost										
		ECO6.3 Residual value										
		ECO6.4 Sharing economy										
	Socio-environmental	ECO6.5 Sustainably sourced materials										
		ECO6.6 Circularity										
		ECO6.7 Environmental awareness										
	Environmental economic	ECO6.8 Cost of saved GHG emissions										

The tool should be adopted as early as possible to raise awareness of the choices on ZEN criteria and KPIs early enough, but it particularly helps in shaping ZEN development as part of the second stage of the ASAP model (i.e., ‘Shape’), which also correspond to step 3 of NS3467:2023. This is the latest point

where a commitment to ZEN should be made explicit. However, since the tool displays all the stages of NS3467:2023, it could be also used by projects to check if they are addressing design issues timely as part of the project management process.

3.3. Collaborative perspectives.

An effective ZEN development should include the definition of a supportive strategy to ensure that actions are pursued in a **collaborative** manner, as the interdisciplinarity of the ZEN definitions and related choices requires. Indeed, collaboration has been defined as a factor increasing the chances of success of ambitious projects. However, collaboration is influenced by different elements.

Learning from case studies, we claim that those elements refer to **goals, contracts, organization, and culture**, and they must be addressed from the early stages to enhance collaboration.

Thus, we propose a **table-like tool** (Table 4, in Appendix C, developed in (Vergerio & Knotten, 2024b)) suggesting several elements that were found to affect collaboration, posing challenges, or playing as success factors, in connection with projects goals, contracts, organization and culture. Such elements are differences, clarity of goals, prioritization of goals, top goals, clustering of actors, owners/clients' involvement, early involvement of relevant parties, economics, requirements, experience with technical solutions and tools, duration of the project, tools, needs of involved parties, process management, project environment, trust, ownership over goals/projects, attitude, roles and power of involved parties. A shorter and simplified version of Table 4 is reported below (Table 3).

Table 3 – The elements affecting collaboration in projects and how to address them.

Goals	Clear and transparent goals, linked from the program to the project. Prioritize the goals, and if necessary, link them to bonuses for the involved organizations.
Contracts	Define contracts and execution models that makes it possible for the actors to influence the project choices. Clarify responsibilities and roles early in all organizations of the ZEN program. Acknowledge the risk of ZEN and share risk and reward throughout the organizations.
Organizations	Agree on a collaboration- and information process to be used in the ZEN. Provide tools and training. Use and empower ZEN champions to effectively achieve the goals.
Culture	Plan and invest in the culture of the ZEN program and projects. Enable inter project learning. Work and secure that trust is an important part of the culture, both through contracts and actions.

The tool should be adopted as early as possible to build awareness over the elements that affect collaboration in connection with goals, contracts, organization, and culture. It is good practice that the elements are addressed as early as possible, but they should also be followed up throughout the implementation of the project, up until the end of construction (step 6 of NS3467:2023).

The full version of Table 3 is reported in Appendix C for those who want a more thorough understanding and to use it in practice.

4. Z.En in practice

For a better anchoring to practice, we recommend having the ZEN organization (Figure 10, Figure 13) in mind when adopting the Z.En in real-world projects. Moreover, examples of ASAP-actions as they were experiences in selected pilot projects of the FME ZEN Research Centre could help in the same way. They are collected in this chapter together with the feedback from various stakeholders on Z.En in general and ASAP in particular.

4.1. Examples from pilots

The examples in the following are based on previously published literature connected to FME ZEN Research Centre and on a new ZEN report on pilots (Thomsen et al., 2024).

(A)NTICIPATE

A **stakeholder analysis** highlighting networks has been developed for Nyhavna ((Vergerio et al., 2024), Figure 2), where links represent the influence of actors' decisions and behaviour on each other, suggesting that goals alignment and collaboration are needed to pursue ZEN. The network illustrates the complexity of the panorama of stakeholders and the centrality of some actors, whose involvement is important for sharing of information and strategies, as they affect the overall delivered performance and an informed decision-making process.

Among the stakeholders, the presence of resilient land and project **owners** and ambitious developers has been a driver toward ZEN implementation in *Ydalir* and *Flytårnet* and *Oksenøya (Fornebu)*, respectively. Thus, their involvement through dialogues has been very important (see below).

Despite the key role of project owners, it is rarely the case there is just one recognized organization at the **lead** of ZEN realization. Such a circumstance (i.e., one clear leading party) can be more likely to happen when there is a single ownership, like in campus *Evenstad*, or an ambitious municipality who organizes a governance model for the project. Example of the later comes from *Ydalir* or *Nyhavna*, where the municipalities established a new agency/company in charge for the development, including engagement, regulation, and communication. For an effective leadership, tools to follow-up on ambitions are important. In connection with *Sluppen* pilot, a tool¹¹ to incorporate GHG considerations in future planning work was developed by the municipality of Trondheim.

Examples of **competences** involved early in the process can be found in *Nyhavna*, where a conceptual study for the energy systems was prepared by a consultancy company in the very early stages (Asplan Viak, 2021), and *Ydalir*, where researchers conducted early LCA on alternative scenarios (Lund et al., 2019). A good collaboration with ZEN researchers has been considered a driver toward ZEN realization from the municipality of Bærum in connection with *Flytårnet (Fornebu)*. In *Ydalir*, **implementing parties**, i.e., developers, were involved early in a conceptual study phase that led to the definition of a common masterplan, basis for voluntarily agreements (between municipality and another existing landowner) or land development contracts (between municipality and developers, purchasing land). In the same pilot, as part of the public procurement process for the school and kindergarten, construction firms and suppliers were invited into dialogue conferences before formal tendering. The same was done

¹¹ <https://sites.google.com/trondheim.kommune.no/kdpsluppen/klimanorm-for-sluppen>

with potential developers and contractors in setting up a public-private partnership agreement for mixed housing development (Hamdan, De Boer, et al., 2021).

Dialogues took multiple forms in ZEN pilots, including pre-tender conferences and conceptual study phase, in *Ydalir*, and participatory activities, such as the ones promoted by the Bodø ByLab project and the public-private partnership forum connected to *Bodø* pilot. Another platform to build dialogues and citizen engagement was established in connection with *Sluppen*, organized by the municipality in collaboration with +CityxChange¹².

These types of platforms encourage **innovation**, as opportunities for co-creation and learning. In *Ydalir*, it was documented that the conceptual study phase based on workshops gave the actors a common understanding of the complexities and challenges associated with the development of green neighborhoods (Hamdan, De Boer, et al., 2021).

The importance of clarifying **financial resources** and **levers** is motivated by the experience of several pilots – Enova funding was critical in enabling innovative products and processes, such as the micro energy system for *Furuset*, the procurement of a conceptual study for the energy system at *Nyhavna*, or the workshop-based conceptual study phase at *Ydalir* (initiated after receiving support from Enova).

The planned *Fornebu* Metroline will contribute to making the area an excellent one for zero-emission mobility solutions. Securing such **decision areas** can be crucial for a ZEN success.

The collaboration among landowners to develop the neighbourhood infrastructure together at *Ydalir* can be considered an example of **preliminary agreement**. However, this is only indirectly related to ZEN (it is a ZEN pilot area, but it happened before ZEN masterplan was defined). The agreement between a municipality-owned development agency and a private owner to follow the masterplan for the area is a more comprehensive case, also connected to *Ydalir*. We can argue that the establishment of an agency or company dedicated to the development of the area is an action of agreement to collaborate in ZEN in itself. The establishment of new companies has been experienced in connection with *Ydalir* and *Nyhavna* pilots. This was done by the municipalities, which are the main landowners. The involvement of other owners is such organizations would be a further element of discussion in future projects, as well as the alignment between company's vision and mission and ZEN goals and how to work with them.

(S)HAPE

The central action of this stage is the break-down of the program into **sub-projects**. In *Ydalir*, the whole neighborhood project has been broken down into 19 different subdevelopment projects with different owners, developers, and timelines. Same in *Fornebu*, the pilot has been broken down into two main parts: Oksenøya and Flytårnet. Each of these parts are divided into different subdevelopment projects. For example, Tårnkvarvalet is one of the subdevelopment projects in Flytårnet.

Regarding commitment to ZEN by selection of **criteria** and **KPIs**, *Ydalir* has selected the GHG emissions, energy, and mobility as the main criteria to target in the masterplan. The masterplan is attached to land development contracts, where possible. Continuous dialogues and follow-up are

¹² <https://cityxchange.eu/>

encouraged to guide developers in the interpretation, which might differ among actors (Hamdan, De Boer, et al., 2021).

There are not examples of cases where specific ZEN goals have been bound to a **bonus** system, but incentive mechanisms have been considered in the context of ZEN pilots experience. A plan to implement a non-mandatory environmental program was documented in connection with *Sluppen*, as (Hamdan et al., 2023) notes. The target are ambitious developers, who are awarded more points in procurement the more they are willing to deliver beyond the current minimum requirements.

A similar logic could be connected to ZEN goals – the more you target, the better you are placed in tendering. In *Ydalir*, incentives were not related to goals but rather to competences – the choice of skilled (thus, expensive) advisors and team members by contractors were not considered a disadvantage in the price competition in public procurement (Hamdan, De Boer, et al., 2021).

It is hard to document any explicit discussion on what the critical projects within ZEN pilots are, which should be an essential question when discussing program **feasibility** and **risks**. However, it became obvious that for *Nyhavna*, for example, the study, design, and delivery of the local energy systems are critical link in the chain. In the quality program for the area, the municipality establishes that a plan for the energy system and infrastructure must be drawn up before detailed regulations can be implemented. A secure and independent energy system was also a key element for the success of *Evenstand* pilot, which required collaboration with the supplier of the energy system.

Regarding **final agreement**, the same examples reported above on preliminary agreement could be mentioned. It is also worth mentioning, as a potential form of agreement, that the municipality sub-plan (Norwegian: KDP) for *Nyhavna* includes a suggestion to the city councilor to consider establishing a joint venture among owners, tenants, and other relevant stakeholders in the area. It is important that a similar initiative comes with a careful discussion on the connection between overall program and individual projects goals.

(A)SSESS

Collaborative models of implementation have been preferred in *Ydalir* for the development of the school and kindergarten projects, which “allowed for more interaction and dialogue during the project development process” and “gave the project team more room to think comprehensively about the project’s solutions and specifications” (Hamdan, De Boer, et al., 2021). The project was indeed considered as a success - delivered faster, within budget and with very few conflicts. Collaborative contract models have been already recommended for *Nyhavna* as well (Trondheim Kommune, 2021).

Different pilots such as *Ydalir*, *Fornebu*, *ZVB* computed different **ZEN KPIs** based on their selected main criteria. **Revisions** have been introduced in the masterplan of *Ydalir* based on the feedback received from the evaluation of the ZEN KPIs.

Pilots will contribute to reduce **uncertainties** thanks to the testing of advanced and innovative technologies for energy supply and storage, like in *Bodø* and *Furuset*.

(P)IN

Binding mechanisms were experienced as public-private land development contacts in *Ydalir*, and the same is likely to happen in other pilots in future. Similar requirements should be reflected in contracts among private landowners and developers and their executive parties, to ensure that the commitment to ZEN is preserved at all levels.

In the so-called ZEB Laboratory, a building pilot from FME ZEB, the final delivery included an advanced monitoring system as **long-term strategy** to keep delivering benefits. Indeed, this system can assist building operators in making informed decisions, while also encouraging the users to a wise and aware use of the building. As a matter of fact, the system also enables the accurate assessment of energy production and demand, measuring the capacity of the building to outweigh its emissions and meet the zero-emission target.

The benefit of lessons learnt (which should be **documented**) are obvious for *Evenstand*. Statsbygg being the project owner, the potential is significant – the experience gained can be transferred to their portfolio consisting of approximately 2000 buildings in Norway. The experience with different procurement models in *Ydalir* has already been transfer to new phases of the project (Hamdan, De Boer, et al., 2021).

Political anchoring of ZEN was experienced in connection with, among others, *Nyhavna*, *Fornebu* and *Bodø*, via the municipal quality program, the KDP, and the municipal plans for climate and energy planning, respectively. This does not solve the problem of actual realization, as implementation rely on (often voluntary) follow-ups by ambitious developers, but such plans are a good starting point to look for the necessary support at top levels. In *Mære*, the motivation is rooted in a need for the whole agricultural sector (i.e., reducing its direct climate impact by 5 million tons by 2030), encouraging the realization of similar projects.

4.2. Stakeholders' perspective

The concepts discussed in chapter 2 and 3 were presented in an online workshop in April 2024 to collect feedback from partners and to anchor the idea to practice. Participants were representatives of Statsbygg, Trøndelag county, Nyhavna Utvikling AS, Elverum Vekst AS, Bærum municipality, Bodø municipality, Multiconsult, as well as NTNU and SINTEF Community. What all participants (except for NTNU and SINTEF) have in common is their potential role as lead organization for a ZEN development and the involvement in a ZEN pilot. During the workshop, the focus was on the ASAP model and on its implementation as a tool to work with ZEN goals.

First, ASAP (put in the context of the overall framework) was introduced at a general level to understand whether the partners would find it useful to support ZEN realization and whether they are using similar processes.

Participants believe that ASAP resembles the processes they are already working with, so it should and could be merged with them. However, they also point out that ZEN is often made of many processes at once, which makes it hard to have one single framework to describe them all. Building such a framework is ambitious. Nevertheless, ZEN includes both planned and emergent initiatives, which we should be able to capture and balance, and requires communication and coordination with many actors. Thus, having a common framework as something to come back to, always on the background, and to use it to

involve the parties and to get everyone on the same page is useful, and they would use ASAP if they had to start a new ZEN development.

ASAP was later presented in more detail, action by action (final version presented in Table 1) in the context of the planning and building process (Figure 12). The objective was to collect comments on the actions included and discuss how the actors could imagine performing them.

This activity opened the workshop into a broader discussion on what are/would be the drivers for ZEN realization and what are the main challenges/barriers. Drivers and challenges touched recurrent topics and are summarized in Figure 14, also based on follow-up comments/discussions within FME ZEN Research Centre. Of course, the lack of a driver translates into a barrier, as well as a measure to address a challenge builds up a driver.

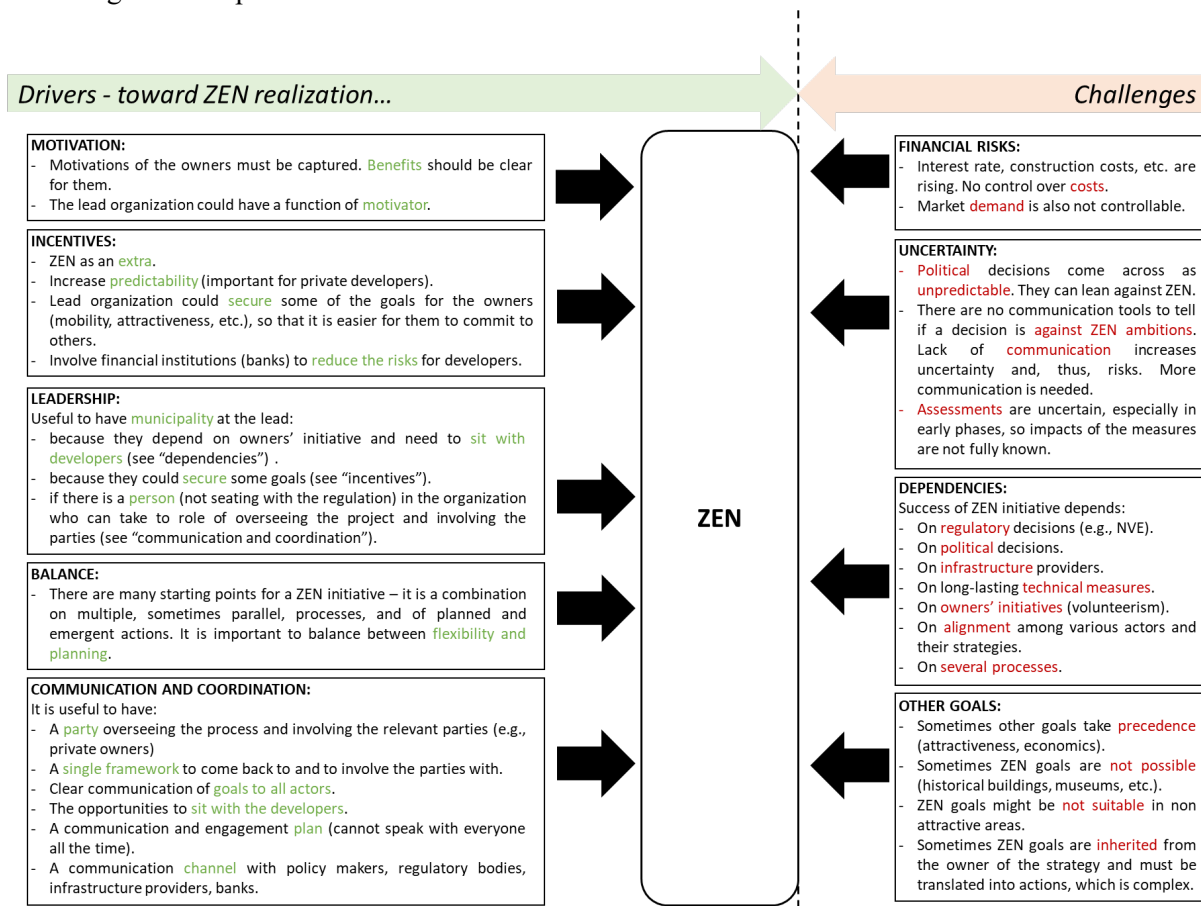


Figure 14 – Stakeholders' perspective: drivers and challenges of ZEN realization.

To encourage ZEN realization, it is essential that benefits are clear to **motivate** the owners, because, where it is not the landowner, the municipality depends on their initiative. Lack of motivation is today a challenge. **Incentives** for the owners/developers would be increased predictability and the reduction of risks. More actors should be involved (e.g., banks) to search for measures to reduce the financial risk for developers. A lead organization should have a function of motivator, but also increase the predictability by, for example, securing some goals (e.g., mobility, attractiveness, etc.) for the owners.

However, it is rarely the case that there is just one organization in a **leadership** position. According to our results, having the municipality at the lead would be useful because they have a need to sit with the owners (as they depend on their initiatives) and because they could secure some of the goals. An enabling factor for this to happen is that there is a dedicated person in the organization (not directly involved in the planning) who takes care of the process of involving parties and oversees the whole development. Indeed, ZEN has many starting points, there are many parallel initiatives and processes – **balancing** planning and flexibility is an important element to capture both planned and emergent activities.

Because of this fragmented nature of a ZEN development, **communication & coordination** are important drivers, and their lack represents a barrier. This could be guaranteed by having dedicated people in the organizations involved, as well as one single framework always in the background. Such framework would also allow better communication of the goals to the various actors. Lack of communication is a challenge today. It is essential that communication is planned, and that special communication channels are opened to reduce uncertainties (e.g., with policy makers, regulatory bodies, infrastructure providers, banks).

There are variables that are outside the control of a project, such as costs, market demand, etc., which are increasing the **financial risks** for the owners. Similarly, political decisions, which are outside the control of the projects, come across as unpredictable, and this is an additional **uncertainty** increasing risks for the owners. Certain political decisions could drive against ZEN ambitions, but there are not tools to measure and communicate this. Setting goals and ambitions requires early assessments, which are also uncertain, so impacts of the measures are partially unknown. Uncertainty and risks are also connected to the high level of **dependencies** that characterizes ZEN development. ZEN realization depends on decisions at the political and regulatory level. Moreover, a missed delivery by infrastructure providers or non-aligned owners can compromise the whole project. The municipality, as potential lead organization, cannot force the owners to choose certain goals¹³, but could work in the direction of building incentives, namely the conditions for the owners to be willing to commit to ZEN (motivator role).

Last but not least, **other goals** can take precedence over ZEN goals, for example economics, or they are important must-have if ZEN goals should also be target, like attractiveness. This makes ZEN projects not always suitable and localization a critical factor requiring more attention. Moreover, ZEN goals might be the goals of a super-ordinated organization and, once inherited by actors down the line, such goals must be translated into measures and actions, which is a complex task. The complexity is also related to the fact that impacts of the measures are not fully known yet and their provision might require long time.

¹³ According to the current interpretation of the law, there are not legal basis for plan provisions setting energy and environmental targets that are stricter than the Norwegian building code (i.e., TEK) (Junker et al., 2022).

Because Z.En should be of guidance for the lead organization to address important success factors for ZEN realization, we made sure that ZEN Enabler rises the attention of the important topics that emerged through the workshop, including:

- Multiple actors, their influence and strategies.
- Goals and motivations of the owners.
- Risks (economics, uncertainty, different interests, dependencies, ...).
- Process management.
- Communication and engagement.
- From goals to actions.

Results from the workshop are further discussed in terms of open challenges towards ZEN realization in the discussion and conclusion (chapter 5).

5. Discussion and concluding remarks

In this report we have wrapped up some of FME ZEN Research Centre experience concerning organization- and process- related aspects of ZEN development (chapter 2), including the introduction of a new framework (section 2.2) supporting the lead organizations, with the involvement of relevant stakeholders, toward realization thanks to the so-called ZEN Enabler, or Z.En (chapter 3).

The ambition was to define one single framework to come back to whenever there is a need for clarity on the overall process and on the enabling actions for ZEN. Indeed, as we learnt from the pilots and the stakeholders' perspectives (chapter 4), ZEN realization is often made of many processes at once, and coordination and communication are considered key success factors toward ZEN realization (Figure 14). Thus, the need for coordination and communication could be the main driver to the deployment of Z.En, in general, and ASAP in particular, with all its recommended actions (Table 1). Adopting Z.En at the beginning increases the chances that the following conditions are met:

1. **Goals** can be well managed throughout the process because:
 - processes occurring at the overall neighbourhood level are taken care of by running necessary analyses, involving stakeholders, and formulating ZEN goals.
 - processes occurring at project level are taken care of by steering decisions and securing them, anchoring ZEN.
2. All involved organizations have access to operational knowledge on the ZEN definitions as the basis to support expression and execution of **mandates** on them.
3. **Framework** is taken care of to enable collaborative perspectives in ZEN projects by addressing the elements that affect collaboration.

However, because there are multiple ways to perform the recommended actions, Z.En does not tell you how to do them, but only that they should be attended to in order to increase the chances of success and effective project execution. Stating the actions is important to build awareness over the processes, but many challenges are hidden behind their implementation, which again requires further attention.

Some of the **challenges**, as they emerged thanks to ZEN stakeholders' perspectives (section 4.2), are generally discussed here to rise their attention, including motivation, plan provisions, external variables, and uncertainties, and stakeholders' interaction.

A great portion of the uncertainty in ZEN developments comes from the dependencies among the underling projects, where the fall out of a critical project or owner can cause the failure of the whole. Z.En encourages discussion and follow-up around this topic from the early stages. However, a successful outcome of this process is largely dependent on the **motivation** and willingness of the owners to engage and commit.

According to the current interpretation of the law, not even municipalities, as possible lead organization, has the opportunity to set requirements that are stricter than building regulations via **plan provisions** in overall and detailed plans to enforce ZEN realization. (Junker et al., 2022). Unless there is only one owner, the alignment of intentions is hard to achieve.

Even when there is just one owner, dependencies are not absent, and they refer also to **external variables** that the projects do not have control over, such as market dynamics, political, and regulatory decisions.

Nevertheless, it is almost never the case that there is only one owner, as infrastructure providers are always key stakeholders in ZEN development. Innovative solutions required from suppliers are associated with longer processes and more **uncertain knowledge** on the actual impacts of such solutions. The same problem affects, more in general, all estimations in the early stages, where data are either not available or based on assumptions. However, such estimations are of key importance in the process of setting the goals.

Because of such a variety of actors, disciplines, projects, etc., involved and their interdependencies, **stakeholders' interaction** is crucial to preserve goals, decisions, and information. Project procurement and procurement processes are important arenas for stakeholders' interaction during projects development, if properly utilized. This is where a relationship between purchasers and suppliers is established, and where goals should typically be translated into requirements, which can be a difficult task, in case of partially unknown solutions as those needed for ZEN project.

In the face of all these challenges, we recommend that:

- More attention is given to the identification and communication of the **benefits** of realizing a ZEN for owners and other actors, including users, as a motivation to engage and commit.
- We leverage on the **experience** of ZEN pilots to understand how ZEN realization can be anchored via planning tools, as done in Ydalir, through a joint master planning as basis for detailed regulations, or by Bærum kommune, with guidance on ZEN development for Fornebu through municipality sub-plan (Norwegian: KDP). Nyhavna is also experiencing the definition of a common environmental strategy for the area.
- If lead organization has no power to require certain targets to private owners, a focus should be on building motivating conditions, i.e., **incentives** – e.g., sharing the burden on some of the targets, addressing other goals (e.g., attractiveness, qualities for the users) that the projects cannot solve individually and that are influencing the sustainability of the realization. Localization becomes a critical topic to address. One could also argue that bringing clarity about the processes can be a motivation, as it reduces the frustration of the actors involved.
- More attention is given to build platforms for the **communication** among actors influencing ZEN realization, such as funding institutions, banks, regulatory bodies, policy makers, developers, energy system suppliers, innovation partners, etc. to understand each other's strategies since the early stages.
- More attention to **procurement** processes, involving suppliers and procurement departments of purchasing parties early and with a clear mandate. Previous research has shown that procurement departments of potential lead organizations (e.g., municipalities) in ZEN are not sufficiently involved and do not have a clear mandate on ZEN projects, where project managers often take over the role, and a clear purchasing strategy is missing (Hamdan et al., 2023). On the other hand, early involvement of suppliers in implementation has proven to be a success factor in innovative projects, to have the right competences at the right time, and to find optimized solutions when there is still room for changes (Vergerio & Knotten, 2024b). More attention should be given to understanding each other's perspective for a better interaction among purchasing and supplying parts.

The political perspective and the important topics that we should address for ZEN realization is discussed in ZEN process guidelines (Rokseth et al., 2024). More about the problem of uncertainty in assessments and on the topic of communication can be found in policy recommendations for ZEN.

In conclusion, we would like to stress that the deployment of Z.En, in general, and ASAP, in particular, could also happen at a more general level, as a reminder of a sequence that is handy **at all levels** (both political and design decisions, both neighbourhood and building plans): **anticipate – shape – assess – pin**. The integration with current existing processes should be discussed in each organization interested in realizing ZEN projects.

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Appendix A – Using Z.En

This Appendix provides guidance for using the current report and put the Z.En in practice in the form of a check-list tool.

Depending on your role in a ZEN project, you might want to use this report in a different way.

If you are...	... you should use the report to...
Lead organization	<ul style="list-style-type: none"> • reflect on the ZEN organization (Figure 10). • deploy Z.En, starting from ASAP-model (Table 1). • define a deployment strategy for ASAP (Figure 13) to involve relevant party in ZEN realization. • be aware of the elements in a project that can have an impact on the capacity of the organizations to collaborate in ZEN (Table 4).
Owners & developers' organization	<ul style="list-style-type: none"> • understand your potential role towards ZEN realization (Figure 10). • relate to ASAP process (Figure 13). • be aware of the goals (Table 2) to be addressed when selecting your project team. • be aware of the elements in a project that can have an impact on the collaboration capacity of the project team (Table 4).
Executive party	<ul style="list-style-type: none"> • understand your potential role towards realization (Figure 10). • relate to ASAP process (Figure 13). • relate your work on the project to ZEN goals and ambitions via the ZEN KPIs (Table 2). This will help: <ul style="list-style-type: none"> ○ communicate the goals throughout your organization and/or the project team. ○ select the appropriate competences. ○ increase the project management success. • be aware of the elements in a project that can have an impact on the collaboration capacity of the project team (Table 4).
Researcher & regulatory body	<ul style="list-style-type: none"> • learn about Z.En (chapter 3) and further investigate and discuss the topic of project/program management, governance, planning, and building process for ZEN realization.

Ultimately, the report should help the deployment of an Enabler for ZEN (i.e., Z.En). Putting Z.En in practice means, to a great extent, asking the right questions at the right time.

In this Appendix, the questions to be asked are summarized as a practical checklist for the lead organization to follow to ensure the implementation of Z.En, element by element:

- ASAP model,
- ZEN KPIs in operation, and
- Collaborative perspectives.

For a better understanding of the context and the questions, please refer to the relevant sections of this report, which are specified in the following.

ASAP model (ref. section 3.1 and Appendix B)

The ASAP tool is a 4-stage process (**Table 1**), called Anticipate – Shape – Asses – Pin, to ensure, primarily, effective goals management. The typical questions to address in connection to its implementation are presented step by step.

Anticipate: A mapping and preparatory stage to preliminary agree on a neighbourhood program informed by context, ownership status, opportunities and needs, organization model etc., including **owners' goals**. TIPS: Typical questions to address in this stage are:

- What needs is the development responding to? Are they addressed in the strategic goals for the neighbourhood?*
- What are the stakeholders and what are power, interests, relationships? Are all the relevant ones properly involved?*
- Is there a shared understanding of what is the lead organization? Is there one?*
- How are future neighboring transformations influencing the development? Is this being discussed?*
- What is the planning and ownership status of the area/alternative ones? Is it clear?*
- Are all owners involved in the planning and programming process?*
- What are the opportunities for the area/alternative areas? Can we build synergies with ongoing processes for smart management of resources? Is this being discussed?*
- Are the benefits to develop a ZEN articulated and communicated to the different stakeholders?*
- Have dialogues with relevant stakeholders been initiated?*
- What are relevant competences and possible implementing parties to involve at this stage? Is it clear?*
- What are the financial resources and levers supporting the project? Are they clear and transparently communicated?*
- What are the lessons we can learn from other projects to encourage innovation? How can we leverage on workshop, visualization, and joint learning activities to build innovation? Is this being discussed?*
- How should this specific ZEN development be organized and governed (e.g., collaboration, procurement, etc.) to encourage innovation? Is this being discussed?*
- Are important decision areas non directly related to ZEN anchored for follow-up?*
- Is there a preliminary agreement among relevant parties? Does this provide all useful information about the development (e.g., map of owners, opportunities and resources, etc.)?*

Shape: A collaborative programming work between lead organizations and individual developers to formulate the goals, at both levels, i.e., neighbourhood and individual projects, and in connection. This should finally result in individual **projects' mandates** (i.e., what individual projects can and should deliver). TIPS: Typical questions to address in this stage are:

- What are the trade-offs among competing goals or actions? Have they been clarified, and priorities and principles set for future decision-making?*
- What is the contribution of the individual project to the overall program? Has it been made explicit enough?*
- What are the external and internal risks to the program? Are they clear? Is the neighbourhood program feasible? Has this been verified in collaboration with individual projects?*
- How should risks be allocated/shared? Have risks been discussed?*
- Have the projects clearly committed to ZEN and identified the ZEN criteria and KPIs to target?*

- Are projects' goals clearly stated and formulated as 'action + what + where + how'?*
- Have (voluntary) bonuses been distinguished from (mandatory) goals/requirements and bonded to incentive systems?*
- Are all owners on board with the ZEN program by now? Is there an agreement in place, with goals and relationships specified?*

Assess: An iterative process happening at the level of each individual project building up a ZEN to guarantee that **sound decisions** are taken (based on the KPIs assessment). TIPS: Typical questions to address in this stage are:

- Are individual projects preferring collaborative models for implementation?*
- Can the actors in the individual projects effectively exploit their competences and influence the choices?*
- Do the individual projects have a good climate for innovation?*
- Are the projects working with multiple design options on the table to ensue optimization?*
- Are ZEN KPIs computed at building (under responsibility of developers) and neighbourhood (under responsibility of lead organization) level to choose among alternative options?*
- Are internal risks (i.e., potential obstacles) identified in each project and feasibility kept in check to agree on potential revisions of the goals?*
- Are projects deploying Choose by Advantage (CBA), or similar methods, to compare alternatives?*
- Are the projects performing necessary exploratory actions to mitigate uncertainties?*

Pin: A set of actions following the results of the assessment. The objective is to secure decisions and their effects in each project in such a way that that can be followed-up, including documentation of the **lessons** learned. TIPS: Typical questions to address in this stage are:

- Do the project teams have proper competences to follow-up on ZEN goals?*
- Are the project teams translating the ZEN goals into design solutions?*
- Are the project teams formalizing controllable factors to meet the goals?*
- Are there binding mechanisms (e.g., contracts and specification) to ensure that projects' decisions are followed-up?*
- Have critical projects being contracted, with plan and cost, for execution?*
- Is there a strategy for the effects of the projects' choices to keep delivering benefits on a long term (e.g., management strategy for the use phase)?*
- Are there effective routines to document strategies, as lessons learnt for new projects/phases?*

See **Table 1** and **Appendix B** for the full description of the recommended actions of ASAP.

ZEN KPIs in Operation (ref. section 3.2)

The tool (**Table 2**) is a table representing the interplay between ZEN targets (in terms of KPIs) and design choices in a project lifecycle. ZEN KPIs are displayed by row and steps of a project life by column. The tool can be used to formalize goals and commit to them, increase project management success, and communicate goals for onboarding and ownership creation. It must be revised in each new ZEN development, as each project has its own specificities.

TIP: Typical questions to be asked in connection to the use of the tool are:

- How do the choices of the projects influence a ZEN performance? Is the tool, in its original form, reflecting those interplays accurately for this specific ZEN project?*
- What should each building program include?*
- Are we addressing design issues timely to control for the final performance (ZEN KPIs)? And have we onboarded the necessary expertise to do that?*
- Are we using ZEN criteria and KPIs in the communication of the goals? Are they reinforced throughout the planning and building process?*

See **Table 2** and ZEN process guidelines ((Rokseth et al., 2024), in Norwegian) for more details.

Collaborative perspectives (ref. section 3.3 and Appendix C)

The tool (**Table 3**) is a table suggesting several elements that were found affecting collaboration positively or negatively throughout a project lifecycle and since the early stages. Elements are presented by row and steps of a project life by column. The tool can be used as a set of warnings and recommendations to enable better collaboration when dealing with goals, contracts, organization, and culture.

TIPS: Typical questions to be asked in connection with the adoption of the tool are:

- Are goals clearly formulated and not just visions?*
- Are goals describing an end state and not a process?*
- Are goals being prioritized?*
- Did we define goals versus bonuses to encourage innovation?*
- Are goals reinforced while the development progresses?*
- Are we addressing differences and conflicts of interests?*
- Are the program/project owners sufficiently involved?*
- Are roles and responsibilities being clarified?*
- Are the tools being agreed upon and effectively communicated?*
- Are we involving the right competences at the right time?*
- Do we have ZEN champions in each organization as permanent interfaces to coordinate the process and exchange knowledge among projects?*
- Is the economic framework clear, in balance with ambitions, and transparently communicated?*
- Are we working to onboard parties with the purpose and build ownership?*
- Are we taking care of the people?*
- Are we discussing trust?*
- ...

See **Table 3** and **Appendix C** for the full list of recommendations.

Appendix B – ASAP (extended information)

In this appendix we propose ASAP as a tool. The four stages of ASAP are described in more detail specifying *WHAT* they entail for *WHOM*, *WHY* it is important from the two different *PERSPECTIVES* of neighbourhood program and building/infrastructure projects, which *ACTIONS* should the relevant parties (i.e., authority, lead organization, developers, etc.) perform and *WHEN*.

(A)NTICIPATE

WHAT: It is a mapping stage, consisting in the **analysis of the context** in terms of, among other things, needs and opportunities. Relevant **stakeholders** (including owners) must also be identified and engaged. The attention is on the start-up, with necessary preparatory actions, of a ZEN development and of the individual projects under its umbrella.

WHY: The final objective is that a preliminary neighbourhood program is based on the awareness of the context (i.e., needs, opportunities, stakeholders, interests, expectations, etc.), including formalized lead organization's & **owners' goals**. Such awareness is important to make sure that the development will be well accepted throughout its entire life and that it will bring value to the different actors, including final users.

WHOM: For the scope of this stage (neighbourhood), one can expect that the actor mostly concerned should be the **lead organization**. However, also individual **developers** should be concerned by these actions at the individual projects' level. Given the strategic nature of the stage, the **local authority** also plays a role.

ACTIONS: The actions must include the development of demographic analysis, stakeholder analysis (based on power-interest matrix), needs assessment, and consultation plan, with the final objective to ensure users' involvement and to enable co-creation and innovation within a ZEN development ((Wiik, Homaei, et al., 2022), pages 13-17). We additionally suggest that both **lead organization**, at neighbourhood level, and **developers**, at building/infrastructure projects level, make sure that:

- **Stakeholders' analysis** is performed via alternative methods depending on decision area and stage. For example, a network analysis¹⁴ could be preferred as it helps putting an emphasis on the relationships between the actors, illustrating the need for dialogues or partnerships. Networks must also include actors delivering recourses such as knowledge (e.g., research institutions) and finances (e.g., funding institutions, banks).
- Analysis of the context also entails the collection of knowledge of the **ownership** of the area, as it affects how the development will be organized, and an effort is put in engaging with the owners and to understand their goals (see also section 3.3).
- There is a shared understanding of what is the **lead organization** that, as owner and manager of a ZEN program, is a key actor.

¹⁴ As an example, a stakeholder analysis based on network was produced for Nyhavna pilot, in Trondheim, in a former ZEN report (Vergerio et al., 2024).

- **Competences and implementing stakeholders** are started to be selected and involved (see also section 3.3). As a preparatory action, the selection of suitable suppliers and partners for collaboration and risks sharing to (for example) form procurement consortia with, is recommended (Hamdan, Andersen, et al., 2021). Selection of competences is very important - multidisciplinary teams should be built, with early involvement of relevant competences, e.g., energy specialists (Trulstrup et al., 2023).
- Analysis of the context also entails the collection of **knowledge of the planning status** for the area/s (existing programs and plans and their status, sequential requirements, etc.) and of the neighboring ones, as they can affect the future performance of the neighbourhood and its parts. The analysis entails, as much as possible, discussions around the possible uncertainties, meaning the **transformations** and how they can impact the development under discussion.
- Analyses of the context also entails the **exploration of the opportunities**, with a special focus on those for follow-ups from running projects and on smart resources management. For example, analysis of the market for used materials, of pre-existing buildings, of multifunctional areas/buildings should be performed to plan for reuse and for joint use of resources. Moreover, we encourage to think about connections between ZEN ambitions and other potential goals, as realizing a ZEN could bring other **benefits**, which should be clearly communicated.
- **Dialogues** are planned (consultation and communication plan) and needed communication channels opened, (e.g., with all owners, policy makers, regulatory bodies, infrastructure providers, etc.) to reduce the uncertainties due to the high dependence of ZEN realization on external and complex decisions. Dialogues with market players could be established in connection with the exploration of opportunities. Dialogues should also include potential implementing parties, also in the context of pre-tender (Hamdan, 2021), (Hamdan, De Boer, et al., 2021).
- **Innovation**¹⁵ is **encouraged** through explorative behaviours. Search for experience and lessons from outside the ZEN development (or from connected projects that have been already completed) and encourage activities such as workshop, visualization, and joint learning (Hamdan, 2021).
- A preliminary idea on the **financial resources and levers** (incentives, funds, loans, etc.) should also be formulated and transparently communicated (see also section 3.3). This should be in line with the level of ambition for ZEN.
- **Decision areas** that are **not directly connected to ZEN** but important for its success (e.g., qualities for the communities and users, attractiveness) must be anchored for follow-up to make sure that the process do not lose track of them due to the focus on ZEN¹⁶.

¹⁵ Innovation is also promoted by choosing suitable forms of organization and governance for ZEN, based on integration, early involvement of relevant actors (including owners), supportive procurement systems, etc. (Hamdan, 2021) (see section 3.3).

¹⁶ The PI-SEC wheel (Nielsen et al., 2018) gives recommendations in this sense in the context of Smart Energy Community (developments where the core decision area is the energy strategy scenarios), suggesting establishing a so-called 'Core of Community' description.

- **Preliminary agreements** to collaborate in ZEN among relevant parties are formalized and can include some outcomes from the actions listed above (owners map and their goals, consultation and communication plan, map of opportunities and benefits, financial resources/levers, etc.).

All these actions should help the lead organization to draft a preliminary program with strategic goals for the neighbourhood development, and the developers of the individual building/infrastructure projects under its umbrella to relate to it in framing their own goals. All owners and developers and the relevant parties should be on board with the vision, via preliminary agreements, by the end of this stage.

Political anchoring of ZEN in municipal strategies and plans is outside our scope, but this is when it should be already happening, especially if the lead organization is the **local authority** itself. Consultations are a valuable instrument in this phase, and before, to allow ambitious private actors to influence the discussion and bridge the distance between public and private actors, which has been observed in ZEN pilots (Hamdan et al., 2023). In particular, anchoring decisions not directly connected to ZEN but important for its success (e.g., qualities for the community and users, attractiveness of the area) can build an incentive for the owners to commit to ZEN and reduce the uncertainty around political decisions and transformation.

PERSPECTIVES: From a ZEN **program** perspective, it is important to refer to a specific area of the city and that strategic goals are informed by the awareness of the contextual elements and of stakeholders' interests and power, including owners' goals, which cannot be ignored and should be linked to ZEN. From a **project** perspective, this is the stage where it is important that the building/infrastructure plan of the different developers is checked against the programming and planning status for the area, including connection with ZEN vision.

WHEN: Some of these actions are typically performed at the political level (e.g., municipal plan strategy), which is outside the scope of this report. Within a ZEN implementation, they should take place before any regulatory work at the individual building projects level has started. We can think of this stage as correspondent to **steps 1 and 2** in NS3467:2023 for individual building developments. Indeed, this is the stage where the owner/s must have some preliminary ideas on the financial resources, plots availability and specialists who will be needed in future projects' teams and own organization (e.g., more competences in some fields, more preliminary studies, more management capacity needed, etc.). All these aim at being equipped to handle the complexities that will start to arise while moving on into the development process.

Other relevant actions connect this stage to the rest of Z.En – all parties should:

- **Beware the effects on collaboration** of goals, contracts, organization, and culture. See section 3.3 of this report.
- Ensure **communication** of ZEN goals and continuous **onboarding**. See section 3.2 of this report.
- Beware the **effects of choices on ZEN** criteria and KPI. See section 3.2 of this report.
- Ensure KPIs are used as common knowledge basis to draw a vision for ZEN. See section 3.2 of this report.

(S)HAPE

WHAT: It consists of a collaborative programming work between lead organization (interested in a final program for the area) and individual developers (doing programming for their projects) to negotiate on the **contribution of individual projects** building up the overall development. This requires some elements to be clarified, such as goals/requirements (including underlying trade-offs), ambitions/bonuses, ZEN program's risks (including critical projects and interdependences), and projects' interfaces.

WHY: The final objective is to formalize the framework for the discussion for future decisions and to properly formulate the goals, at both levels and in connection. This should finally result in individual **projects' mandates** (i.e., clear definition of what individual projects can and should deliver).

WHOM: In this stage, all organizations have a role as drivers. Both **lead organization** and individual **developers** should be concerned by the actions of this stage. Collaboration between the lead organization, on one side, and the individual developers of the projects, on the other, is of key importance. The **local authority** preserves a supervision function because of its regulatory mandate.

ACTIONS: The process of shaping entails the following actions performed collaboratively between **lead organization** (neighbourhood program) and individual **developers** (building/infrastructure programs):

- Possible **trade-offs** in terms of competing goals (or courses of actions) are identified at the neighbourhood level first, and **priorities** set by the lead organization after hearing the relevant parties¹⁷. When such trade-offs occur throughout the projects, it must be clear which is the criteria to be prioritized. The lack of priorities was found to be a challenge in collaboration efforts (see section 3.3). The task can be managed with the support of the example in Box 1.

Box 1. *Example - Goals formulated for the neighbourhood are showing conflict.*

Trade-off identification:

Goal a) "Increase the block density -ZEN KPI- without comprising the population density -ZEN KPI- in the plots by planning for tall buildings" and Goals b) "optimizing availability of solar radiation in the public spaces in winter by admitting only buildings below 5 floors".

Priorities selection:

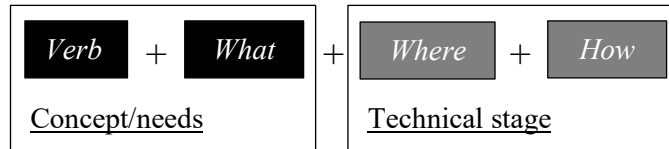
If compromises or clear value judgement are not possible, a priority can be chosen based on *robustness*, hence, replying to the following question: *which course of action shows more compatibility with other choices for the neighbourhood?* For example, one could think that having tall buildings is compatible with/keep open three other choices, such as having more permeable areas, green spaces, active frontages, while the choice of short buildings close them out and fits only with one, for example not interfering with other local landmarks.

- The overall development is specified as the result of individual projects that are **broken down** based on currently enforced regulatory instruments (e.g., Norwegian: KPA, KDP, reguleringsplan), if available, plots ownership status, sequential requirements, possible public or private projects/developments already ongoing, etc., as mapped in the 'Anticipate' stage.

¹⁷ This could be done by setting up processes for collaborative weighting on different areas of decisions with the involvement of the parties, directly or indirectly, affected by the project.

The practice of breaking down ZEN into modular projects¹⁸ is supported by previous research on program procurement (Hamdan, De Boer, et al., 2021).

- It is ensured that **goals** are **properly formulated** for the neighbourhood and for individual projects. Indeed, goals should represent an end state, and not a process, and they should be measurable. A way to express them can be the following (Del Savio et al., 2022):



The ‘where’ and especially the ‘how’ aspects (technical stage) will be further elaborated and specified at each individual project level, but general directions should be given here. This strategy for goal formulation allows to clarify expectations, and, if done using ZEN criteria, to steer the projects towards the achievement of ZEN goals (and awarding of related points). In the next stages of projects life, all choices must be checked against these goals and assessed via the ZEN KPIs (see ‘Assess’ stage).

- Goals at neighbourhood and project levels are connected to ensure that the contribution of the individual projects is made explicit. This is done thanks to **feasibility** studies iterated between neighbourhood and building level programs together with the definition of **risks**, internal and external to the ZEN program. Risks can affect the feasibility of the programs. As a consequence, needs for revisions in the programming and planning status for the area should be identified. The work must be informed by the studies performed in the ‘Anticipate’ stage.

NB1: External risks are interfaces that cannot be fully anticipated and/or controlled (e.g., changing of contextual variables, like political decisions, development of the neighboring areas, etc.). They must be identified based on the uncertainties (transformations), as they can impact the future behaviour for the neighbourhood as a whole. Internal risks are defined as potential obstacles within the neighbourhood program, threatening the achievement of its goals, and they include the interdependencies between projects within ZEN. Such **interdependencies** should be clarified here, and supply chain specified, including common assets. In this context, projects are identified as critical and non-critical ones. The critical are the ones from those the whole depends (e.g., energy system), and, as such, they require a particular attention as they are critical link in the chain.

NB2: Discussion on risk is not only important to ensure feasibility, but also because it affects trust, collaboration, creativity, and innovation. As an owner is ZEN you should be ready to take more risks than normally, i.e., to **share risks** with your executive counterparties (program owner with projects’ owners, in this stage, and project’s owner with main contractor, down the line). Thus, the discussion on risks should include opportunities for risk sharing in collaborative settings (see also section 3.3).

- If not done before, a **commitment to ZEN** is made explicit by **selection ZEN criteria** and **KPIs** to target at neighbourhood and building/infrastructure levels, based on the formalized goals and on the level of control that the specific development can have on them. The tool presented in section 3.2 can be used for this purpose. Also, the selection must be informed by the studies

¹⁸ The definition of sub-projects should clarify the architecture (ZEN ambitions and goals, supply pyramid), the interfaces (information and knowledge exchange, partners, shared assets, ...), and standards (common requirements and KPIs) (Hamdan et al., 2023), as ‘Shape’-actions encourage.

performed in the ‘Anticipate’ stage and keeping in mind the potential neighboring transformations there identified.

- **Ambitions** are separated from goals and translated into bonuses by the mandating parties (see also section 3.3). While goals are translated into expected requirements, bonuses are connected to an incentive system, where the implementing counterparties (individual projects’ owners for the lead organization, in this stage, and main contractors for the projects’ owners, down the line) can voluntarily chose to address them to have process (e.g., faster processing time) or economic (e.g., more money, more points in a tender) advantages. This is also supported by literature (Hamdan et al., 2023), where such good practice was mapped in connection with a ZEN pilot.
- Among goals/requirements and ambitions/bonuses, the ones that are considered ‘**tradable**’ are identified. They are those that can be transferred to another party (which must be identified), if following feasibility studies reveal that they cannot be achieved within the scope of a certain project.
- Final **agreement** between lead organization and developers to collaborate in ZEN is set up. The agreement should clarify the goals and the relationship between the two levers: lead organization and ZEN program, on one side, and developers and projects’ programs, on the other.

All the described activities should help clarifying, in relevant arenas (e.g., start-up meeting) priorities from the lead organization and contributions from developers as basis of the projects’ mandates and must involve the stakeholders identified during ‘Anticipate’ actions for the decision areas that concern them.

The **local authority**, under its regulatory mandate, can supervise this process as part of the regulatory work, in the so-called start-up meeting (part of the Norwegian ‘plansak’), which indeed is an occasion for criteria clarification, for negotiation on alternatives, and for checking projects’ consistency with the planning and programming status of the area. Needs for revision are normally identified here.

Political anchoring of ZEN in municipal strategies and plans is outside our scope, but this is when it should be already happening, especially if the lead organization is the local authority itself. It is often the case that plans for the area are not in place. In this case, (joint) master planning¹⁹ could be used here as a strategy of coordination among the multiple owners and actors, as suggested by previous research work (one of the principles for program procurement according to (Hamdan, De Boer, et al., 2021)).

PERSPECTIVES: From a ZEN **program** standpoint, it is important that there is a clear definition, from the lead organization and through a collaborative programming work, of how the individual projects are expected to contribute to the whole and which common driving principles/priorities should be there for future decision-making. From an individual **project** perspective, since this is the stage where the requirements are shaped, it is important that expectations are checked against the overall neighbourhood program in order to define needs for its revision and to agree with the lead organization on the individual projects’ goals (translated into requirements) and ambitions (which can be attached to a bonus system).

¹⁹ In ZEN pilot Ydalir, “a master plan was developed that formed the basis for preparing the detailed land use plans and provided guidelines for the implementation of ZEN ambitions in the various development projects” (Hamdan et al., 2023).

WHEN: These actions should be performed at latest at the beginning of the regulatory work of each building project (i.e., start-up meeting of regulatory work). The stage can be aligned with **step 3** of NS3467:2023 of individual projects. Indeed, this is when the projects' owner/s should define feasibility, success criteria (as basis for the definition of minimum requirements versus bonuses), a first draft of the implementation strategy, participation strategy, etc.

Other relevant actions connect this stage to the rest of Z.En – all parties should:

- **Beware the effects on collaboration** of goals, contracts, organization, and culture. See section 3.3 of this report.
- Ensure **communication** of ZEN goals and continuous **onboarding**. See section 3.2 of this report.
- Beware of the **effects of choices on ZEN** criteria and KPI at all stages. See section 3.2 of this report.
- Ensure KPIs are used as common knowledge basis to support the **drawing** of, and **commitment** to, projects' goals in connection with ZEN. See section 3.2 of this report.

(A)SSESS

WHAT: It consists in **assessing individual projects** with the programs in mind. The attention is on individual projects, which has been unrolled for sketch and preliminary projects, and on whether they manage decisions in accordance with ZEN goals and ambitions.

WHY: This is an iterative process, whose final objective is to make sure that **sound decisions** are taken in each project, meaning that the choices are referring to the overall framework agreed upon.

WHOM: Individual **developers** are the ones mostly concerned by the actions since they are now the main process drivers (i.e., holding most of the capacity to monitor and change the process to achieve a result in each project). The **lead organization** maintains its function of overseeing the whole. The **local authority** preserves a supervision function because of its regulatory mandate.

ACTIONS: To ensure sound decisions in the individual projects, individual **developers** (through the procurement of their project delivery teams) should timely ensure that:

- **Collaborative models** of implementation are preferred. This can favour good discussion in the project, such that owners and executive parties can align on project's requirements, and decisions are better informed by early involvement of relevant competences/suppliers. For good collaboration, other elements should also be addressed (see section 3.3).
- "Firms involved in project delivery team can use capabilities to create a favorable climate for **innovation** during the design and construction, such as competencies, key individuals, and flexibility" to support innovation (Hamdan, 2021).
- Compatible **options** are defined with an open mind for innovation, and choices are made in accordance with the driving principles defined before (e.g., *robustness*, see Box 1 above).

- Relevant building/infrastructure-levels ZEN **KPIs** are computed through estimations²⁰ and simulations and used as basis to make choices among alternative options.
- Project teams use **Choosing by Advantage** (CBA)²¹, or similar methods, to compare alternatives.
- **Internal risks** (i.e., potential obstacles) per each project are further specified based on the new information because they can impact the feasibility of the formulated projects' goals. Need for revisions is discussed.
- **Uncertainties** are taken care of by drawing possible exploratory actions to manage them (e.g., new competences, studies, agreements, dialogues etc.).

The **lead organization** must timely ensure, enforced by the agreement with the developers, that:

- In all building/infrastructure projects the **activities above are performed** or provide for centralized management capacity to support some of these activities.
- **Feasibility** of the overall program is kept in check while the projects progress. Need for re-negotiation of 'tradable' goals must be identified before it is too late.
- Relevant neighbourhood-level ZEN **KPIs** are computed through estimations and simulations and used as basis to make choices among alternative options.

All these actions together should guarantee that sound decisions are taken (based on the KPIs assessment) at each project level and that relevant arenas are used to assess and negotiate on those.

The **local authority** beside being (potentially) the lead organization, has also a regulatory mandate as responsible for the quality of the overall urban development. Thus, it is entitled to verify that the projects are consistent with the programs. This can be done via plan proposal for regulatory work and pre-conference for building permit (at a preliminary project stage), but also framework permit, and start-up permit, depending on the stage of the process of the individual projects. They indeed are occasions for negotiation on alternatives and possible revisions. The authority can also point out the need for performing an updated stakeholder analysis, reinforce their involvement, connect with relevant interlocutors (e.g., mobility players) and interfaces (e.g., new projects neighboring ZEN).

PERSPECTIVES: The **project** perspective is the one that should be mostly adopted from this stage in order to progress in the projects by staying consistent with the programs. From a ZEN **program** perspective, which is owned by the lead organization, it is important that proper arenas are used for the purpose of checking and negotiating such consistency.

WHEN: The 'Assess' actions will typically happen iteratively throughout the entire life of each individual project, hence, from projects' **steps 4 to 6** in the NS3467:2023, also in light of what has been discussed in the previous stages at the individual project level.

Other relevant actions connect this stage to the rest of Z.En – all parties should:

²⁰ We acknowledge that in innovative project such as ZEN, the assessment are uncertain, meaning that the impacts of the measures are not fully known yet. As a consequence, come uncertainties and risks will remain.

²¹ [CBA: A Decision Making Method](#), as described by the Lean Construction Institute.

- **Beware the effects on collaboration** of goals, contracts, organization, and culture. See section 3.3 if this report.
- Ensure **communication** of ZEN goals and continuous **onboarding**. See section 3.2 of this report.
- Beware of the **effects of choices on ZEN** criteria and KPI at all stages. See section 3.2 of this report.

(P)IN

WHAT: It consists of actions to ensure that all projects' **decisions are pinned**, secured for follow-ups and for actual exploitation of their benefits on the long term.

WHY: The final objective is to **secure** the decisions and their effects (via management strategies/organizations/funds of, e.g., green spaces, join services, etc.). Over time, by documenting the measures put in place, **lessons** on mechanisms and strategies are collected and can be transferred to new projects/phases.

WHOM: To ensure that decisions can be followed up and benefits maintained, projects must have certain characteristics. Because of its function of overseeing the whole, it is the **lead organization** who should check that this is the case, by involving relevant **developers** and their project teams. **Local authorities** can also oversee this stage.

ACTIONS: The **lead organization** should involve the **developers** under the scope of the agreement set in 'Shape' stage to make sure that in all individual projects:

- The project **teams** have competences on ZEN ambitions, translate ZEN goals into design solutions, and formalize controllable factors (i.e., actions that can be taken in project management to ensure that projects' goals are met) to follow-up on the decisions.
- There are **binding mechanisms** according to which the decisions taken at each level must be followed-up (e.g., contracts specifications).
- Critical projects have been **contracted** (e.g., shared services), and, thus, money allocated (Plan & Cost for execution).
- There are in place **long-term strategies** to ensure that the effects of the decisions are lasting over time (e.g., projects have management strategy post-occupation).

It must also:

- **Document** adopted strategies (e.g., funding schemes, development models, competences involved, etc.) to make sure that lessons learnt can be passed further, enriching the knowledge on opportunities for the next development/phase when it will be prepared in a new 'Anticipate' task. 'Exchanging' successful practices with a broader ecosystem is supported by previous research to ensure innovation in Sustainable neighborhoods projects (Hamdan, 2021).

All these actions together should guarantee that securing mechanisms are in place and that relevant arenas are used to document and lock critical decisions.

The **local authority**, as landowner, shall also secure these aspects through development agreements with owners/developers (as part of the regulatory work) and in procurements contracts with new owners/developers or services/materials suppliers, depending on the ownership status and the stage of the process. The local authority also has a regulatory mandate, and as such can use regulatory and building permission processes (Norwegian ‘plansak’ or ‘byggesak’), depending on the stage of implementation of a project, to check whether choices’ follow-up is guaranteed by selected development models, competences, and materials and suppliers’ specifications in pre-conference, framework permit, and start-up permit, respectively.

PERSPECTIVES: As in the ‘Assess’ stage, the **project** perspective is the one that is adopted to ensure that decisions at this level are secured for follow-up in all projects of the neighbourhood. From a **ZEN program** perspective, which is owned by the lead organization, it is important that proper arenas are used for this purpose.

WHEN: The ‘Pin’ actions will occur at each project level to secure strategic decisions, thus from project **step 4 to 6** in the NS3467:2023.

Other relevant actions connect this stage to the rest of Z.En – all parties should:

- **Beware the effects on collaboration** of goals, contracts, organization, and culture. See section 3.3 of this report.
- Ensure **communication** of ZEN goals and continuous **onboarding**. See section 3.2 of this report.
- Beware the **effects of choices on ZEN** criteria and KPI at all stages. See section 3.2 of this report.

Appendix C – Collaborative perspectives (extended information)

In this appendix we propose Table 4, developed in (Vergerio & Knotten, 2024b) as a **table-like tool** suggesting several elements that were found to affect collaboration, posing challenges, or playing as success factors, in connection with projects goals, contracts, organization and culture.

Such elements are differences, clarity of goals, prioritization of goals, top goals, clustering of actors, owners/clients' involvement, early involvement of relevant parties, economics, requirements, experience with technical solutions and tools, duration of the project, tools, needs of involved parties, process management, project environment, trust, ownership over goals/projects, attitude, roles and power of involved parties.

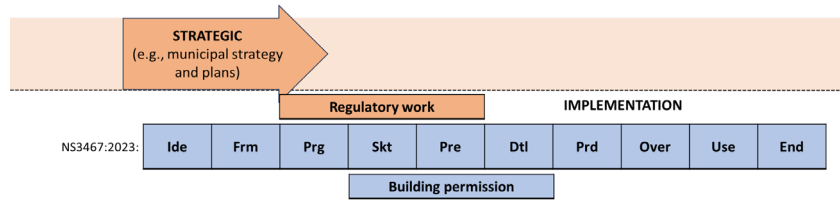
All have an implication on the collaboration capabilities of the ZEN organization as a whole and, thus, on its success. In the tool (Table 4, in Appendix C), they are displayed by row, described in the context of collaborative perspectives, and addressed via recommendations concerning the whole programming and designing process.

The tool can be seen as a set of warnings and related recommendations to be used across the ZEN organization, when working with goals, contracts, organizations, and culture, with the final objective to build a supportive framework for the project by **enabling better collaboration**.

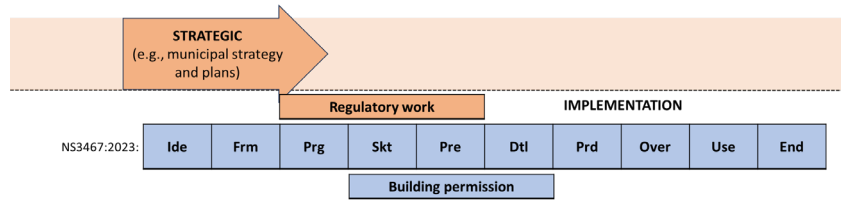
The connection of the tool with existing processes (i.e., NS3567:2023, regulatory work and building permit application in Norway) is also specified in Table 4.

Table 4 – The elements affecting collaboration in projects.

		NS3467:2023:									
		Ide	Frm	Prg	Skt	Pre	Dtl	Prd	Over	Use	End
Goals	<u>Differences.</u> In visions, interests, etc., among parties can be a challenge in collaboration.	Make a goal hierarchy linking overall ZEN goals with the goals of all participating building projects.									
		Find a common language to speak about vision and goals for the building/district across stages.									
	<u>Clarity of goals.</u> It is considered a success factor in project for an effective collaboration.	Plan for an extra effort at the start of ZEN to clarify goals.									
		Make sure that goals are properly formulated (e.g., about a final status and not a process, measurable, etc.) and not only visions/ambitions.									
		Make sure that goals are properly communicated and reinforced throughout the process.									
	<u>Prioritization of goals.</u> If lacking, the potential for effective and efficient allocation of resources (including work on collaboration) is hindered.	Define priorities through discussion between ZEN project's owner (e.g., local authority) and building projects' owners/developers.									
		Make a goal hierarchy linking overall ZEN goals with the goals of all participating building projects.									
	<u>Top goals for the project.</u> Having them is considered a good practice as a common ground to stretch the project until it meets high performance.	Define goals versus bonuses (also in combination with the economic framework).									
		As an owner in ZEN, reward innovation.									
		As an owner in ZEN, take more risks (i.e., share risks with executive parties). Risks allocation impacts innovation and creativity.									
Contracts	<u>Clusters of actors.</u> Caused by power/interests and roles dynamics, affecting collaboration.	Define collaborative models for ZEN that allows all the parties to influence the project choices, when relevant, and make sure this is reflected in the contract arrangement in terms of stated roles and responsibilities.									
	<u>Owner/client involvement.</u> It is considered a success factor in projects, as owners are the main decision-makers, and should then take part to the collaboration effort.	The presence of multiple owners, both private (e.g., developers) and public (e.g., municipality, mobility players), is a challenge in ZEN. An effort should go in involving all owners in the process, as critical decision makers. E.g., mobility players in programming.									
	<u>Early involvement of parties.</u> It is considered a success factor as it guarantees access to knowledge and information and to have solutions tested.	Plan for involving the parties in ZEN early enough to exploit their expertise, and make sure this is reflected in the contractual arrangement in terms of stated roles and responsibilities.									
	<u>Role identification of parties.</u> A challenge in collaborative models, as parties are involved in certain stages of a project for the first time or in a different fashion than usual, and they are not sure about their contribution.	It is important to define and clarify the roles of the different parties early with a clear mandate regarding their roles and responsibilities because, in ZEN, actors are asked to participate in stages they are not used to (e.g., developers in district programming).									



Contracts	<u>Economics.</u> In collaboratively setting the goals, it is what determines what it is possible to imagine for the project.	Be aware early in the process for ZEN that expectations and economic frameworks must be in balance.
		Financial resources for ZEN should be clarified, as the economics will be set by multiple owners. Infrastructure/services may depend on a common budget, which should be agreed upon. The budget should be transparent for all to commit on.
	<u>Requirements.</u> The alignment over them is considered a driver to collaboratively and interdisciplinary find optimized solutions.	Set requirements in projects within ZEN as the common ground. This implies that requirements at projects' level should be discussed as part of a collaborative programming work involving all projects of the district.
		As ZEN were never built before, acknowledge risks with fair agreements and plan for sharing and mitigation actions.
	<u>Experience with technical solutions and tools.</u> The lack of it can be a challenge and causing the withdraw of collaborative parties.	Plan for staged processes for ZEN.
		In order to follow-up on the whole project, plan for documenting decisions and routines.
		As people will change and competences potentially lost, plan for it and ensure continuous onboarding.
		Guarantee continuity on the follow-up of ZEN goals by appointing ZEN champions, centrally and at each project level.
		Communicate that duration can also be an opportunity to build more ownership, more time to talk to all parties about the goals.
		Stress that duration increases the potential for learning.
Organiza- tion	<u>Tools.</u> Of those supporting collaboration, there are well-know and newer ones, thus, different levels of competences in industry.	Agree on the collaboration, information processes and tools to be used in ZEN.
		Make sure they are effectively communicated.
		Provide training and onboarding to make sure that everyone can use them efficiently.
	<u>Needs of involved parties.</u> As they differ among actors, it is important that tools adopted in the collaboration process can accommodate for them.	As collaborative models in ZEN will bring different parties together in stages of the project that they are not used to (e.g., developers in district programming), make sure that they can all relate to the adopted tools (models, contracts, software, workshops, etc.).
Use standards and plans to use the tools across stages.		



Organiza- tion	<u>Process management.</u> It is considered a success factor in collaboration, such to have the right competency at the right time to solve issues.	Plan and manage the contribution of the different actors to the ZEN development. Include ZEN champions centrally and at each project level as interfaces to coordinate processes and exchange knowledge among projects.
	Culture	<p><u>Project environment.</u> It is enabled by collaboration (i.e., an atmosphere to ask questions, to make things work, for parties to commit to each other).</p> <p><u>Trust.</u> It is a fundamental element of collaboration and a key issue when it comes to culture.</p> <p><u>Ownership over goals/projects.</u> It is considered a success factor as it affects individuals' motivation in collaborative efforts and in projects.</p> <p><u>Grabbing the low-hanging fruits.</u> As a tendency in projects, it is a threat to ambitions.</p> <p><u>Roles and power of parties.</u> Those inherited from tradition influence the behaviours of the parties, affecting the way they collaborate (or not collaborate).</p>



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