# Is it possible to achieve a friendly and affordable urban district retrofitting?

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***Abstract:*** *The impact of the building sector on the environment is enormous: 40% of the overall energy consumption in Europe is related to the building sector and represents about 1/3 of Europe's CO2 emissions. More than 50% of all materials extracted from earth and 25% of all virgin wood are transformed into construction materials and products. It is necessary to improve the energy and environmental quality of the existing building stock that actually is not sustainable, to meet EU 2020 and 2050 energy, carbon and economic goals.*

*In order to meet these goals, 3% of the total EU building stock would need to be deep-renovated each year for the next 40 years. Renovation is a key strategy to reduce the energy impact of the building sector. Energy efficient retrofitting measures and their implementation at district level (i.e. district heating, heat island effect, PV installations, etc.) are showing more and more clearly that a building scale approach is not optimal in reaching significant and cost-effective improvements across both buildings and districts energy performance.*

*District retrofitting approach is frequently the most sustainable one taking advantage of the synergies among buildings, wasted energy exploitation, efficient use of renewable energy sources, cogeneration systems, and economies of scale. But the complexity of decision making grows exponentially when the intervention targets the neighborhood or the district scale, due to the larger number and wider variety of stakeholder interests involved. Furthermore, the increased complexity of decision making tends to become a barrier for innovative solutions. Is it possible to develop new methods and tools to make friendly and affordable the process of urban district retrofitting? The session will address this issue from the point of view of cities, research, software developers and users.*

*District, retrofitting, energy efficiency, urban sustainability*

**Introduction**

This paper considers the 2020 and 2050 challenges for a sustainable built environment in Europe, and the district strategy as a way to maximize the efficiency of retrofitting for a mass approach. The research framework is outlined in the first section. The three following parts of the paper detail the results of a study carried out among key stakeholders in urban retrofitting, to clarify their needs in order to enact friendly and affordable sustainable urban districts retrofitting. Finally, the last section offers a short overview of a proposed Integrated Decision Support Tool, a software developed to match the needs expressed by the stakeholders and support them in achieving the urban retrofitting targets.

The research presented in this paper and the IDST software are outputs of the EU FP7 FASUDIR project[1], funded by the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 609222.

**Research framework**

Previous results from research projects have shown that many isolated energy retrofitting interventions applied on single buildings would have been more sustainable if the surrounding neighborhood would have been taken into account. In some cases even negative impacts on the energy efficiency of other buildings and the district energy supply systems were caused. For example existing district heating grids often run less efficiently if the heat demand density of the supplied area is reduced by building retrofitting[2]. Therefore it is necessary to consider the total energy balance of urban neighborhoods before planning specific building retrofitting interventions. In order to avoid contrary interactions between energy retrofitting interventions at building and neighborhood levels, a centralized coordination is essential. Therefore, to create sufficient preconditions for building retrofitting interventions, the best way is to start with neighborhood retrofitting concepts. These concepts include, among others, a city model of the current state of the existing buildings and the surrounding infrastructure. Based on these, energy saving potentials and opportunities for the integration of renewables in the neighborhood can be estimated by creating retrofitting scenarios. Each scenario is evaluated according to its ability to increase the sustainability of the district by the means of ecological, economic and social issues. Moreover, neighborhood retrofitting concepts point out possible synergies and interactions between buildings and energy infrastructure. A holistic neighborhood scale approach thereby supports building owners, municipalities and energy supply companies in their decision making.

Light-house projects in different European countries have shown that the creation of neighborhood retrofitting concepts requires large expert knowledge and much time. A large amount of data about the existing buildings and the district morphology must be collected and processed in order to create neighborhood retrofitting concepts[3]. This work can only be done in an efficient way with adequate IT-support. The use of GIS systems in combination with building simulation software provides the necessary functions to create viable

neighborhood retrofitting concepts in an effective way. Nevertheless existing GIS tools and building simulation software basically are not designed to be used for neighborhood retrofitting concepts. Important aspects like life-cycle analysis (Life Cycle Analysis, Life Cycle Costs, financial mechanisms) and further sustainability issues cannot be assessed with them. Also the special requirements appearing at neighborhood scale, such as adequate consideration of the different stakeholders needs and citizen's participation, are not manageable with currently existing tools on the market.

Hence, further research work must be conducted with the purpose of developing a holistic methodology that is able to evaluate the missing aspects. The FASUDIR project is providing a comprehensive methodological approach to create sustainable neighborhood retrofitting concepts as well as a supporting platform for the implementation of the most appropriate scenario in real projects. Based on the developed methodology an "Integrated Decision Support Tool" is being developed. It can support planners of neighborhood retrofitting concepts in the concept development stage and the subsequent implementation stages of the concept. In the following sections we report the results of a wide-ranging survey undertaken in Italy, Hungary, Spain, Germany and Britain to understand more fully the profile and user requirements of Government, City and Planning stakeholders.

**Government Stakeholders**

In this section, the overall profile of the government representatives in the survey will be presented: the first subsection defines in detail the type of projects, related stakeholders, and key focus areas for governments; the second subsection deals with the specific objectives set by governments when participating in urban district retrofitting, and the indicators used to monitor their involvement; the third subsection details the financial perspective of the government stakeholder; the fourth and final subsection presents the needs of governments in order to successfully enact friendly and affordable sustainable urban districts retrofitting.

*Stakeholder overview*

One of the key stakeholders in urban retrofitting, government (both central and regional) usually deals with projects of public interest.

| *scope* | *buildings* | *inhabitants* | *owners* | *value (€)* |
|---|---|---|---|---|
| | 1-100 | 0-2000 | Gov/city/ Church/ private | 170, 000 to M5.3 |
| Barracks, Offices Hospitals | 80-100 | | 1 | 200,000 -- 1M |
| Schemes for retrofitting | 20-100 | 1000-2000 | | |
| Sustainable retrofitting, incl mixed social and private houses | Block to district scale | 20 to 600 | PPI | Max. 300-1500 €/sqm, |

*Table 1 – Characteristics of projects governments usually enact*

Governments are usually involved in urban retrofitting by defining and enacting policies and strategies, which bring them in contact with a variety of stakeholders.

| |
|---|
| General advice (for public and specialists). Technical research (for specialists) Demonstration retrofit projects (for public and specialists). Skills training and course development (for education sector). Policy advice at national, regional and local levels. |
| Users, Local Government and Municipalities, Experts at the Building Ministry; Building solution providers; Planners, Architects, ESCOs |
| Politicians, researchers, building solution providers |
| Regional authorities |

*Table 2 – Types of stakeholders with whom governments are usually involved*

Governments tend to favor the district approach, and focus on social aspects – by considering how to support bottom-up initiatives, and what high-level strategies to enact in order to support successfully the social needs of the large territories they govern, through careful top-down approach.

| |
|---|
| Retrofitting measures on district scale can have financial advantages like scaling effects |
| The public initiative is designed to focus on critical issues on the regional territory, and creating a unitary program that is of interest to other participants (municipality, private investors), for an effect of scale. |

*Table 3 – Reasons to plan on district level, for governments*

| |
|---|
| I believe that the top-down planning is successful if it defines directions, not certain solutions. Lately there were examples, and in all the cases the same mistakes appeared. The primary requirement is to properly develop the local conditions, habits, traditions, the genius loci and based on these investigations a specific, local development suggestion has to be made. (It might seem to be school-bookish, but regarding my experiences the planners consider the local analyses as a torture, or as a necessary evil. Another necessary evil for developers is the social involvement during the development process, although with proper tools (brainstorming is rarely successful) useful information can be collected from them. |
| The regional strategy informs all the planning and sets the key axes. We allocate funding based on size of cities (reserving a quota to smaller municipalities) and urban decay on a relative city scale, and follow a set of key sustainability indicators |

*Table 4 – Governmental strategies for top-down planning*

| |
|---|
| Vocation and altruism. representing the common interest against personal interests (e.g. in case of an apartment-block: there's an entrepreneur with his shop, he wants easy accessibility to his shop and a lots of parking lots while the community wants the street for pedestrians only). Unfortunately in Hungary very few bottom-up development sget to the realization phase. |
| Participation, "accompagnamento sociale" (social companionship – the community interacts constantly throughout the project) are key. It is crucial that basic critical issues are matched with work carried out, and that there is a capacity to re-discuss planning at urban level to provide the services necessary in the area (planning documents are often too old for a society that changes very quickly) |

*Table 5 – Success factors for bottom-up approaches, according to government*

*Stakeholder objectives*

The prevalent economic objective of governments is an overall, strategic improvement of economy, with less focus on financial issues and more attention devoted to sustainable development. Other objectives broaden further this perspective.

| |
|---|
| social contentment, local development of the economy and sustainable indicators |
| We enact matching funds for economical sustainability: the more funds the municipality can raise, the more funds the region provides; our main objective is to direct the housing market towards affordable rents |
| Tool should be based on the economic criteria from CEN/TC 350 standards and existing methodologies |
| Provide policy and technical advice concerning the historic environment |

*Table 6 – Economic objectives of governments*

| |
|---|
| aesthetic aspects, cost efficiency, employment |
| German Assessment System for Sustainable Building (BNB) for the retrofitting of governmental owned buildings include ecological and social aspects |

*Table 7 – Other objectives of governments*

When dealing with macro scale benefits, the governmental approach is quite varied – in some cases it is not taken into account at all, while others prefer to monitor a large range of indicators.

| |
|---|
| depends on the project |
| By environmental, social, economic indicators, monitored throughout the project |
| The BImA dos not assess the macro scale effects because it considers the retrofitting projects as isolated measures |
| Macroeconomic calculations conducted by research institutes |

*Table 8 - Assessing macro scale benefits of district retrofitting, according to governments*

*Approach to financing*

Governments appear to be the stakeholder that monitors financial metrics less closely, leaving the assessment of financial planning to the promoters and planners at the more local level.

| *Payback period?* | *How long?* | *Rate of Return?* | *Hurdle?* | *Others* |
|---|---|---|---|---|
| | | | | cost-neutral |
| | | | | LCC calculation |

*Table 9 - Economic and financial criteria used by governments*

Additionally, governments tend to face no financial risk, or rather displace it to the developers of urban retrofitting projects.

| |
|---|
| Not a concern when financing public entities (municipalities and social housing agencies), but we ask for sureties when financing private entities or cooperatives. |
| The BImA has no financial risks because it is financed by the German Government |

*Table 10 - Financial risk management for governments*

The most common source of financing by governments is through grants (which they either distribute or provide directly), together with bank loans, owner participations, and ESCOs.

| *grants* | *loans* | *owner* | *ESCO* | *tax incentives* | *others* |
|---|---|---|---|---|---|
| yes | yes | yes | no | no | - |
| yes | yes | yes | yes | | |
| 45% | | 55% | | | |
| yes | | | | | |

*Table 11 - Sources of financial funds for government projects*

*Stakeholder needs*

To undertake the complexity of urban projects, the government stakeholders highlighted as most useful the availability of an e-platform for communication, working as an information repository and offering decision support.

| e-platform | repository of information | decision-support | as back-up | help with negotiations | logistical tool |
|---|---|---|---|---|---|
| 8 | 4 | 4 | 2 | 1 | 2 |

*Table 12 – Helpful characteristics of an integrated decision support tool, for governments*

When defining the specific features of the decision support tool, government stakeholders offered a broad range of possibilities, with no strong preferences for alternative options. As an exception, there was a slight preference for testing user design solutions, over the possibility of model-prescribed options.

| | | | | |
|---|---|---|---|---|
| *high level insights* | 5 | VS | *more detailed* | 4 |
| *Easy to use* | 4 | VS | *more specialised functionalities for analysts* | 4 |
| *identifying the constraints (eg legal, planning, technical) for possible solutions* | 4 | VS | *guiding the weighting of multiple objectives* | 3 |
| *Ability to use live in a decision conference* | 1 | VS | *computationally intensive back-room research* | 1 |
| *decision support system that tests user proposed solutions* | 3 | VS | *model prescribed solutions* | 1 |

*Table 13 – Preferred features of an integrated decision support tool, for governments*

**City Stakeholders**

In this section, the overall profile of city stakeholders is presented: the first subsection defines in detail the type of projects, related stakeholders, and key focus areas for cities; the second subsection deals with the specific objectives set by cities when participating in urban district retrofitting, and the indicators used to monitor their involvement; the third subsection details the financial perspective of the city stakeholder; the fourth and final subsection presents the needs of cities in order to successfully enact friendly and affordable sustainable urban districts retrofitting.

*Stakeholder overview*

As the key manager of urban regions, cities are fundamental stakeholders, especially through their capacity for large scale planning and development.

| *scope* | *buildings* | *inhabitants* | *Owners* | *value (€)* |
|---|---|---|---|---|
| project development of public facilities | 3-4 | 0 | 1-2 | 450, 000 |
| Buildings, often blocks, with max of 10 | 500-1,000 | 100,000 | various | 400,000 |
| Renewal planning includes demolition and reconstruction | From 2-3 blocks to 2 Msqm | 20 to 15K | Large range | Large range |

*Table 14 – Characteristics of projects cities usually enact*

Cities are strongly involved with the local stakeholders, as the local government body, due to their capability for planning and project approval.

| |
|---|
| Relevant stakeholders in a municipality itself (eg the office of asset management, legal and public procurement, the decision making body etc). |
| Commissioning of the implementation of the retrofitting projects to the developing companies; Presentation of the projects in the city councillor |
| Review and approval after a proposal made by a private developer. |

*Table 15 – Types of stakeholders with whom cities are usually involved*

Cities by nature deal with district-scale projects, aiming towards a balance between supporting the local construction market and providing necessary public services. This balance is sought through compensational strategies and participatory efforts to involve the citizens.

| size, amount of concerned people |
|---|
| The city focuses on the identification of public interests, using the approval of private urban projects as a way to finance or realize public services: the so called “urbanization costs” can be either infrastructure realized by the private developer on behalf of the city, or a monetary compensation that the city further uses in other areas. Additionally, if a variant to the general urban plan is requested (e.g. a higher percentage of housing v tertiary) the city calculates the extra value that this generates for the developer in order to assess the compensation for the city (again to be used for public infrastructure). |

*Table 16 – Reasons to plan on district level, for cities*

| |
|---|
| The retrofitting measures must be consistent with the integrated city plans. Retrofitting projects can only be approved if they will not implicate an increase in rental fees |
| Proponents adhere to the regional framework, or they propose variants which the city assesses in order to evaluate compensations or integrations to align with the general objectives of the plan. |

*Table 17 – City strategies for top-down planning*

| |
|---|
| In some cases they are private investments, in other they fulfil public targets; in general it's fundamental that there is a participation and a feeling of belonging and ownership from the population towards the project |

*Table 18 – Success factors for bottom-up approaches, according to cities*

*Stakeholder objectives*

Cities interact directly with building owners, and often set specific targets as a support for political decision making and a communication tool with citizens. The financial aspect is not too relevant directly, but the effect on the housing market and the financial participation of owners are considered crucial – and therefore both important elements for policy definition.

| |
|---|
| improvement of energy efficiency -Thermal transmittance, BMR-,<br>the increase in the rate of used renewable energy sources- reduction of CO2 emission |
| Improvement of the energy quality of the buildings. Giving competent advisory for owners. Providing cost transparency for political decision making. Encourage the participation of building owners in the retrofitting projects |

*Table 19 – Economic objectives of cities*

| |
|---|
| Public interest, economic development, social inclusion, improvement of environmental conditions |
| Most important objective is the prevention of gentrification in the retrofitted districts<br>The rental fees should not be increased by the retrofitting measures. Social Stability<br>CO2-Emissions. |

*Table 20 – Other objectives of cities*

Cities appear to find their own methodologies to assess macro scale benefits, using a variety of instruments, with a preference for experimental approaches and case study exchange.

| |
|---|
| Experiences have shown that 1 Euro invested in retrofitting measures will leverage follow-up investments of 7 Euros. |
| We are participating in EU projects targeted at assessing urban performance (e.g. CLUE) in order to define best practices and monitoring strategies. |

*Table 21 – Assessing macro scale benefits of district retrofitting, according to cities*

*Approach to financing*

Cities implement different financial criteria, depending on the typology of project: in some cases, metrics are used to monitor projects undertaken by the cities themselves, while in others, financial performance is used as a way to choose between different proposals or to assign priorities.

| *Payback period?* | *How long?* | *Rate of Return?* | *Hurdle?* | *Others* |
|---|---|---|---|---|
| yes | < 10 years | yes | different | +ve NPV |
| no | | | | optimal cost-benefit ratio . |

*Table 22 – Economic and financial criteria used by cities*

On the other hand, financial risk is usually offset to developers, with cities taking a directional and monitoring role.

| Not a focus of city planning. |
|---|

*Table 23 – Financial risk management for cities*

Cities are often redistributing grants, and deal with private owners as main sources of funding (both as self-provided or obtained through loans). In some cases they involve ESCOs or enact tax incentives, depending on local law.

| *grants* | *loans* | *owner* | *ESCO* | *tax incentives* | *others* |
|---|---|---|---|---|---|
| yes | yes | yes | yes | no | - |
| | | Vast majority | | | |
| yes | Mostly | | rarely | yes | |

*Table 24 – Sources of financial funds for cities*

*Stakeholder needs*

City stakeholders highlighted the need for an e-platform providing decision support and back-up towards other stakeholders, related to their central role in decision making for urban projects.

| e-platform | repository of information | decision-support | as back-up | help with negotiations | logistical tool |
|---|---|---|---|---|---|
| 3 | 1 | 3 | 3 | 1 | 1 |

*Table 25 – Helpful characteristics of an integrated decision support tool, for cities*

For city stakeholders, several features of a decision support tool are equally valid. In particular, the possibility to identify constraints for the proposed solutions was considered very relevant, matched with a slight preference for testing user-proposed solutions. Additionally, city stakeholders expressed a slight preference towards back-room research, with results being proposed to project participants in a following step.

| | | | | |
|---|---|---|---|---|
| *high level insights* | 2 | VS | *more detailed* | 2 |
| *Easy to use* | 2 | VS | *more specialised functionalities for analysts* | 2 |
| *identifying the constraints (eg legal, planning, technical) for possible solutions* | 3 | VS | *guiding the weighting of multiple objectives* | 0 |
| *Ability to use live in a decision conference* | 1 | VS | *computationally intensive back-room research* | 2 |
| *decision support system that tests user proposed solutions* | 2 | VS | *model prescribed solutions* | 1 |

*Table 26 – Preferred features of an integrated decision support tool, for cities*

**Planning Stakeholders**

In this section, the overall profile of planning stakeholders is presented: the first subsection defines in detail the type of projects, related stakeholders, and key focus areas for planners; the second subsection deals with the specific objectives set by planners when participating in urban district retrofitting, and the indicators used to monitor their involvement; the third subsection details the financial perspective of the planning stakeholder; the fourth and final subsection presents the needs of planners in order to successfully enact friendly and affordable sustainable urban districts retrofitting.

*Stakeholder overview*

Including architects, urban designers, and energy consultants, the planners are a sizeable contingent in the stakeholder breakdown for district scale projects. They take the most active and direct planning role, implementing a wide variety of projects for diverse clients.

| *scope* | *buildings* | *inhabitants* | *owners* | *value (€)* |
|---|---|---|---|---|
| Energy Concepts | 1-6 | 100 | n/a | n/a |
| Project preparation | 1-5 | cca 700 | 90% privately owned apartments | na |
| integrated regeneration | 48 | 1200 | 300 | 12.83M |
| urban scale or district. | 5-15 on 90.000 – 250.000 m2 | retail or tertiary with 0-300; towns with 40.000 - 100.000 residents. | 1 to 5 | Up to 16M |
| district scale, incl former industrial areas | 20.000 to 1Mm2 | | | |

| | | | | |
|---|---|---|---|---|
| Energy concepts for cities | 1000 | 1000 | various | |
| Energy concepts for districts | 2,000-3,000 | 23,500 | various | 20M |
| Building solutions | Very wide | | | |
| refurbishment concepts | 4 | 50 | 40 | 560.000 |

*Table 27 – Characteristics of projects planners usually enact*

The types of stakeholders that planners interact with are the most varied – planners find themselves often at the center of a web of different interests, and are in dialogue with a variety of voices in society.

| |
|---|
| municipality, grant manager; engineers |
| Authority leading the tenders, municipality (deputy, committee, deputy-board), mayor's office, competent departments, authorities, inhabitants, NGOs, social service organizations. |
| Public administrations (politics and administrative official), certifying bodies, than developers, building firm, owners and final client. |
| Professional Associations, investors, building solution providers |
| Architects and building contractors |
| Users, Landlords, Communities, Owners, Building Solution Providers, Municipalities |

*Table 28 – Types of stakeholders with whom planners are usually involved*

As direct actors, often taking an intermediation role in urban planning, planners experience the complexity of matching different (and often diverging) needs, and the difficulties of harmonizing all the stakeholders involved in the different stages of a project, especially at district scale.

| |
|---|
| When working on district we usually have a significant construction project involving full remake of buildings and/or complete redesign of the architectural structures. In this case a retrofitting may be intended as substitution. On the other hand, when dealing with private buildings works tend to maintain the former use of the spaces and the works are lighter. |
| The use of synergies between buildings can improve the payback period. District interventions like heat networks are often more efficient than on single buildings |
| Of course the scale is so important in the way to approaching a project, its important the public space and facilities, and overall to go deep in the district way of life, neighbourhood, organizations, etc. |
| More people, more power, less costs for the whole project. But it is much more complicated because you need to communicate with a lot of people and listen to them. |

*Table 29 – Reasons to plan on district level, for planners*

| |
|---|
| The key criteria is to fit the budget-frame, technical solutions are tailored according to this; the project of course need to fulfil the legally binding energy performance criteria |
| In case of urban district retrofitting rehabilitation projects it is essential to suit the strategy accepted by the local municipality discussed with the local inhabitants. Mostly the purpose of a city is the proven future of itself in a wide range of aspects. Requirements and terms can be assigned to this aim, but it can't be described generally. |
| The fit of the project to the bigger picture is strictly necessary for its approval but more constraints come from officers and environment procedures. |
| The retrofitting projects must fit to the climate protection goals and the social environment |

| |
|---|
| in the district |
| The knowledge of the environment and the medium is basic, important to work from the beginning with people involved in the area, and not only urban planners, multidisciplinary teams [sociologists, economists, anthropologists] |
| Adhering to a city plan, whereby retrofit programmes or district energy networks are created to benefit the wider borough in order to unlock the site. Typically borough councils/planners are happy to accept a variety of solutions and approaches as long as the overarching objective is achieved in terms of carbon/energy efficiency targets. |

*Table 30 – Planners' strategies for top-down planning*

| |
|---|
| The participation of citizens and building owners from the beginning of the project 'Giving good information and advice to building owners about retrofitting measures, grants, loans etc." |
| The main factor is good communication and information of the building owners and the users. The final decision about each retrofitting project is made on building level by the owner. If they do not want to participate the whole district retrofitting project often cannot be implemented |
| In Hungary bottom-up district retrofitting projects cannot be found. There are market initiated retrofitted places, but those aren't district retrofitting projects. |
| The dialogue and link with the city, working with the local administration in order to be part of the development of the city, and not an autistic project. |

*Table 31 – Success factors for bottom-up approaches, according to planners*

*Stakeholder objectives*

Unlike public stakeholders such as governments and cities, planners have a strong focus on financial objectives, especially when acting as experts on behalf of investors. Related to the cost optimization objectives are the control of the project timeline, and life cycle costs. Additionally, planners tend to adapt further objectives (of environmental and social sustainability) to the financial constraints.

| |
|---|
| Realization of the project within the given support rate |
| Cost optimization defined by cost-benefit analysis, expanded for social aspects |
| Business targets vary from customer to customer. Usually the first goal is to maximize retail surfaces and volumes. Side aspects usually come later. |
| Ensure the economic efficiency of all proposed retrofitting measures |
| Capital cost, running costs (inc. maintenance), return on investment, local economic benefits |
| costs and returns |
| Economic performances of retrofitting measures; Payback time. |

*Table 32 – Economic objectives of planners*

| |
|---|
| Ecological performance;.Marketing (retrofitting useful for buildings with high vacancy rates);. Social aspects (no increase in rents including heating) |
| harmonization of different interests of various stakeholders |
| social contentment and the public interest |
| Another key performance index concerns the elapsing time to end the process. |

| |
|---|
| Finding the most energy efficient retrofitting solution for the whole district<br>Reducing the CO2-emissions as far as possible with the given financial framework |
| Avoiding gentrification by giving grants and tax incentives financed by the city<br>Keeping the climate protection goals of the Government for CO2 and energy demand<br>Increase the retrofitting rate from 0,8 % to 2,0 % per year |
| Try to contribute with our experience in similar projects to the growth of the team. Work with experts of other European countries |
| Carbon, energy, cost, technical or planning constraints, maintenance burden, operational performance, risk (cost/technical), extent of disruption to people and user interaction (usability considerations) |

*Table 33 – Other objectives of planners*

Conversely, the scope of planners does not usually include monitoring macro scale benefits, although case studies are useful when supporting a district project proposal.

| |
|---|
| Citizen surveys |
| Certainly retrofitting projects do bring macro-scale effects about, but we could not assess these effects. |
| Can be a claim in the neighbourhood in order to start new retrofitting projects around. These are very important factors to convince different stakeholders especially city and government authorities. |

*Table 34 – Assessing macro scale benefits of district retrofitting, according to planners*

### *Approach to financing*

Planners evaluate a variety of financial criteria, most commonly using the payback period (sometimes used as a given constraint, especially in projects with a strong commercial/private focus).

| *Payback period?* | *How long?* | *Rate of Return?* | *Hurdle?* | *Others* |
|---|---|---|---|---|
| yes | 10yrs | 4% | | |
| yes | | yes | | Collateral |
| | | yes | 7-15% | |
| yes | | yes | | |
| yes | | | | Owner |
| yes | 3-10 | | | |
| yes | 3-5 (commercial)<br>10+ (public) | | | |

*Table 35 – Economic and financial criteria used by planners*

The responsibility of planners extends also to the financial risk in their proposal, leading to a variety of strategies to manage future uncertainties.

| |
|---|
| We consider only a percentage of the costs related to any unforeseen event. |

| |
|---|
| We consider 10% more for the budget, but our aim is to make the project without this margin. Also we have a plan B for some constructive solutions in order to have an extra control tool. |
| Assess the economical return of the investment, trying always to think in our retrofitting as a new way adding value. |
| Future fuel costs, government changes in support levels, future legislation e.g. price of carbon, carbon reduction scheme liabilities |

*Table 36 – Financial risk management for planners*

Grants are a strong source of financing according to planners as well, with owners representing a sizeable quota of participation in urban retrofitting. The variety of projects brings planners in contact with a variety of different financing sources.

| *grants* | *loans* | *owner* | *ESCO* | *tax incentives* | *others* |
|---|---|---|---|---|---|
| yes | yes | partial | yes | yes, if any | - |
| Yes | yes | | rarely | | |
| yes 80-100% | no | municipality 10-20% | no | no | - |
| yes | no | yes | no | no | rents |
| | 30% | | | | |
| yes | yes | | | yes | |
| yes | | yes | | | |
| yes | | yes | | | |
| yes | | yes | | yes | |
| yes | yes | yes | yes | yes | |

*Table 37 – Sources of financial funds for planners*

*Stakeholder needs*

The creation of an e-platform is again considered very helpful, and while its decision support focus was again highlighted, planners also communicated the need for a transparent repository of all the history and development of the project, which might also be used as supporting evidence when negotiating with other stakeholders.

| e-platform | repository of information | decision-support | as back-up | help with negotiations | logistical tool |
|---|---|---|---|---|---|
| 7 | 3 | 4 | 1 | 3 | 4 |

*Table 38 – Helpful characteristics of an integrated decision support tool, for planners*

Finally, planners considered various features of this decision support tool to be relevant, preferring those elements that leave design freedom and act as supporting guidelines over constraints, detailed elements, and prescriptive solutions. They also expressed a slight preference over the ability to verify changes in real time, during decision conferences.

| | | | | |
|---|---|---|---|---|
| *high level insights* | 6 | VS | *more detailed* | 4 |
| *Easy to use* | 4 | VS | *more specialised functionalities for analysts* | 4 |
| *identifying the constraints (eg legal, planning, technical) for possible solutions* | 2 | VS | *guiding the weighting of multiple objectives* | 3 |
| *Ability to use live in a decision conference* | 3 | VS | *computationally intensive back-room research* | 2 |
| *decision support system that tests user proposed solutions* | 6 | VS | *model prescribed solutions* | 1 |

*Table 39 – Preferred features of an integrated decision support tool, for planners*

**Integrated Decision Support Tool**

As already mentioned, the FASUDIR project is intended to support decision makers and other stakeholders in analysing all the multiple factors involved in energy efficient retrofit projects at district scale (economical, technical, social, etc.) and in assessing their final impact on the district itself. This is not trivial, also due to the complexity of decision making in terms of stakeholders profiles and to the huge number of potential technologies available and parameters involved. ICTs are getting more and more in important in evaluating energy efficiency in buildings as well as in supporting energy efficient design while collaboration among stakeholders is more and more triggered by web based tools, opening important opportunities in the field of retrofit market at building and district scale. For this reason, to address the needs pointed out by research in this area and by relevant stakeholders in the value chain, FASUDIR is developing an interactive and user-friendly decision support tool that will enable analysis of the impact of the building energy oriented retrofitting project on the sustainability of the urban district in an holistic way. The FASUDIR partners believe that a software tool is the best way to advise decision makers on their most suitable retrofitting approach at district scale, facilitating at the same time the necessary communication mechanisms that can forge agreement among stakeholders involved in this process.

In this framework, the FASUDIR Integrated Decision Support Tool (IDST) will be an interactive cloud-based urban planning tool, which will evaluate the retrofitting needs of a set of buildings that share a common urban area, guide the decision makers in the selection of their most suitable energy retrofitting strategy to increase the sustainability of the whole district and consider the district as a whole energy system to improve the global energy balance.

The following figure shows a visual diagram of the FASUDIR IDST.

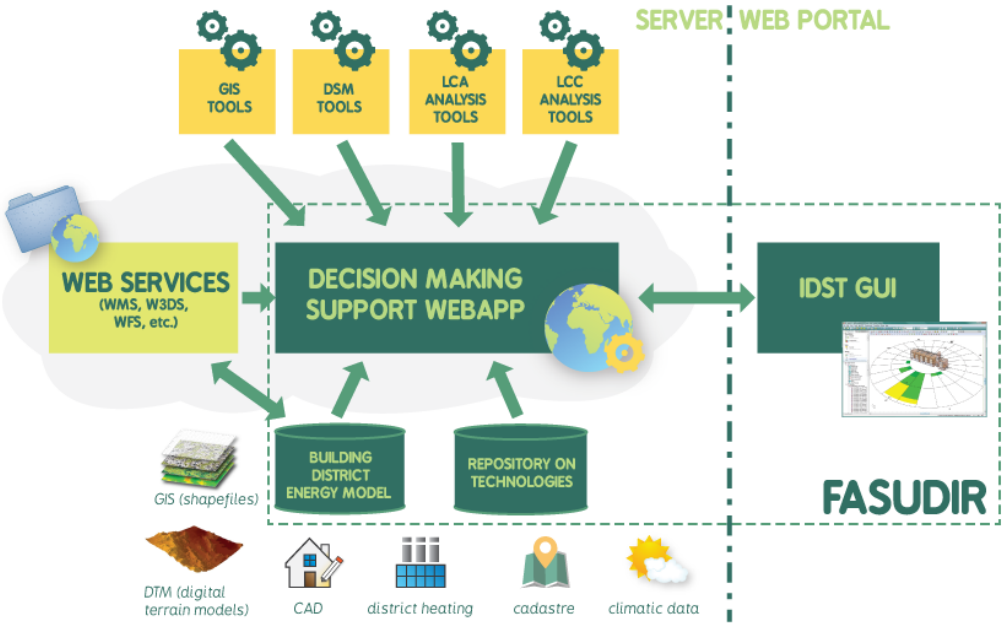


*Figure 1 – IDST architecture*

The key / novel elements of the tool include:

- A set of comprehensive indicators (KPIs) at the building and district scales;
- The use of advanced dynamic simulation tools to derive energy / carbon data;
- A novel selection process for deriving potential energy efficiency retrofitting solutions. The methodology will take into account the different urban typologies together with the priorities of the decision makers and involve business models;
- The use of Life Cycle Costing and Life Cycle Analysis tools to derive lifecycle cost and environmental impact data;
- The use of value analysis to determine the best solution from the range of optimum solutions based on user preferences;
- The ability for users to enter measured data in order compare or calibrate the simulated model with the actual building;
- A rich 3D interactive and intuitive interface.

The FASUDIR IDST will thus be a hybrid methodology of Dynamic Simulation Modelling, Geographic Information Systems (GIS), cloud data storage and analysis, KPIs and optimization / multicriteria analysis tools, aimed at providing an understanding of a city district and the impact that interventions have in terms of performance and efficient operation.

**References**

[1] http://fasudir.eu/

[2] http://www.bmub.bund.de/fileadmin/Daten_BMU/Pools/Broschueren/stadtsanierung_energetisch_faltblatt_bf.pdf

[3] http://www.energetische-stadtsanierung.info/