BUSINESS MODELS FOR ENERGY MASTER PLANNING OF COMMUNITIES AND DISTRICTS

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Business models for Energy Master Planning of communities and districts

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• Introduction
• Possibilities for evaluation
• Discussion of issues
• De-risking measures
• Practical examples of business models
Introduction

- Emission reduction
- Energy Master planning
- Energy planning
- Spatial planning
- Public and private investment
- Business models

Graph: Emissions development in the Scenario ZERO-Basis
Introduction

Energy Master Planning (EMP) in the context of spatial and urban planning

Legally Binding Land Use Plan of a public social housing community in Hamm

(Germany) Source: Chartered Architects Chamber, North Rhine Westphalia
Energy Master Planning (EMP) in the context of spatial and urban planning

- space and society
- space and landscape
- spaces and cultural heritage
- spaces and economic structures
- spaces and mobility
- spaces and climate change
Steps in Energy master planning

The following general steps for a successful local energy planning transition process can be identified as follows:

1. Inventory
2. Establish targets
3. Assess opportunities
4. Develop plans
5. Implementation
6. Measurement and verification

- **Strategic long-term planning phase**
- **Tactical mid-term planning and implementation phase**
- **Operational phase**
<table>
<thead>
<tr>
<th>Step</th>
<th>Stage of the spatial planning process</th>
<th>Activities, targets, methods</th>
<th>Level of design granularity</th>
<th>Potential input energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Informal plans and concepts</td>
<td>Strategic pre design phase, used for pre selection in an early phase</td>
<td>Very low level</td>
<td>Very early stage is often unspecific</td>
</tr>
<tr>
<td>2</td>
<td>Design contest</td>
<td>Often step 3) is initiated with a design contest among spatial planners</td>
<td>-</td>
<td>Insert infrastructure and energy in the decision-making criteria of the award process</td>
</tr>
<tr>
<td>3</td>
<td>Spatial design draft concept</td>
<td>Analysis of overarching regional spatial plans, development of several concepts and decision-making criteria for the selection process; design of specific purpose areas both public and private, floor space, height of buildings, spaces for mobility, business areas, mixed areas (scale of plans 1:5000 – 1:500)</td>
<td>Middle- increasing granularity level with essential indications on environmental, infrastructure, energy</td>
<td>Entrance point at the beginning of this step: integrate energy into the “climate” and “utility” topics with further specification over time; start of energy master planning in the concept phase</td>
</tr>
<tr>
<td>4</td>
<td>Spatial planning steering process</td>
<td>Public body on which the spatial design concept is developed has to start a public participation process in which utilities, citizens and stakeholders from environmental, chambers of commerce etc. are invited give comments, suggestions which need to be answered (1:15.000 scale plans)</td>
<td>Adopting the results from 3); design of the financing and business plan</td>
<td>Utilities propose energy supply schemes in respect to availability of fuels, grids etc. citizens discuss building size, density of buildings. Request for exhaust gas analysis often discussed.</td>
</tr>
<tr>
<td>5</td>
<td>Legally binding land use planning</td>
<td>The public participation is concluded after a certain consensus (no general and fundamental major objections) has been found among stakeholders and the plan has been approved by the municipal or regional councils</td>
<td>High granularity with regard to energy demand, energy supply</td>
<td>Design and final decision making and calculation phase of the energy master planning</td>
</tr>
<tr>
<td>6</td>
<td>Development process</td>
<td>Public entity starts development process; detailed design of infrastructure, mobility, energy distribution and supply, sewage, water, electricity, glass fiber cables etc.; Planning of the energy system, implementation of financial concept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Implementation of infrastructure</td>
<td>Procurement process for infrastructure construction companies, ESCos, grid; implementation of infrastructure</td>
<td>Construction process starts for infrastructure and energy</td>
<td>Supply contracts with end customer(s) for energy and other grid supply services</td>
</tr>
<tr>
<td>8</td>
<td>Settling process</td>
<td>Building construction phase/ building refurbishment phase</td>
<td>Implementation of energy stations for handover of centralized energy</td>
<td>Supply phase starts</td>
</tr>
</tbody>
</table>
Constraints and goals in EMP
Establish target for evaluation
Possibilities for an evaluation

• possibilities for an evaluation of cost-effectiveness of community projects
• A short introduction to economic decision-making criteria with focus on
  • Life-Cycle Cost calculation (LCC) for EMP
  • multiple benefits (bankable LCC on the building level),
  • bankability and risk mitigation of multiple benefits,
  • cost effectiveness.
• Investment costs and capital expenditures
• determination of technical concept and investment costs
  • gathering of accurate investment costs,
  • developing detailed energy demand and supply scenario by simulation
  • specific risks in the calculation of investment costs
• optimization of investment cost.
Business models for Energy Master Planning of communities and districts

Issues

- energy savings
- avoided maintenance and repair costs
- operation cost reduction
- insurance costs
- building comfort and Green Neighborhood Value
- Risks and De-Risking methods and tools
- Key Risk Indicators (KRI) in general
- KRI in EMP for building clusters in particular
Major cost benefits relevant for building clusters and their supply and distribution schemes.

<table>
<thead>
<tr>
<th>Part-LCC</th>
<th>Calculation Method</th>
<th>Variations and Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Energy savings: effects from improving the energy-performance</td>
<td>kWh savings x energy price</td>
<td>Fixed or flexible energy price; reductions resulting from demand side measures and improvement of supply/distribution schemes</td>
</tr>
<tr>
<td>2 Energy savings II</td>
<td>kWh RE replacing fossil x energy price (RE-fossil)</td>
<td>Fossils replaced by RE; calculation based on fixed or flexible energy prices</td>
</tr>
<tr>
<td>3 Reduced maintenance I</td>
<td>Maintenance costs for replaced, worn-out equipment at the end of its life cycle as a percentage of the new investment value</td>
<td>Average percentage value or end of life cycle value</td>
</tr>
<tr>
<td>4 Reduced maintenance II</td>
<td>Downsizing of investment in supply and distribution when demand side measures are carried out; leads to reduction of investment cost related maintenance</td>
<td>A component downsized by 30% reduces maintenance costs of this component</td>
</tr>
<tr>
<td>5 Reduced operation costs</td>
<td>Building automation reduce operation workloads</td>
<td>Consider work plans and operation schedules individually</td>
</tr>
<tr>
<td>6 Insurance costs I</td>
<td>Building components replaced achieve lower premiums and improved protection against loss</td>
<td>EU: compared to pre-refurbished status: -2 up -4€/m² on building surface area; distribution systems: n.a.; supply installations: 3-5% of total LCC.</td>
</tr>
<tr>
<td>7 Reduced absence costs</td>
<td>Relationship between indoor climate, lighting, and absenteeism</td>
<td>Few case studies assessed the relationship: 30-40% less absenteeism</td>
</tr>
</tbody>
</table>
Energy savings

Assessment of utility bills

Climate adjustment of the energy baseline

Energy baseline prices
Energy cost savings

\[ ECS = \sum_{\text{year } 1}^{n} (E_{\text{savings}} \times \text{FEP} \times PIR) \]

\[ + \left( E_{\text{consump., replaced}} \times (EP - RE \ EP) \right) \]

\[ + \text{FEC} + (FIT \times FIA) \]

- **ECS** = Energy cost savings
- **E_{\text{savings}}** = Energy savings
- **FEP** = Flexible energy price
- **PIR** = Price Increase Rate (1/yr)
- **E_{\text{consump., replaced}}** = Energy consumption replaced by RE or CHP source
- **EP** = Energy price
- **RE EP** = RE Energy price
- **FEC** = Fixed Energy Costs
- **FIT** = Feed in Tariff (kWh)
- **FIA** = Feed in Amount (kWh)
Risks and De-Risking methods and tools

- Subsidies and taxation
- Technical – processual risk
- Technical – Technology and product related risks
Risk management

- Risk Audit
- Risk Control
- Risk Management
### Key Risk Factors (KRF) and Key Risk Indicators- KRI

<table>
<thead>
<tr>
<th>Key Risk Factor</th>
<th>Key Risk Indicator</th>
<th>KRI Values</th>
</tr>
</thead>
</table>
| Capital costs for energy supply and distribution | 1) Specific costs overall for the building cluster  
2) Specific capital costs per m² total gross floor space of the building cluster  
3) Capital costs per kW thermal or kW electrical load max | Tbd (technology evaluation)                                                   |
| Energy savings                                | 1) Specific capital costs per kWh th or kWh el saved per year  
2) Energy cost savings /m² yr (per total gross floor space) | 1) evaluates the cost effectiveness of investments per kWh saved in order to compare between different scenarios and investments |
| Energy costs                                  | 1) Energy costs per m² (per total gross floor space of the building cluster)       | 1) Value in use in facility and energy management processes for single buildings, building clusters, industrial parks etc.             |
## De-risking Investment costs

<table>
<thead>
<tr>
<th>Key Risk Factor</th>
<th>Stage of project</th>
<th>Risk</th>
<th>De-Risking measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Investment costs / capital costs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concept</td>
<td>Cost predictions are unrealistically low</td>
<td>Comparison of investment cost indicators (KRI) for comparable types of neighborhoods; consideration of cushion for unforeseen investment costs</td>
<td></td>
</tr>
<tr>
<td>Baseline definition</td>
<td>Unprecise baseline leads to miscalculation of energy supply design</td>
<td>Application of organizational baseline design guidelines such as Investors’ Confidence Project or IPMPVP- Baseline calculation guideline (Ref.)</td>
<td></td>
</tr>
<tr>
<td>Modeling and design</td>
<td>Cost predictions higher than in concept phase</td>
<td>1) Transparent documentation and supervision of scope of work and costs in the concept and design phase; 2) comparison of cost assumptions for major components (A-components) with specific cost values</td>
<td></td>
</tr>
<tr>
<td>Implementation</td>
<td>During procurement and award cost increase takes place;</td>
<td>1) Explicit contract construction contract design according to ISO 6707:02-2017 international standard construction contracts; 2) selection of energy service in order to freeze investment cost budget 3) construction insurance in order to cover construction and bankruptcy risks</td>
<td></td>
</tr>
<tr>
<td>Financing</td>
<td>1) Financing cost increase due to increased interest costs, 2) calculated subsidies are not available</td>
<td>1) Selection of combined long-term financing contracts with interest adoption formula or fixed interest rates over the financing period 2) final cross check with available subsidy programs in the design phase in order to adopt design details to requirements of subsidy programs, management of subsidy applications.</td>
<td></td>
</tr>
</tbody>
</table>
## De-risking energy costs

<table>
<thead>
<tr>
<th>Key Risk Factor</th>
<th>Stage of project</th>
<th>Risk</th>
<th>De- Risking measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy costs</strong></td>
<td>Concept</td>
<td>Unrealistically high energy saving or energy performance values in the concept phase</td>
<td>Comparison to target and performance values for comparable projects (usage, thermal /electrical load) after implementation</td>
</tr>
<tr>
<td><strong>Baseline definition</strong></td>
<td>Unprecise baseline calculations lead to miscalculated energy savings</td>
<td>Application of organizational baseline design guidelines such as Investors´ Confidence Project or IPMPVP- Baseline calculation guideline (Ref.)</td>
<td></td>
</tr>
<tr>
<td><strong>Modeling and design</strong></td>
<td>Modeling results do not match with concept energy savings</td>
<td>1) Quality assurance of the modeling process according to requirements of Investors Confidence Project or IPMPVP savings calculation 2) Selection of energy service business models in order to achieve a guaranteed energy performance indicator</td>
<td></td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>Execution of implementation design on site does not allow to achieve the targeted savings</td>
<td>1) review of implementation design, comparison with modeling assumptions, corrections of implementation design 2) selection of energy service business models</td>
<td></td>
</tr>
<tr>
<td><strong>Financing</strong></td>
<td>Disbalance in the performance phase between the predicted and performed energy savings provides disbalance in cash flow with relevance for the available funding for the financing costs</td>
<td>1) selection of energy service business models 2) consideration of variation in energy savings in the cash flow scenarios 3) Finance insurance product for fixing interest rates over time</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

de- risking measures in the EMP process

resulting business models

required services for EMP
<table>
<thead>
<tr>
<th>Energy supply components Suppliers; Construction contractors; Marketing company; Transportation company;</th>
<th>Development, optimization and testing; Designing, planning, and assembling; Certification/Standardization on Marketing Training Transportation/shipment</th>
<th>Overall superior performance; increased resilience; Increased insulation properties; Includes solar energy gain and storage; Environmentally friendly; Affordability; Reduced operational cost;</th>
<th>Direct assistance of the manufacturers; Provision of training and instructions; maintenance</th>
<th>Building owners; facility managers, Municipalities; Construction companies; Developers; Building managers; Architects and Designers; Engineers, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Partners</td>
<td>Key Activities</td>
<td>Value Proposition</td>
<td>Customer Relationship</td>
<td>Customer Segments</td>
</tr>
<tr>
<td>Services and components; Technology; Personnel; Facility and equipment; Initial investment;</td>
<td>Key Resources</td>
<td>Channels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost Structure</td>
<td>Revenue Streams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed: salaries, facility, equipment; Variable: the cost of materials and components, energy costs, savings others</td>
<td>???</td>
<td>Maintenance inspections</td>
<td>De-risked investment</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Service</td>
<td>Target, expected result</td>
<td>Qualification of parties involved</td>
<td>Remuneration</td>
</tr>
<tr>
<td>-----</td>
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<td>--------------</td>
</tr>
<tr>
<td>1</td>
<td>Baseline building</td>
<td>Cumulation of baseline data for energy consumption or demand of a building cluster</td>
<td>Experienced energy consultant with knowledge in IPMPV protocols</td>
<td>Service fee for working days</td>
</tr>
<tr>
<td>2</td>
<td>Concept</td>
<td>Energy concept for demand and supply side and distribution with sizing of major components after comparing different scenarios</td>
<td>Energy consultant with knowledge in concept design of energy and demand side systems</td>
<td>Service fee for working days (BAU), integrated in total investment costs (ESCO)</td>
</tr>
<tr>
<td>3</td>
<td>Modeling</td>
<td>Detailed sizing of components at hand of a detailed energy model for the building cluster</td>
<td>Senior Energy modeling expert</td>
<td>Service fee for working days (BAU) / integrated in total investment costs (ESCO/Utility)</td>
</tr>
<tr>
<td>4</td>
<td>Detailed design and procurement</td>
<td>Detailed technical design ready for implementation/procurement strategy and documents</td>
<td>Senior designer</td>
<td>Service fee for working days (BAU) / integrated in total investment costs (ESCO/Utility)</td>
</tr>
<tr>
<td>No.</td>
<td>Service</td>
<td>Target, expected result</td>
<td>Qualification of parties involved</td>
<td>Remuneration</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>5</td>
<td>Implementation</td>
<td>Award of construction, approval of technical implementation at the end of the implementation phase</td>
<td>Senior designer</td>
<td>Service fee for working days (BAU) / integrated in total investment costs (ESCO/Utility)</td>
</tr>
<tr>
<td>6</td>
<td>Operation</td>
<td>Cost optimized operation according to the energy targets</td>
<td>Senior operator, facility manager, janitor</td>
<td>Provided by building owner or ESCO/Utility</td>
</tr>
<tr>
<td>7</td>
<td>Distribution, storage and selling of energy</td>
<td>Cost optimized distribution and selling (on spot/blockchain)</td>
<td>Senior operator</td>
<td>Provided by building owner or ESCO/Utility</td>
</tr>
<tr>
<td>8</td>
<td>Measurement/Verification/encashment</td>
<td>Optimized m&amp;v execution, encashment</td>
<td>Senior operator</td>
<td>Provided by building owner or ESCO/Utility</td>
</tr>
</tbody>
</table>
National Workshop with more than 50 active Stakeholders
Developing practical approaches to financing hurdles for EE and NZEQs

3 Workshops: 21 March 2018, 28 September 2018 and 12 February 2019 in Berlin
Subtask F. Business, Legal and Financial Aspects - Mission and Goals

Technical-organizational structure for implementation models

1) Community Owner (A 73 focuses on public/single ownership)
   - Remuneration of Energy Service Provider; risks: cost risks; behaviour of end users
   - Subsidies reduce financial needs, adds transparency; approved subsidies require due diligence of the project; bonus rating

2) End users (tenants/owners)
   - Remuneration of Energy Service Provider; risks: cost risks; behaviour of end users

3) Energy Service Provider / ESCos or Utilities
   - Portfolio: Design, Implementation, Operation, M&V; Risk: technical and business performance

4) Financiers
   - Financing after risk-evaluation, due diligence, transparent project and credit risks;

Grids
- Physical grid stability
- Handling Feed in/Feed out

Subsidies/Loan guarantees and other
- Subsidies reduce financial needs, adds transparency; approved subsidies require due diligence of the project

Risk transfer
Monetary values
Service, investment
Business Model Canvas – Evaluation and design of a business case (Mannheim 2018)

Key Partners
- ESCO
- Grid operator
- Public building owner

Key Activities
- Energy management of the community:
  - Storage
  - Grid intersection
  - Energy production
  - Energy demand, load curve management

Value Propositions
- Optimization of cost-benefits
  - Capital costs resulting from 1. investment
  - Operational LC: maintenance/repair, operation
  - Operational Benefit resulting from service fees, power swap and supply heating supply, storage fees

Customer Relationships
- B2b contracts

Customer Segments
- Public community owners
- Public/private community owners (2. priority)

Key Resources
- Channels
- IT

Cost Structure
- First investment costs, staff costs, operational LC

Revenue Streams
- Service fee, heating & power supply charges

http://www.businessmodelgeneration.com