Participatory engagement of stakeholders with energy models: developing feasible energy concepts for small municipalities

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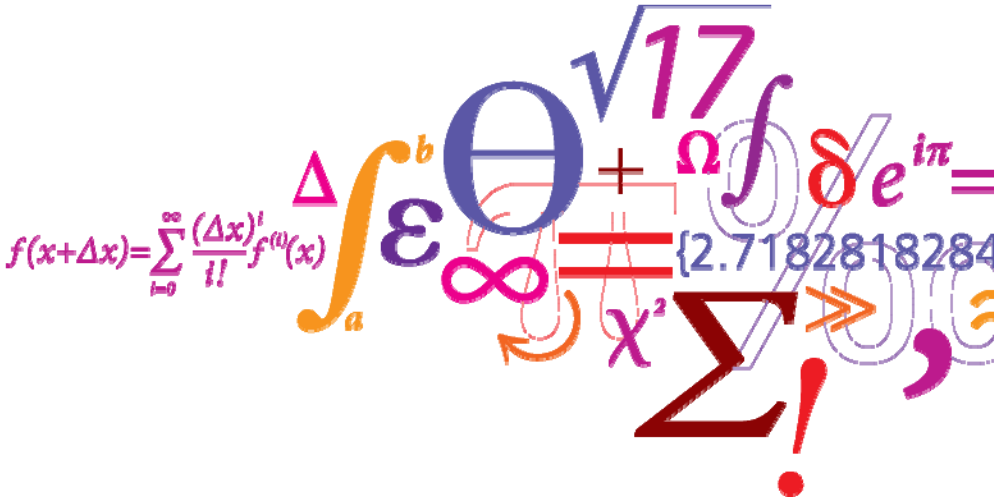
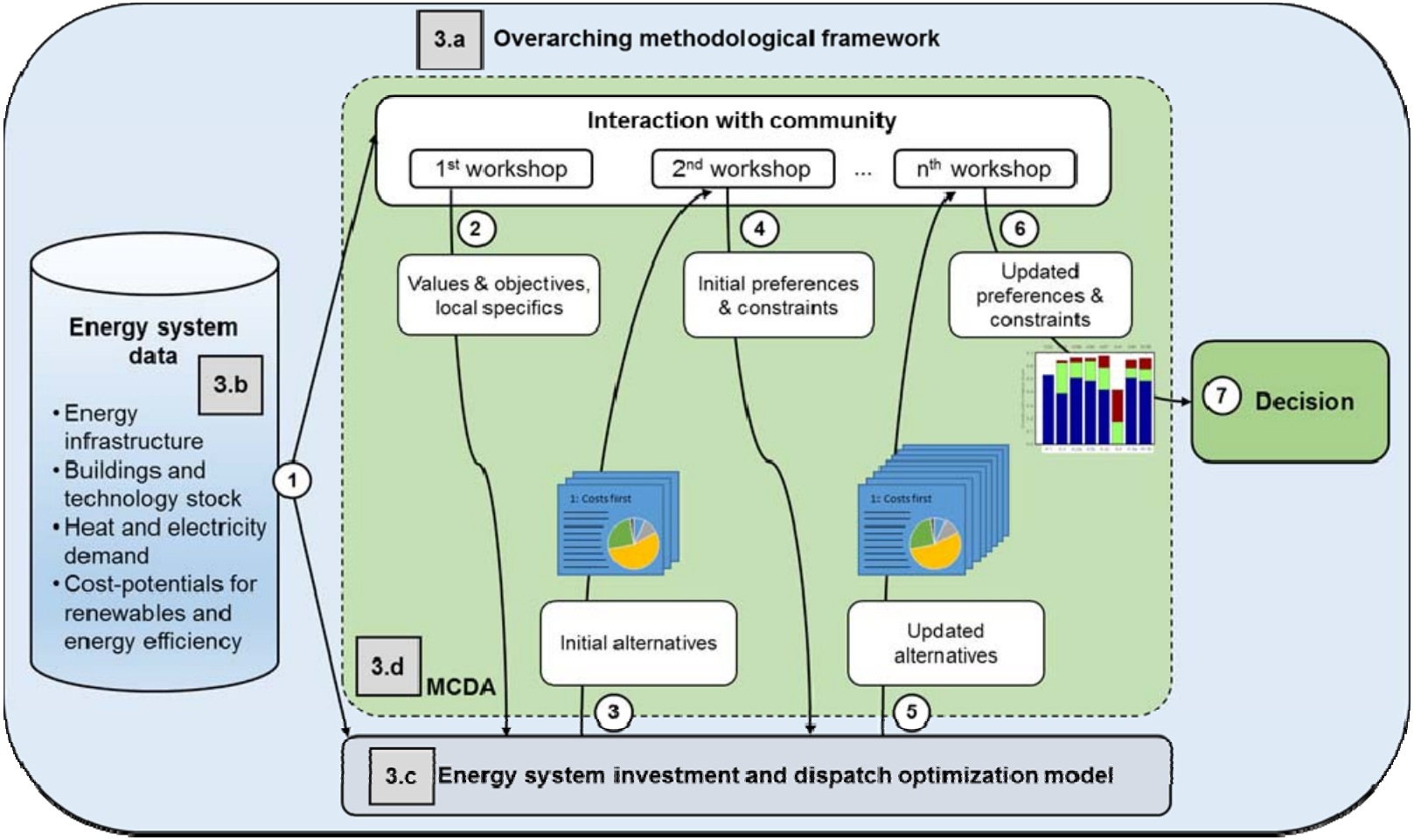


DTU Management Engineering
Department of Management Engineering

McKenna, R., Bertsch, V., Mainzer, K., Fichtner, W. (2018): Combining local preferences with multi-criteria decision analysis and linear optimisation to develop feasible energy concepts in small communities, European Journal of Operational Research, Volume 268, Issue 3, https://doi.org/10.1016/j.ejor.2018.01.036

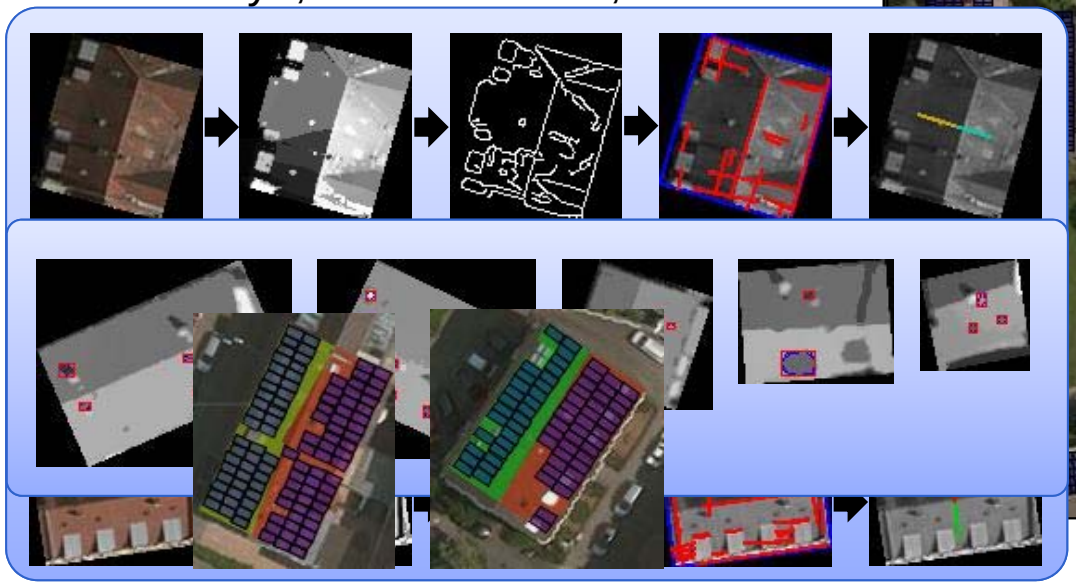
Feasible energy concept development in Ebhausen, Baden-Württemberg (~5000 pop.)



- Iterative process of interaction with stakeholders required

Cost-potential methods: rooftop PV

- Data gathering
  - Building footprints
  - Satellite images
- Determination of roof orientations through line detection algorithms
- Detection of roof structures like chimneys, roof windows, etc.

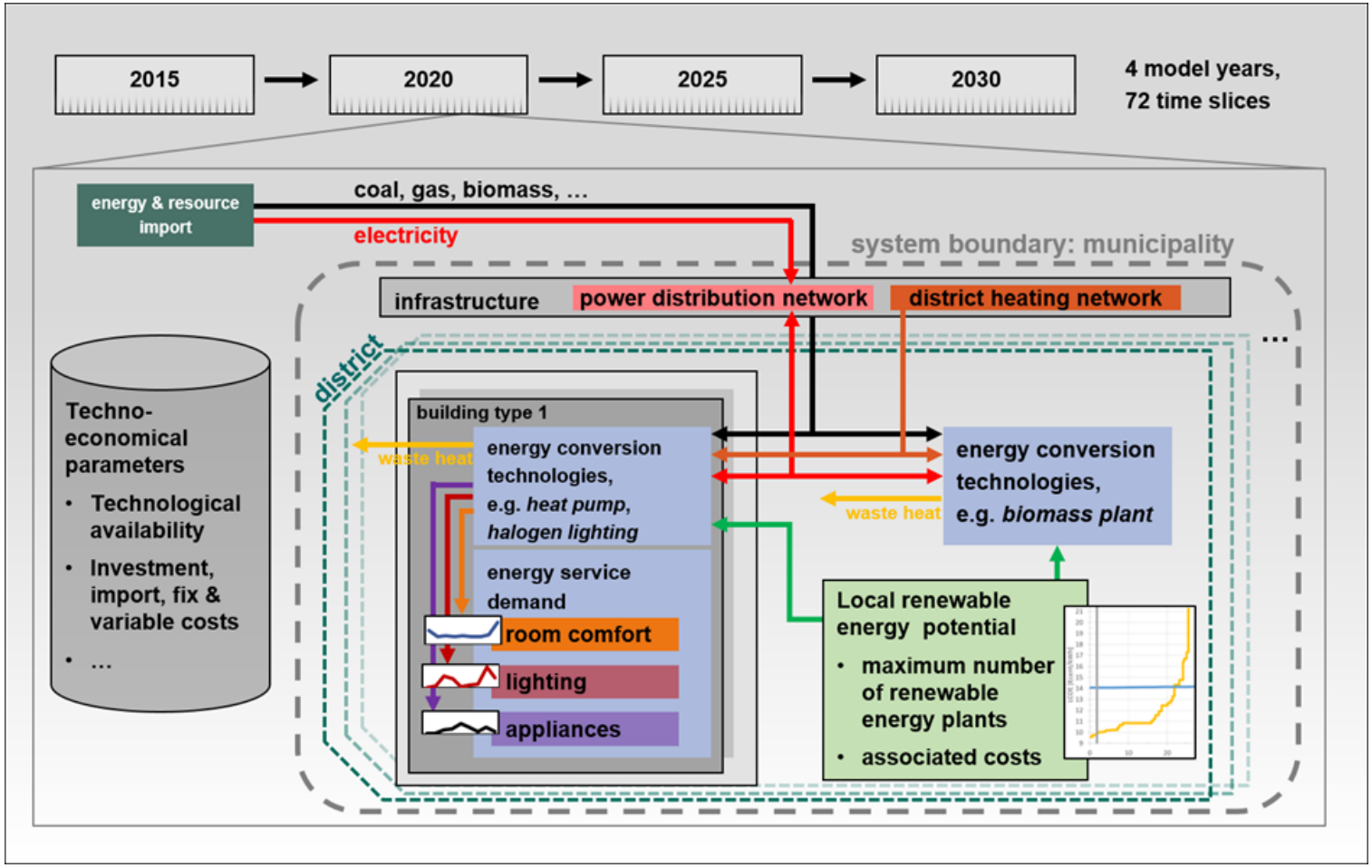


Geodata: OpenStreetMap, Satellite images: Bing Maps
more details in: [Mainzer 2016]

- **Outlook:**
  - Improve existing plant recognition accuracy
  - Improve the 3D geometry detection with remote sensing methods

Mainzer PhD 2018

A transferable model for developing municipal energy concepts: RE³ASON*



- Input data based largely on open sources and model therefore highly transferable

*Renewable Energies and Energy Efficiency Analysis and System OptimizatioN

Energy concept development in Ebhausen, Baden-Württemberg: CO2 Emissions

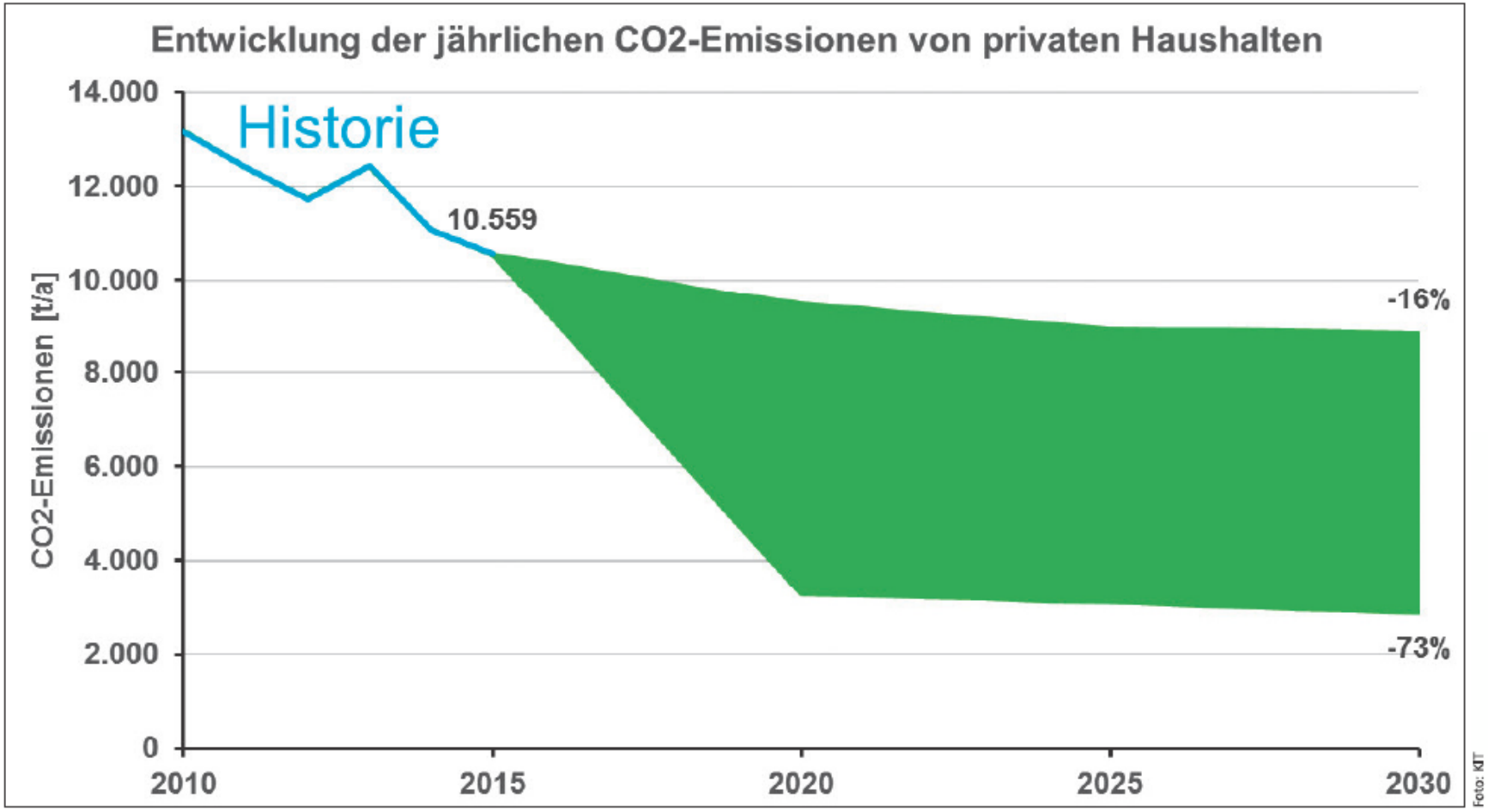
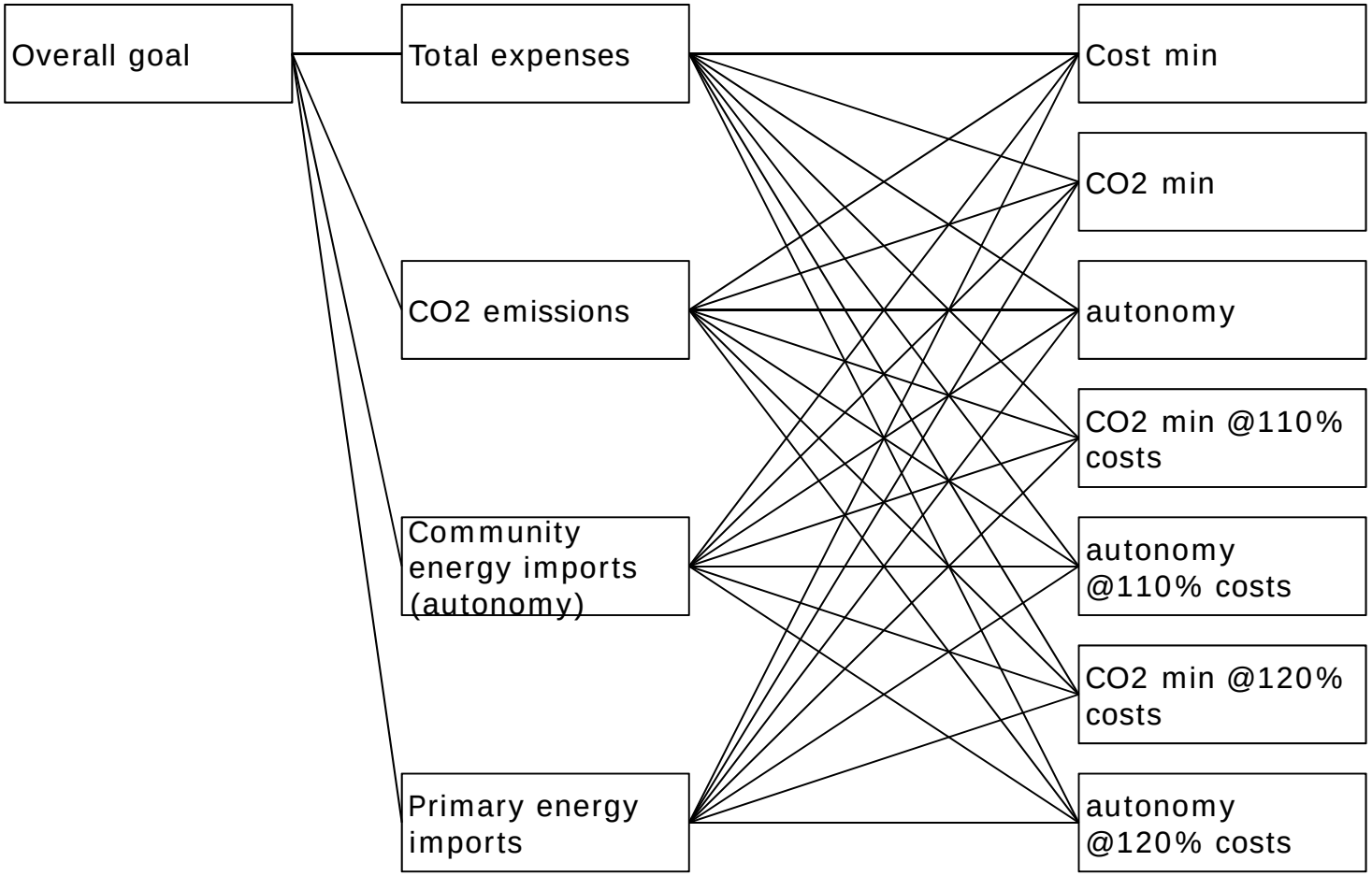
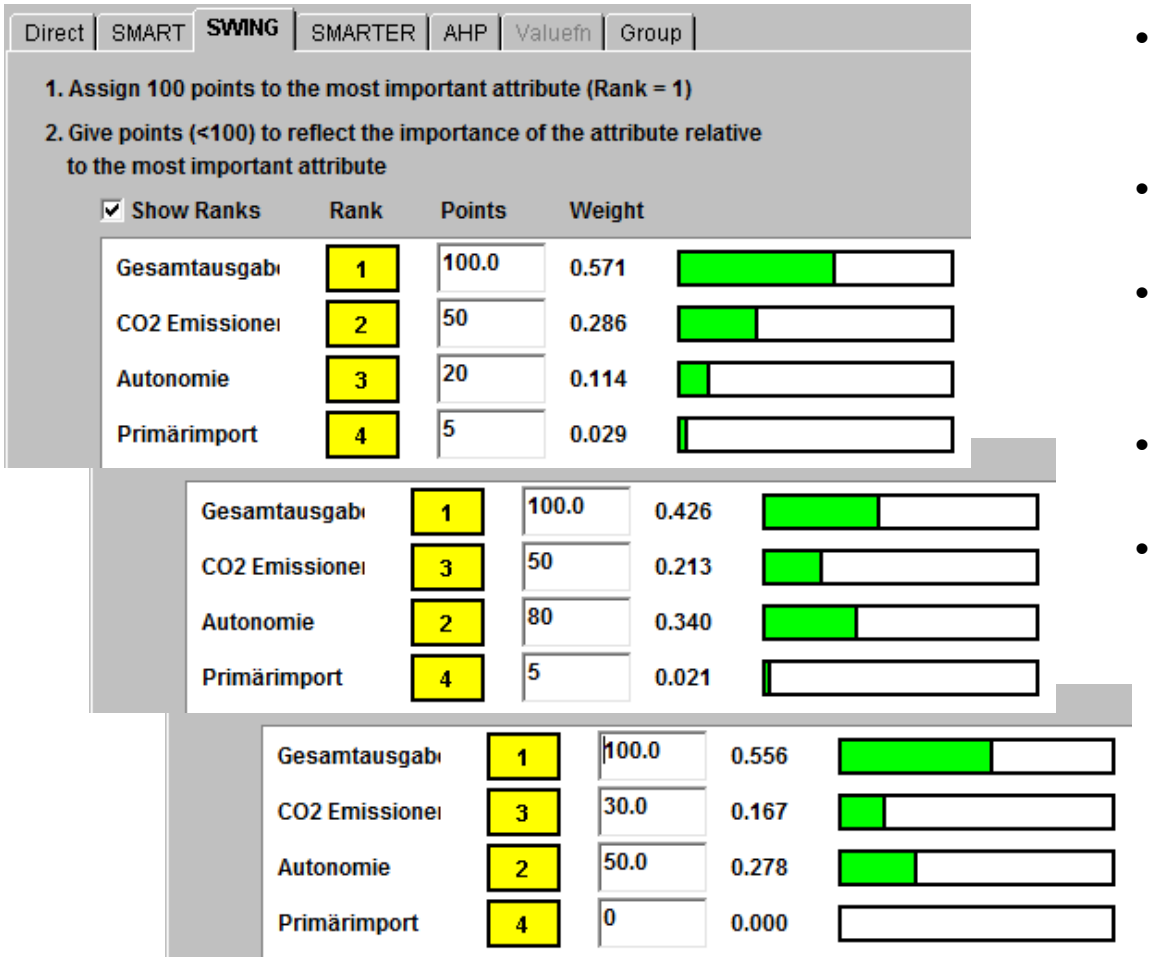


Abbildung 2: Entwicklung der jährlichen CO_2-Emissionen von privaten Haushalten in Ebhausen bis 2030.

Problem structuring: construction of an attribute tree



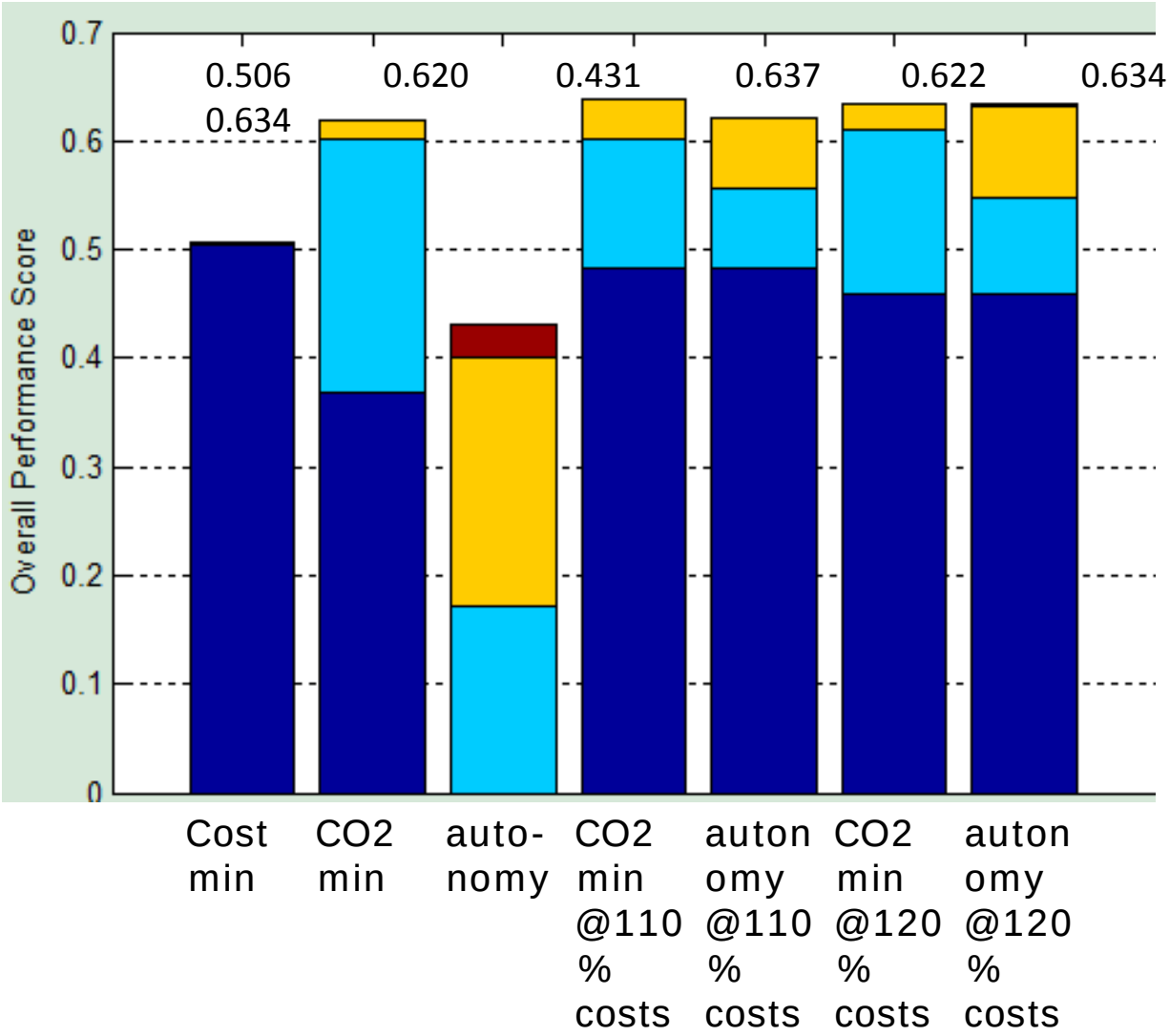
MCDA: weight elicitation

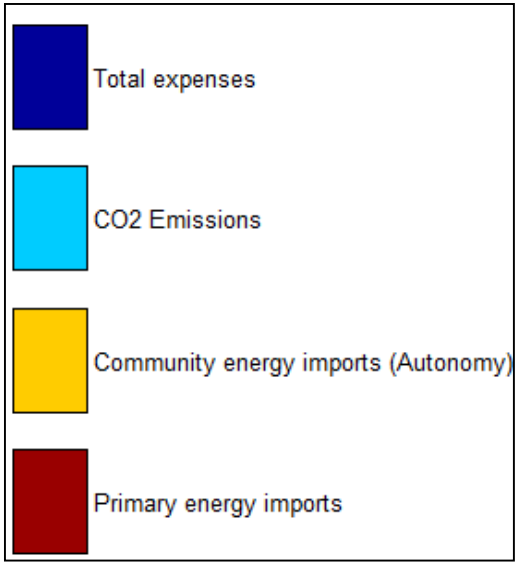


- The SWING weighting method was used for eliciting the weights within the workshop
- Linear value functions assumed
- Controversial discussion concerning the relative importance of the four criteria
- Highest uncertainty concerning the weight of ‚autonomy‘
- Calculation of intervals including the three sets of weights

Criterion	Weight Interval
Costs	0.40-0.60
CO2	0.15-0.30
Autonomy	0.10-0.35
Primary	0.00-0.05

Ranking of the considered alternatives for the assumed deterministic weights

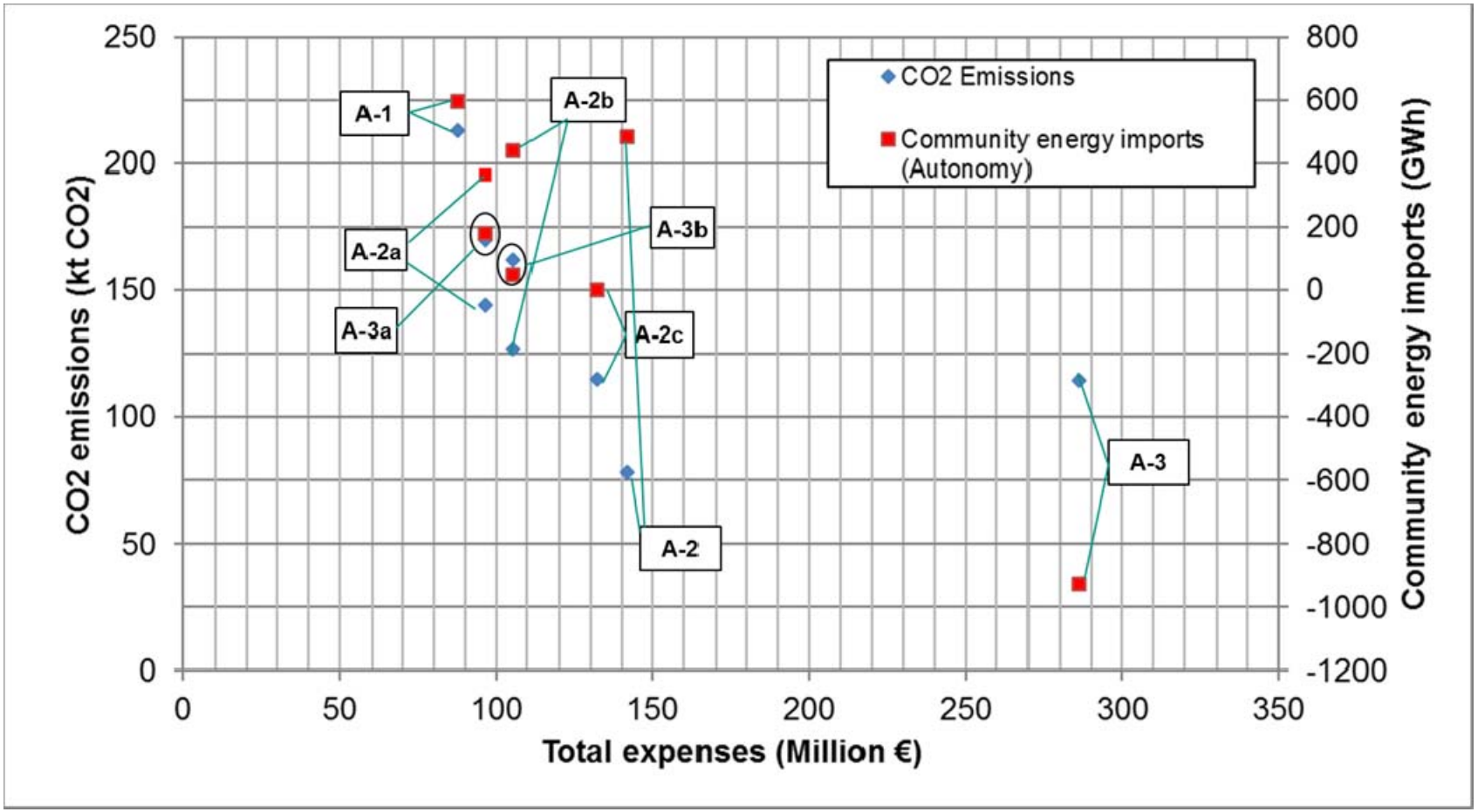




Results of 1000 randomly sampled weights (within the weight intervals): alternatives with highest scores

- "CO2 min": 23%
- "CO2 min @110% costs": 30%
- "CO2 min @120% costs": 11%
- "autonomy @120% costs": 36%

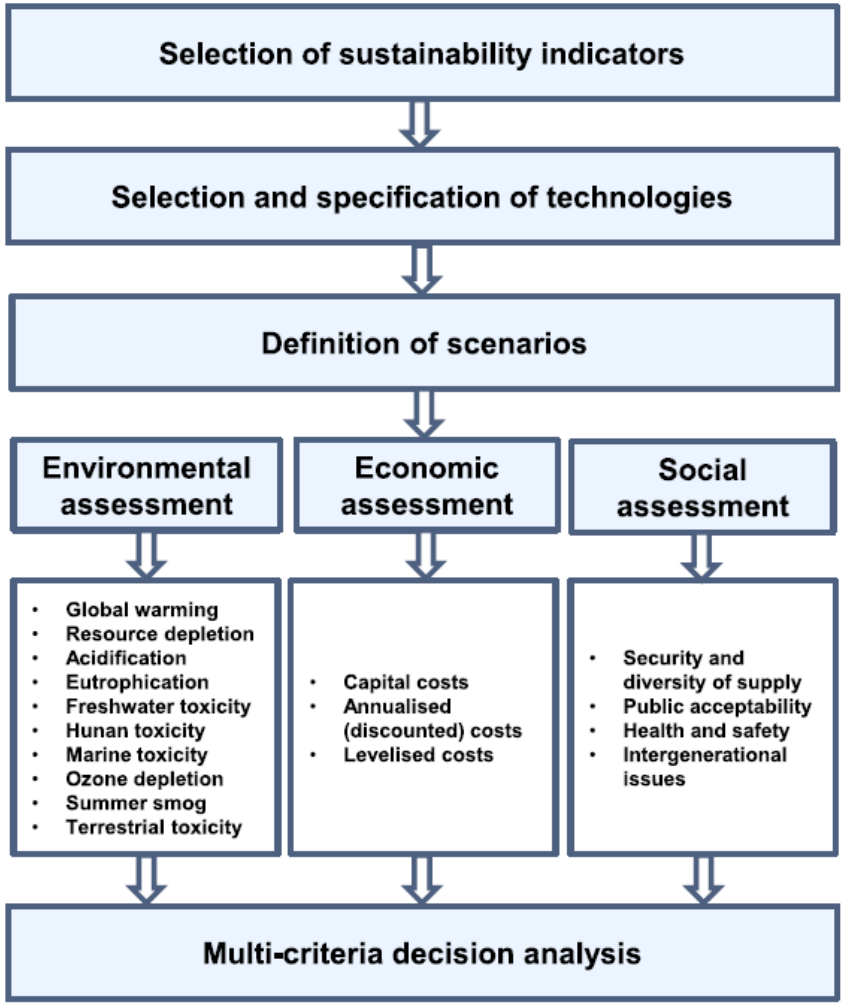
3. Energy concept development in Ebhausen, Baden-Württemberg: 8 Alternatives

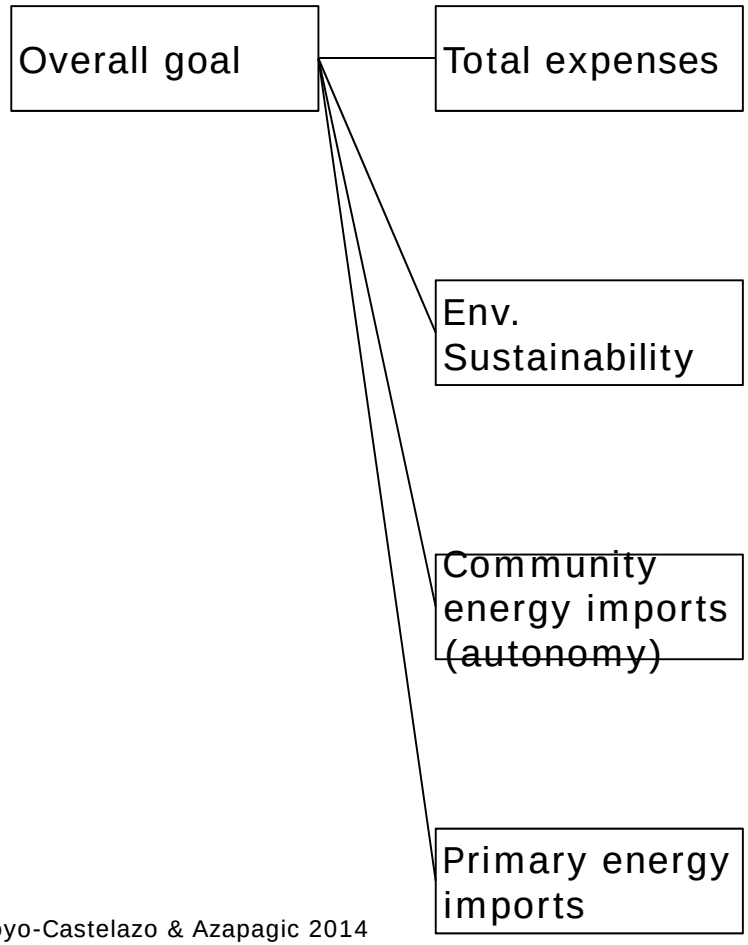


- Moderate compromise in costs yield substantial benefits in terms of CO2 emissions and autonomy

McKenna et al. 2018a

Outlook: sustainability assessment





Santoyo-Castelazo & Azapagic 2014

Backup