

# Societal objectives as drivers of ex-ante evaluation of energy efficiency measures

*José L. Sousa, Polytechnic Institute of Setúbal, Setúbal, Portugal*

*António G. Martins, University of Coimbra, Coimbra, Portugal*

*Humberto M. Jorge, University of Coimbra, Coimbra, Portugal*

## Summary

The Portuguese energy regulator (ERSE) has developed a tender mechanism to promote energy efficiency in electricity consumption (PPEC). This tender mechanism, an actual market transformation instrument, arises following concerns about reducing GHG emissions, attenuating the depletion of resources, reducing the country's fuel dependency, as well as avoiding some more expensive energy production options. The funds, paid by all electricity customers, are used to co-finance the implementation of measures that must contribute to raise energy efficiency in electricity end-use. For the sake of transparency in the ranking and selection of measures, the regulator ensures that rules, criteria and their respective weights are known in advance.

In this work<sup>1</sup> we address a ranking problem applied to energy efficiency measures. We used data from measures candidates to PPEC calls for proposals, as well as the same criteria as the regulator. However our procedure is based on explicitly assumed societal objectives and on defined ranges of values for each criterion weight. The purpose is to find the appropriate set, or sets, of criteria weights that should be used so that measures are ranked according to two simultaneous objectives: minimize the cost of saved energy and maximize overall saved energy. A genetic algorithm is used to search for the best performing set (or sets) of weights, regarding the expressed societal objectives.

This proposal helps strengthen the present tender mechanism through the definition of societal objectives that will influence the criteria weights in face of the competing measures. The analysis of three previous calls for proposals shows that the same set of criteria weights can hardly be suitable for all of them. Then, instead of setting the weights of the criteria in advance, the regulator could set admissible intervals for the weights.

The use of this bi-objective approach is compatible with the regulator practice so far, maintaining the transparency of the tender mechanism and providing a greater flexibility and societal advantage of the portfolio of selected measures for market transformation.

## Acknowledgments:

This work has been partially supported by FCT under project grant PEst-C/EEI/UI0308/2011.

---

<sup>1</sup> Sousa, J. L., Martins, A. G., Jorge, H. M., 2012. A multi-objective evolutionary approach to set criteria weights for ranking energy efficiency measures. Instituto de Engenharia de Sistemas e Computadores de Coimbra, Coimbra. <[http://www.inescc.pt/documentos/2\\_2012.PDF](http://www.inescc.pt/documentos/2_2012.PDF)>.



# Societal objectives as drivers of ex-ante evaluation of energy efficiency measures

José L. Sousa, Polytechnic Institute of Setúbal, António G. Martins and Humberto M. Jorge, University of Coimbra, INESC Coimbra



**Objective:** Present an approach to the ranking of measures to promote energy efficiency in electricity consumption.

**Case study:** a Portuguese tender mechanism—PPEC

Overall performance value of each measure  $j$ , is used to compare measures, for each set of criteria weights:

$$OP_j = \sum_j aA_j$$

Where:

$OP_j$  – Overall performance value of measure  $j$ ;

$a$  – Weight of each criterion;

$A_j$  – Normalized value of each criterion of measure  $j$ .

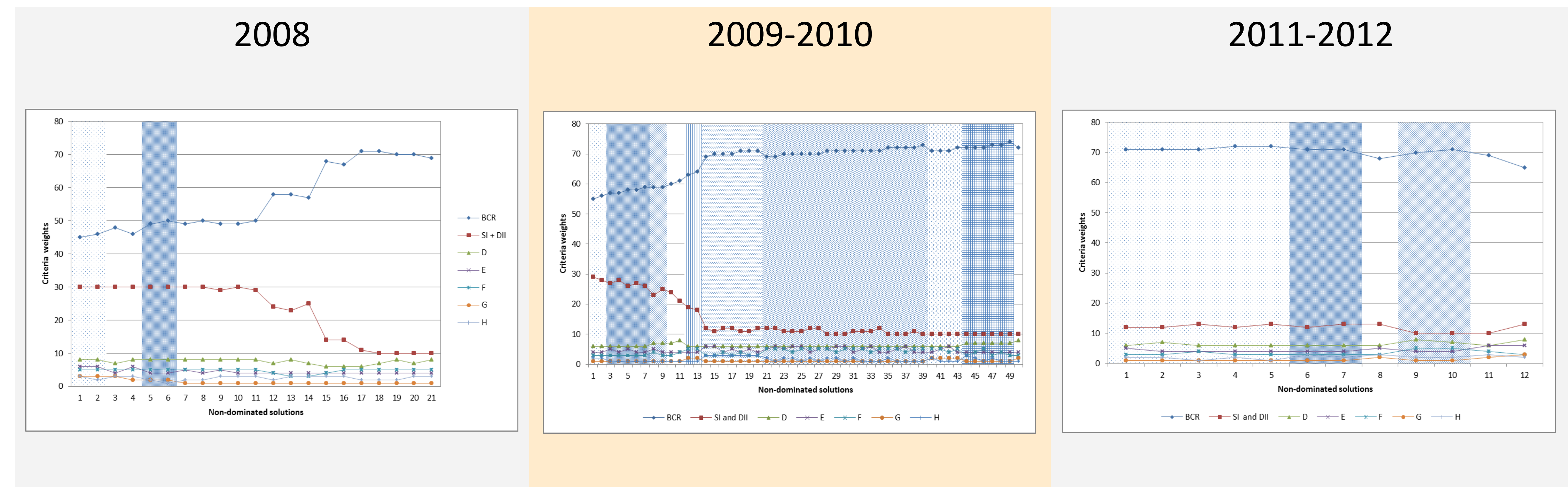
## Criteria

- Benefit Cost ratio (BCR);
- Scale risk (SI);
- Weight of the investment in the total cost of measure (DII);
- Quality of presentation of measure;
- Ability to overcome market barriers and spill over effect;
- Equity;
- Innovation;
- Experience of the promoter in similar programs.

## Weights of the criteria

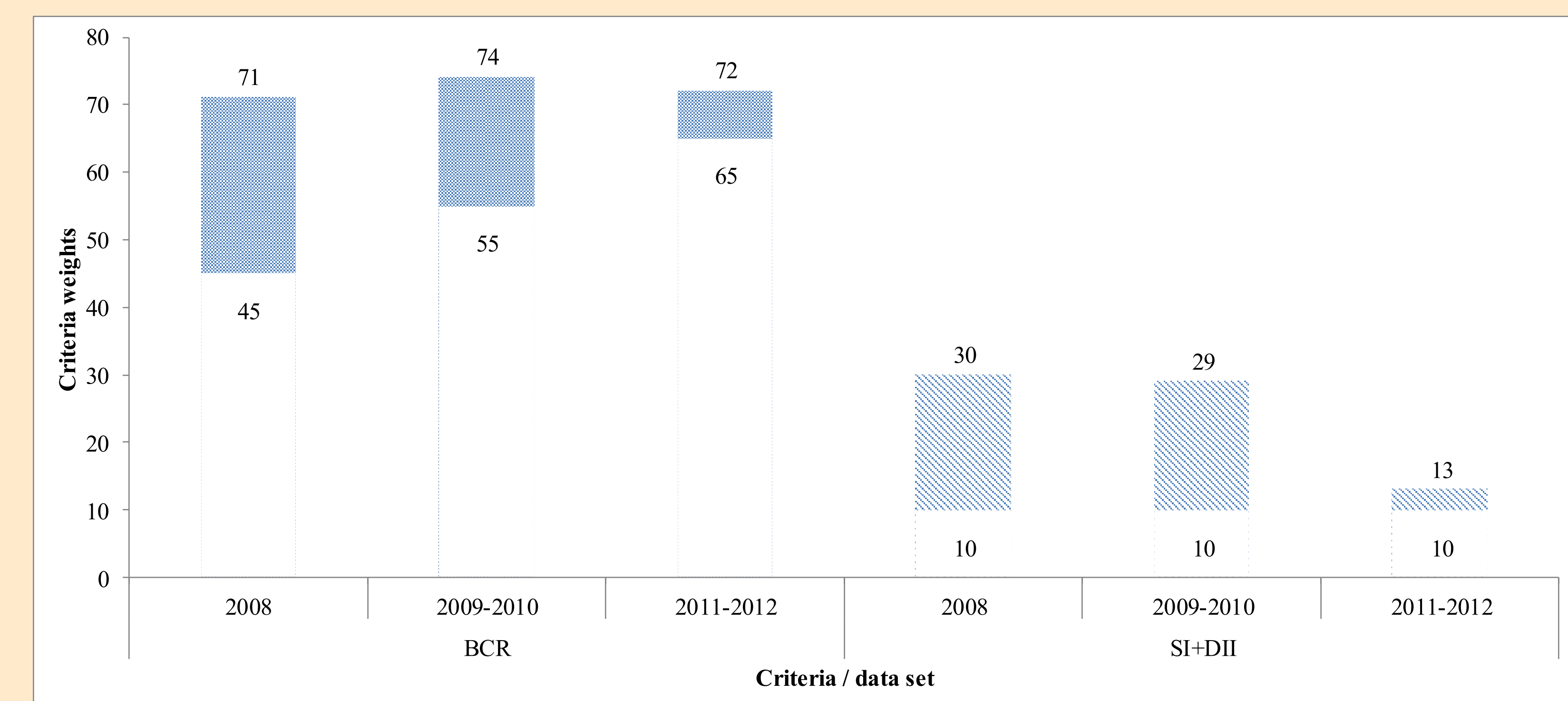
A genetic algorithm is used to search for the best performing set (or sets) of weights, regarding the expressed societal objectives and the extreme values for the weight of each criterion.

## Criteria weights of the non-dominated solutions of the last three calls for proposals



- 1st non-dominated solution is the one that gives best results regarding the avoided consumption objective;
- The last solution is the one that gives best results regarding the cost of each saved kWh objective.

The same set of criteria weights can hardly be suitable for all data sets, regarding the pursued objectives



## Societal objectives

- Maximize the overall saved energy → rank measures by decreasing order of avoided consumption values (AC)
- Minimize the cost of saved energy → rank measures by increasing cost of each saved kWh (CSk)

## Conclusion

The use of this bi-objective approach is compatible with the regulator practice so far, maintaining the transparency of the tender mechanism and providing a greater flexibility and societal advantage of the portfolio of selected measures for market transformation.