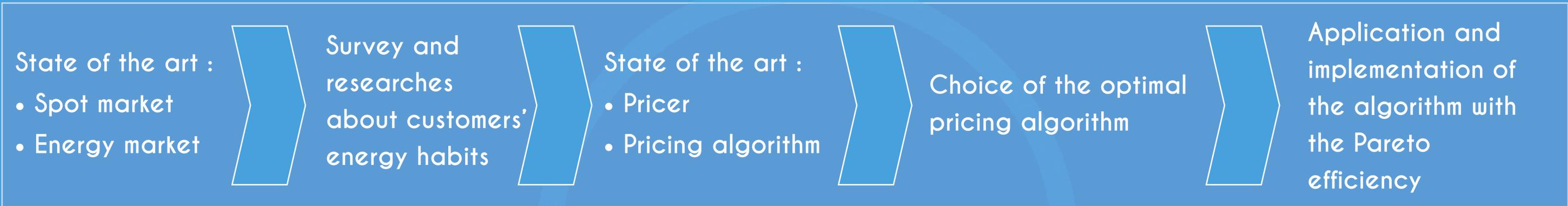


Team n°07— When and where to buy electricity in a Smart-Grid?

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BACKGROUND

Our project is a part of a research program led by Guillaume Guérard aiming to model a local smart-grid, obeying to a demand-response distributed artificial intelligence. Our job was to implement a pricing algorithm to optimize the energy expenses to know when and to whom buy electricity. In this case, we are working at a local scale so all the actors are consumers and producers. The pricer gives us a real time decision to make in order to know what to do with our energy and our needs.

OBJECTIVES

- Write a bibliography on the pricing algorithms in relation with demand-response
- Study the real time variation of the energy prices
- Optimize the pricing decision
- Write a scientific article

METHODS

- Study the key concepts related to the project (spot market, price forecast...)
- Study the pricing algorithm bibliography
- Share information with our fellow researchers
- VBA and C# implementation
- Simulate energy flows in relation with pricing on PowerWorld

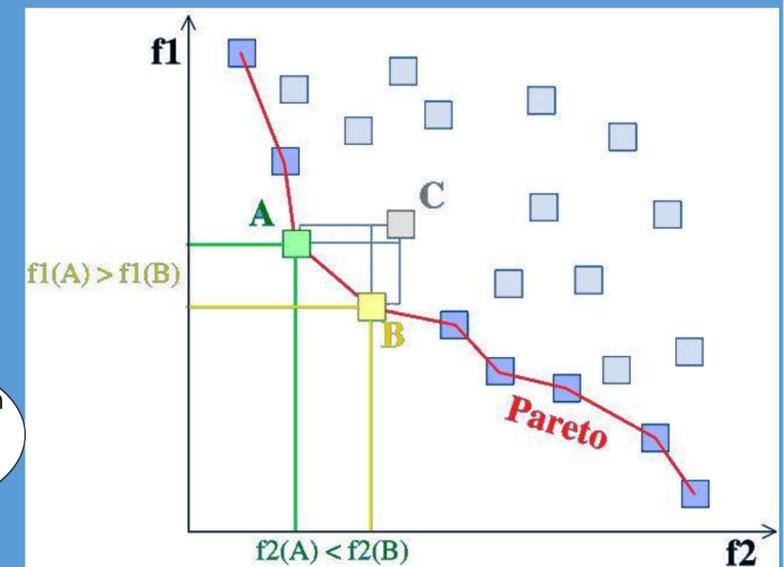
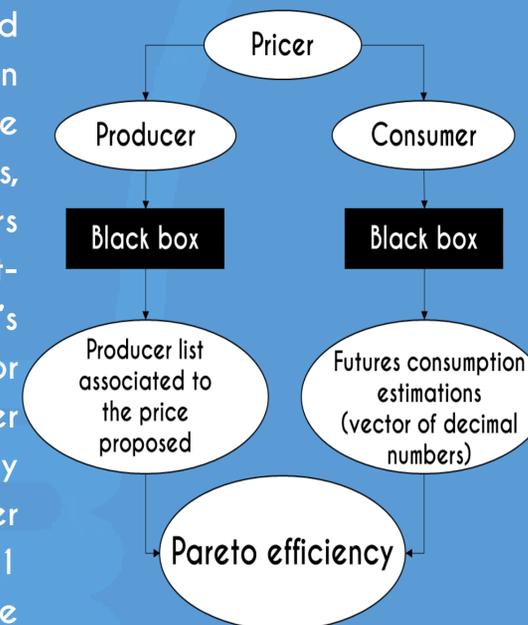
RESULTS

Producer's offer Consumption scheme	O ₁		O _i		[...]		O _m	
c ₁	c ₁	o ₁	c ₁	o _i			c ₁	o _m
c _j	c _j	o ₁	c _j	o _i			c _j	o _m
[...]								
c _n	c _n	o ₁	c _n	o _i			c _n	o _m

This associative chart summarizes the consumption schemes according to the producers' offers. We use the Pareto efficiency to find the most profitable association before comparing it to the market price. The best couple is found with the following formula :

$$\operatorname{argmin} \{ C_i + O_j, \forall i \in \{1, \dots, n\}, \forall j \in \{1, \dots, m\} \}$$

The black boxes hold the input data of the pricer: one for the consumer and one for the producer. On the consumer's side, we gather the energy needs, the internal parameters connected to the smart-home and the user's comfort expectations. For the producer, we gather data on the energy produced, the weather and seasons (with D-1 forecast) and the production forecast of the national provider.



Example of the Pareto efficiency border: if the most efficient situation is where f1 and f2 are the weakest, the point C is not on the Pareto border because it is dominated by the points A and B. The points A and B are both efficient.