JADE Modelling for Generic Microgrid
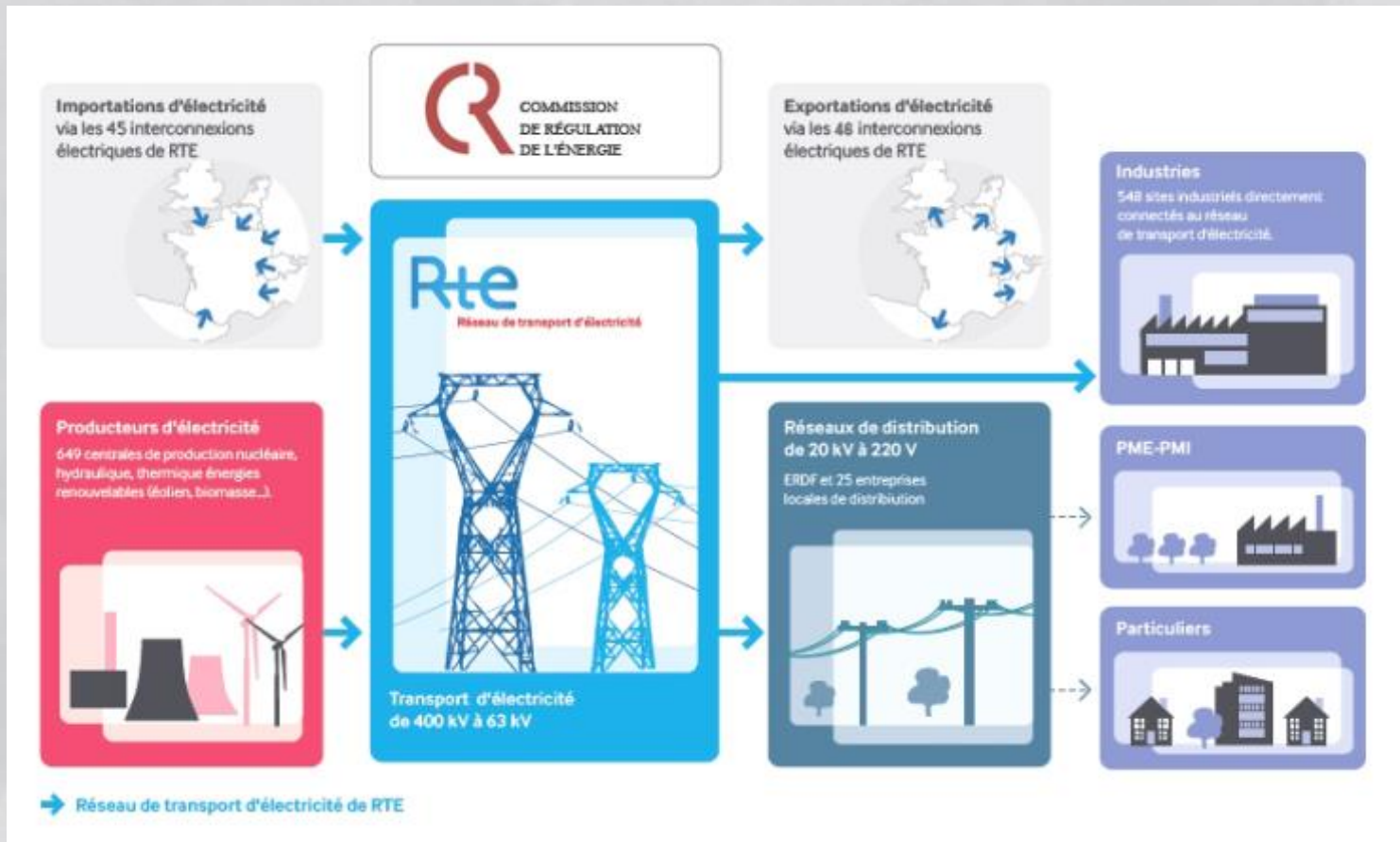
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Smart Grid: a complex system

New challenges

A microgrid

Feedbacks

A Smart Grid ?

Difficulties to integrate renewable energies, home automation, demand-response, flexibility.

- Self-Healing
- Flexibility
- Predictive
- Interactive
- Optimality
- Secured

smart infrastructure

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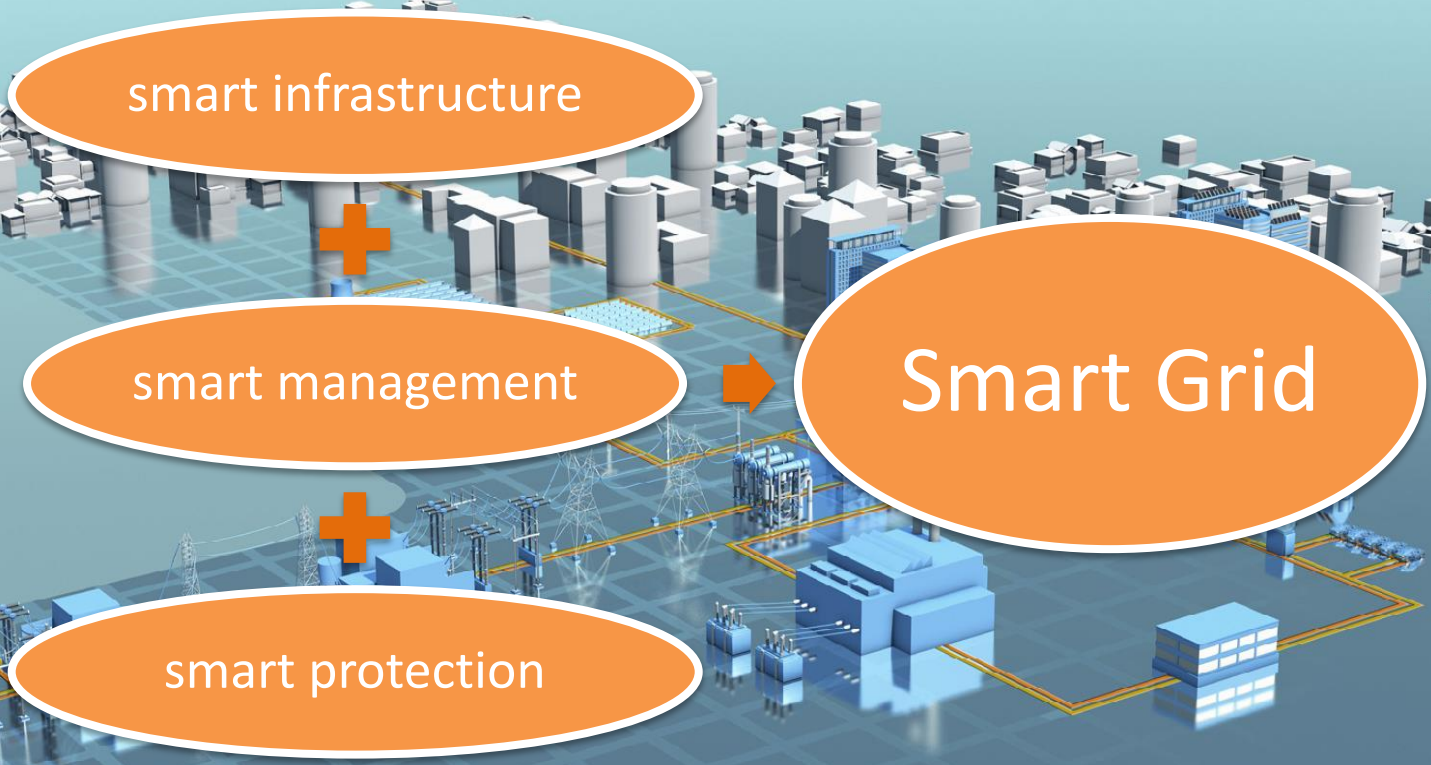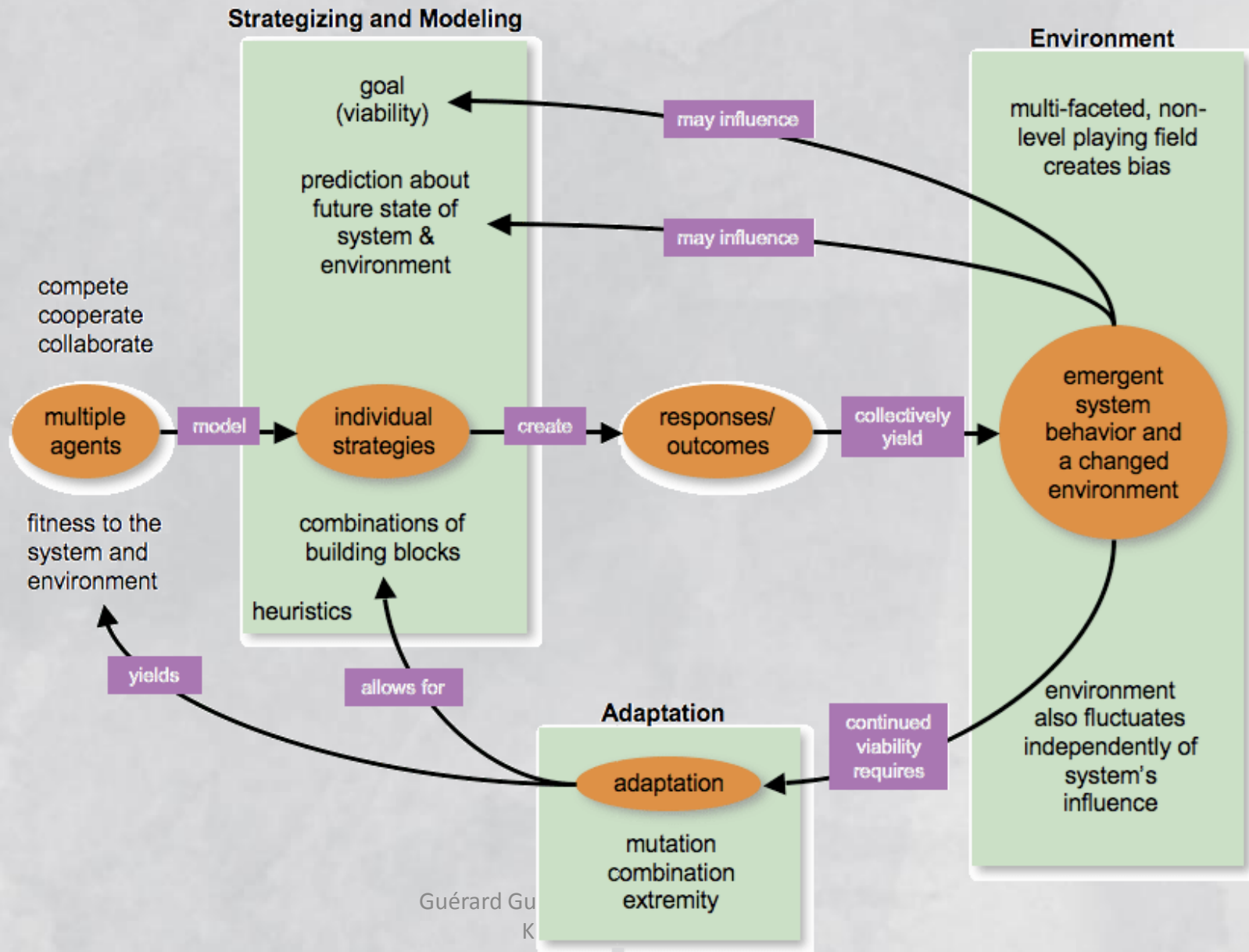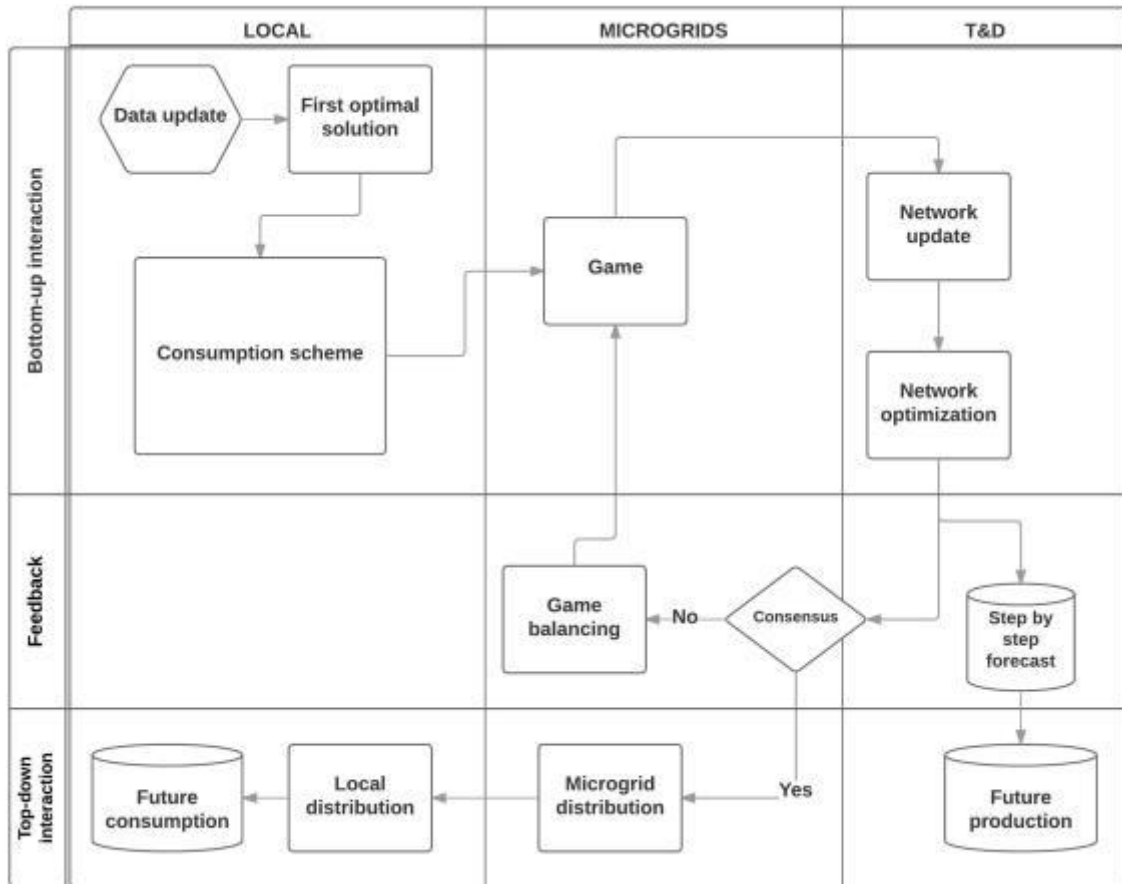
smart management

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smart protection

Smart Grid

Image: Siemens

Smart Grid: integrate the users behaviours.

A complex system

Overall process

- Local

- Microgrid

- Transmission & distribution

Smart grid:

microgrid
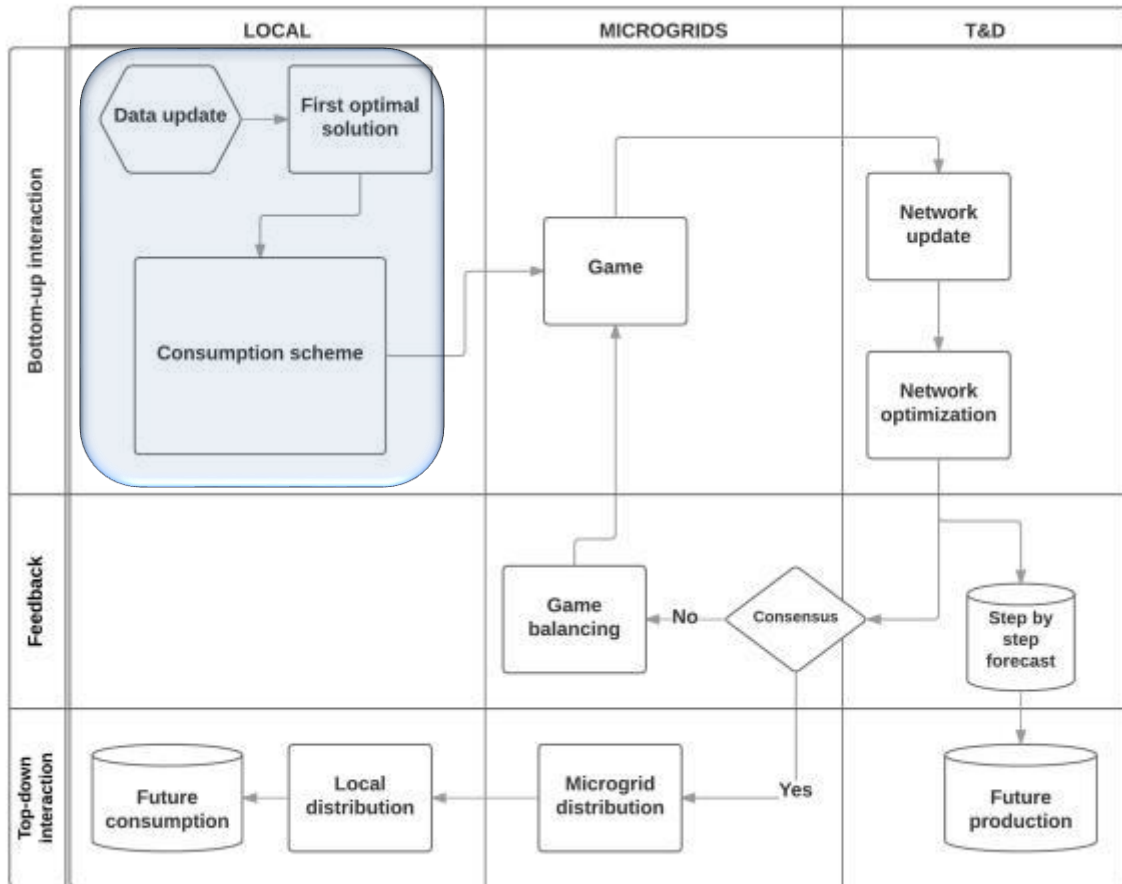
Overall process

- Local
Consumption's schemes

- Microgrid

- Transmission & distribution

Consumption's schemes

House1	House2	House3	House4	House5
1/0/81	1/0/16	1/0	1/0/33	1/0
1/1/80	1/0/16	1/0	1/1/32	3/0
3/0/83	2/1/15	10/0	3/0/35	
5/2/75	3/0/18		3/2/29	
20/4/20	4/3/7		4/1/32	
	5/3/5		8/4/8	
Forecast: 4	Forecast: 6	Forecast: 12	Forecast: 8	Forecast: 6
FOS : 5	FOS: 7	FOS: 12	FOS: 9	FOS: 6

- Priority
- Utility
- Knapsack 0-1

Dynamic programming: Keep in memory any subsolution
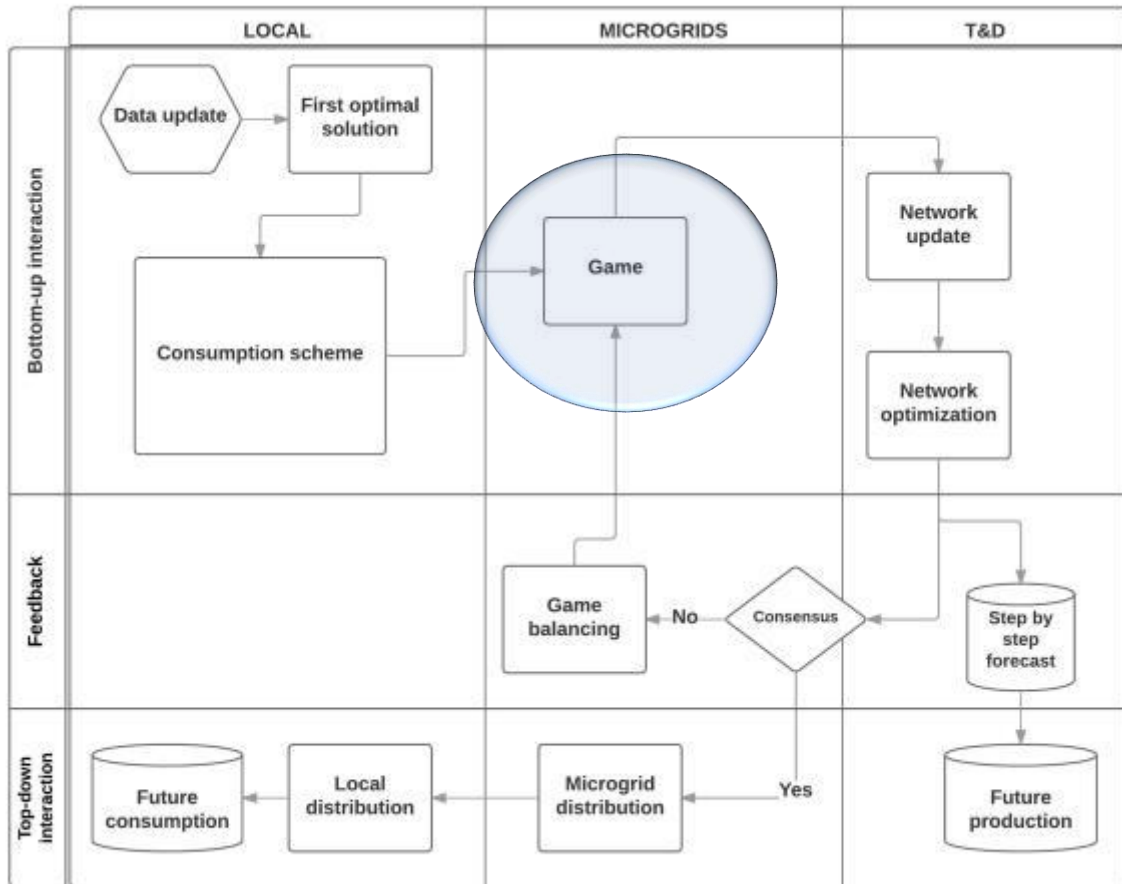
Overall process

- Local

- Microgrid Games

- Transmission & distribution

Games

Strategies based on the priority value/consumption of each devices (one-sided)		DSM Strategies (two-sided) *The behaviour of a consumer may differs to the producers' one. Microgrid's policies can't impose a local strategy but influence all utilities.*			
Set of devices 1	*l/r*		**Response 1**	**...**	**Response i**
Set of devices 2	*l/r*	DSM 1	*l/r*	*l/r*	*l/r*
Set of devices 3	*l/r*	DSM 2	*l/r*	*l/r*	*l/r*
...	*l/r*	...	*l/r*	*l/r*	*l/r*
Set of devices m	*l/r*	DSM j	*l/r*	*l/r*	*l/r*

- Local schemes
- T&D schemes
- Pareto equilibrium

Pareto: best values for both players
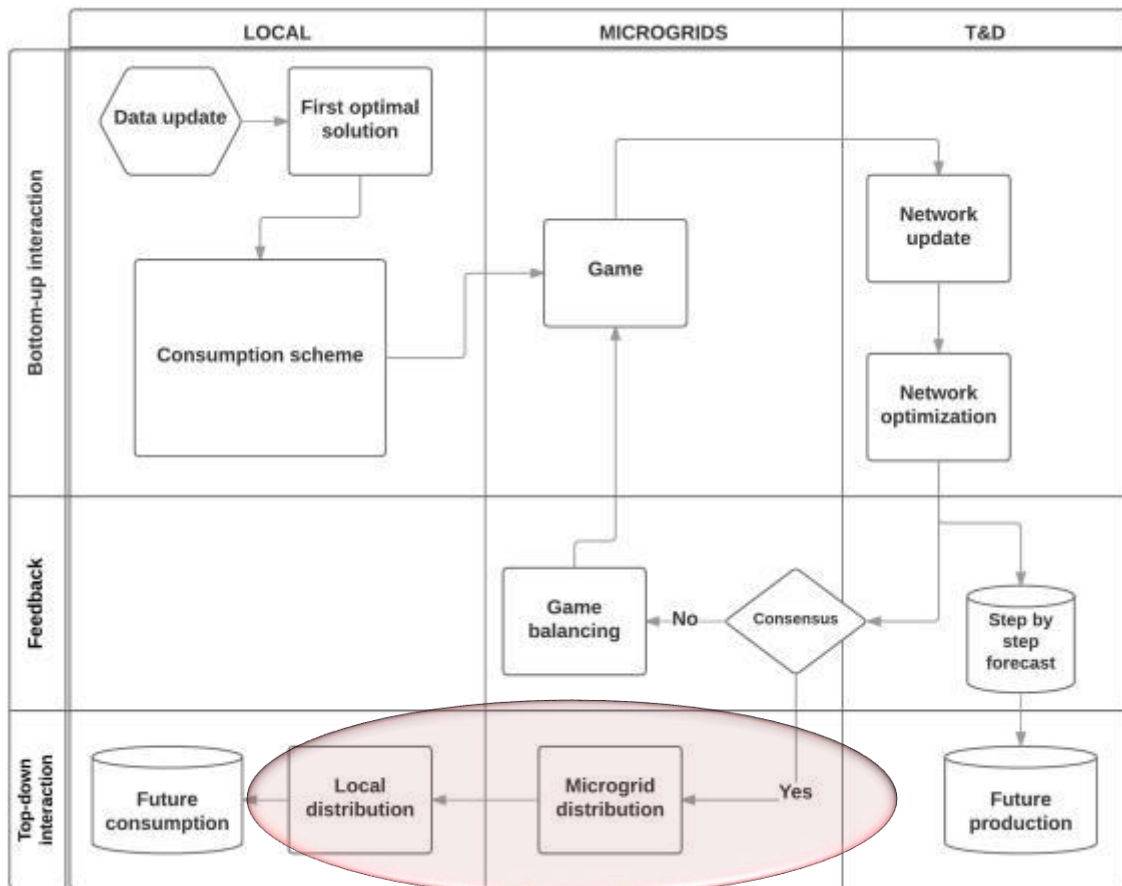
Overall process

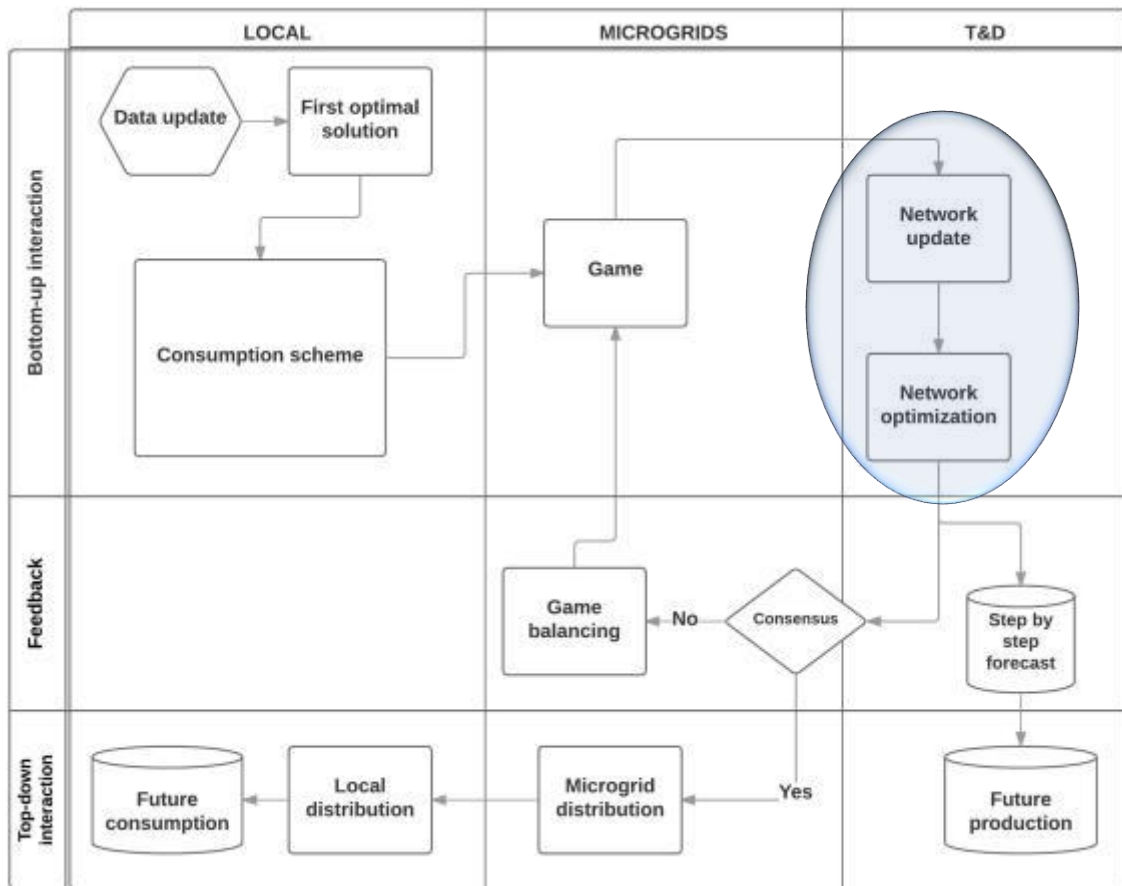- Local
Energy distribution

- Microgrid
Energy distribution

- Transmission &
distribution

Smart grid:

feedbacks

Overall process

- Local

- Microgrid

- Transmission & distribution

Update & routing

Network update

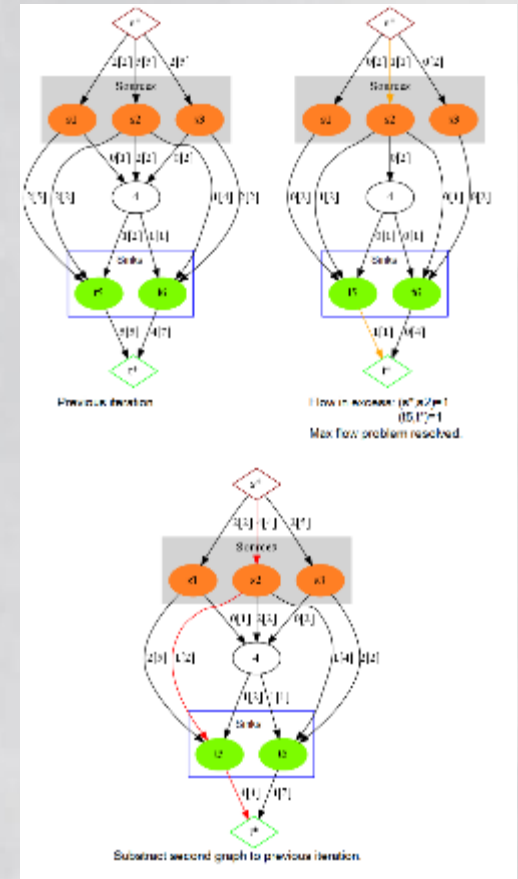### How to build a dynamic graph ?

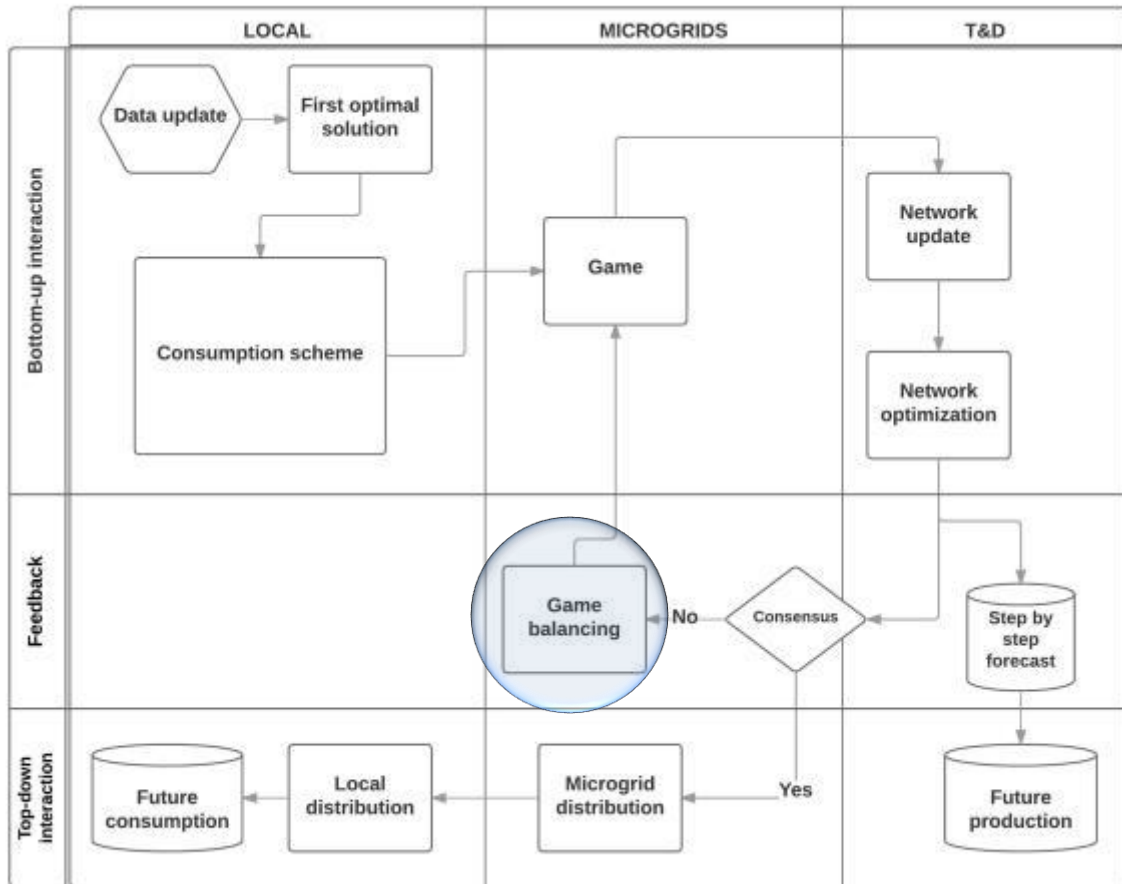## • Pretopology

(E, a₁)

(E, a₂)

(E, a₃)
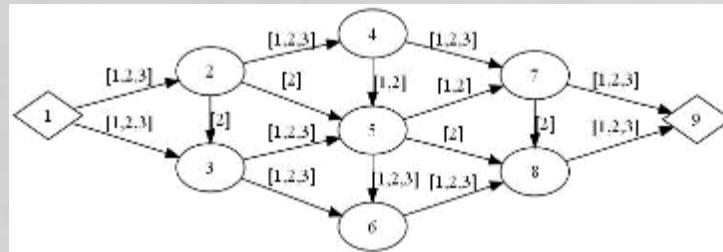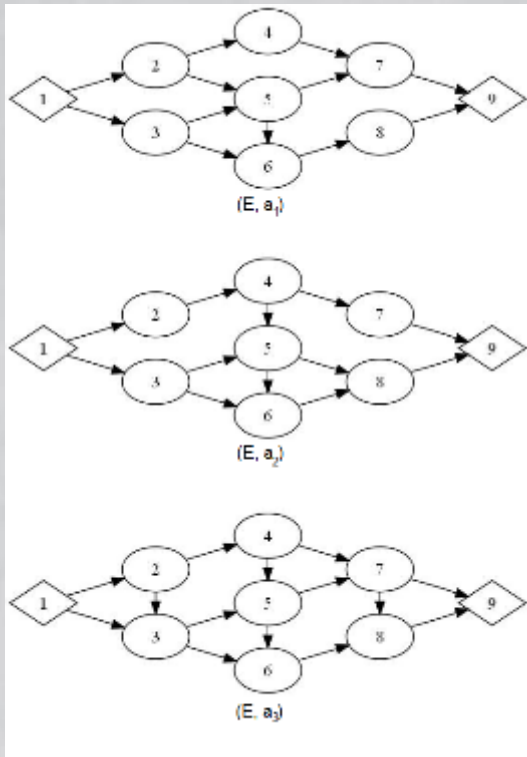
1. A graph for each criterion.

3. The final graph is a Boolean function of the pretopologic spaces.
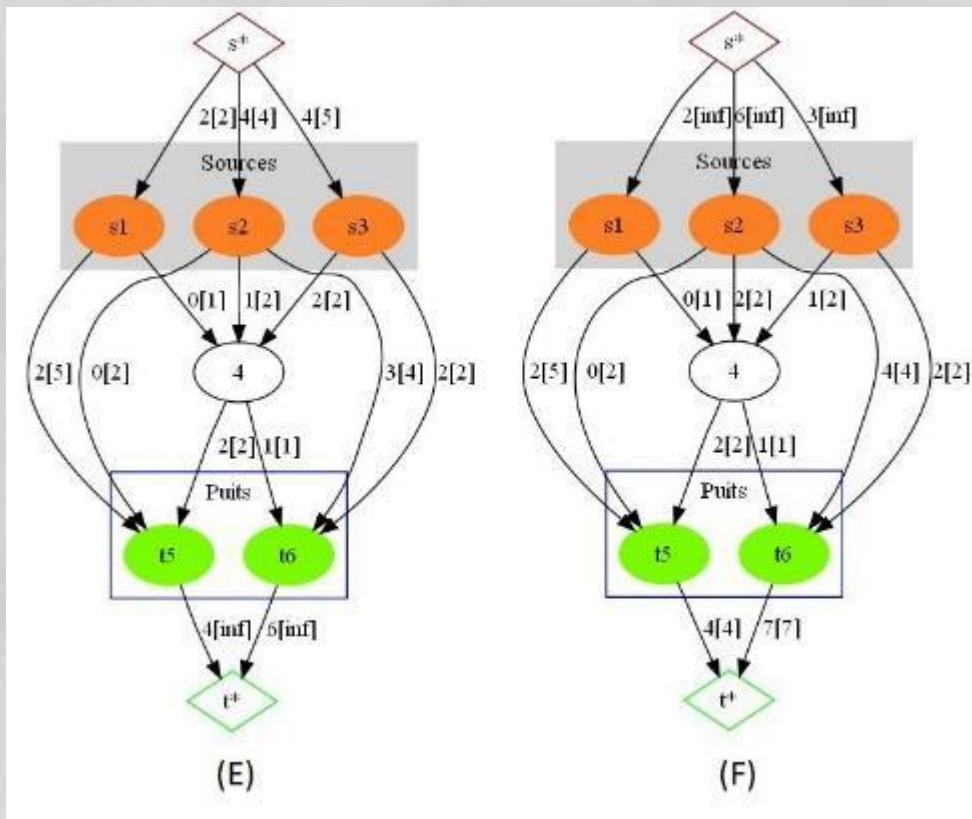
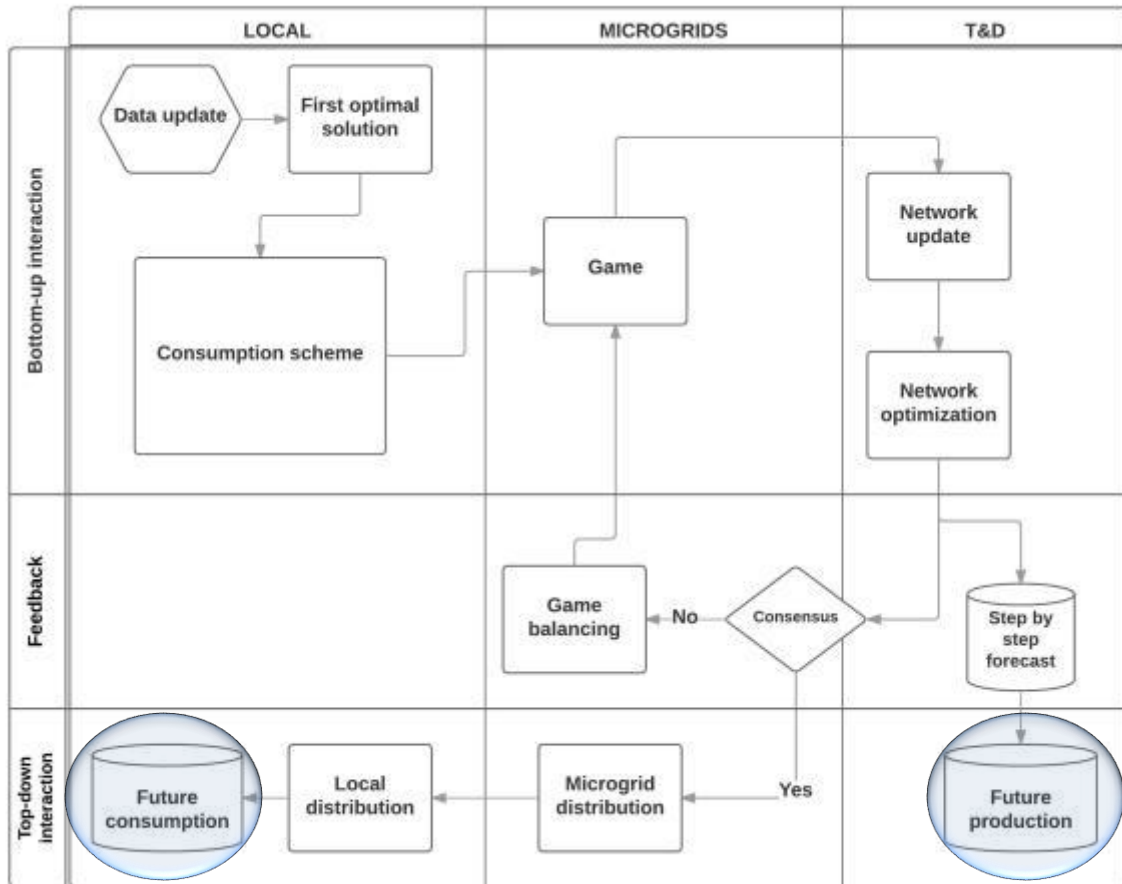3. Resolve the max flow at minimum cost problem.

- Local

- Microgrid
Feedbacks

- Transmission & distribution

Overall process

(E)   (F)

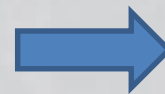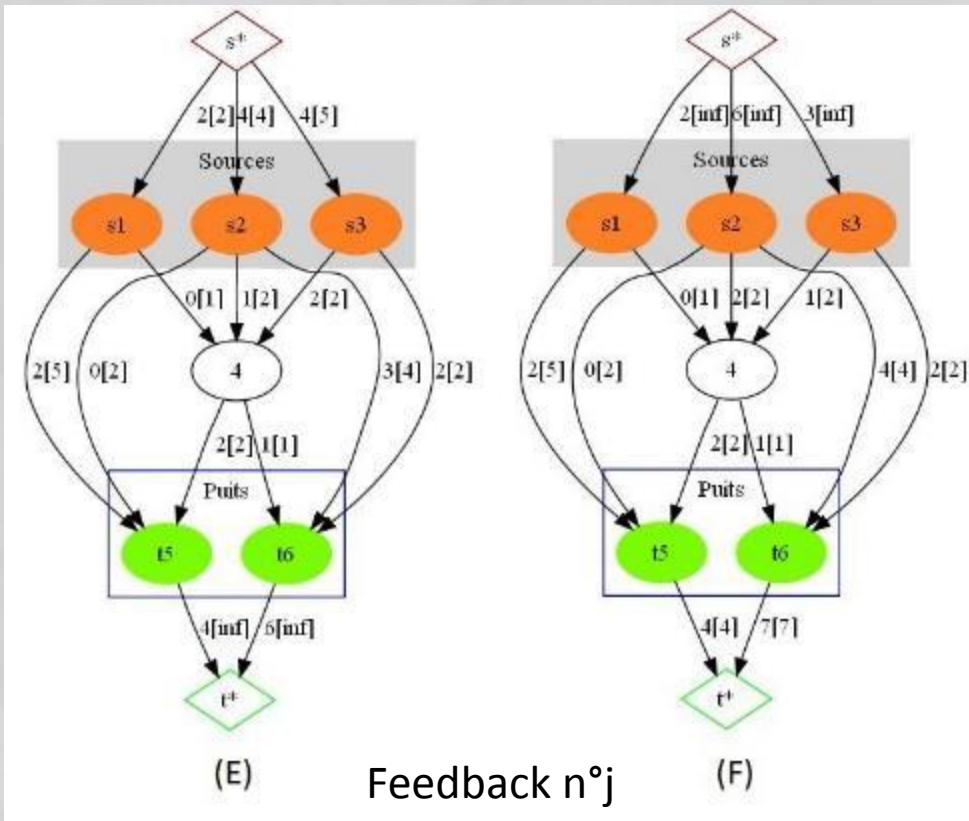- **Current feedback:** Microgrids can change their behaviours.

- Local
  Prediction

- Microgrid

- Transmission &
  distribution
  Prediction

Overall process

Prediction

Feedback n°j

- **Final decision:**

$$2\frac{\sum_{i=1}^{j} j*(x_{result(j)})}{j(j-1)}$$

- x : for each microgrid
- x : for each producer
- Building forecast at the end of the process.
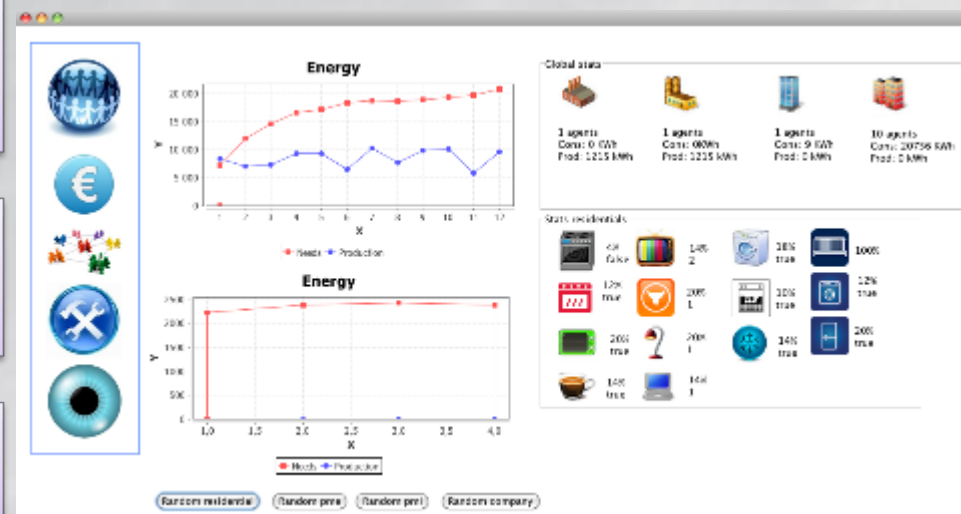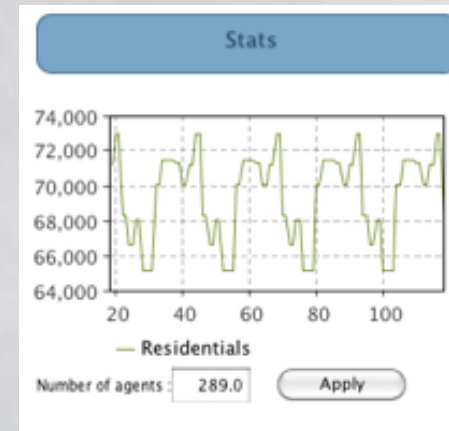
JADE Simulation

T&D

Consumption

Architecture

Self-healing

Communication

Thank you for your attention

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