Artelys
solutions en optimisation

RTE

Towards electricity transmission tariffs Based on long term marginal pricing

Artelys : Nicolas Omont, Arnaud Renaud,
RTE : Jérome Dejaegher

Summary

- T.S.O. Revenue paradigms
  - Costs / tariff
  - Prices / market
- Long term nodal pricing
  - Principle
  - Model
- Conclusion

T.S.O. Revenue paradigms

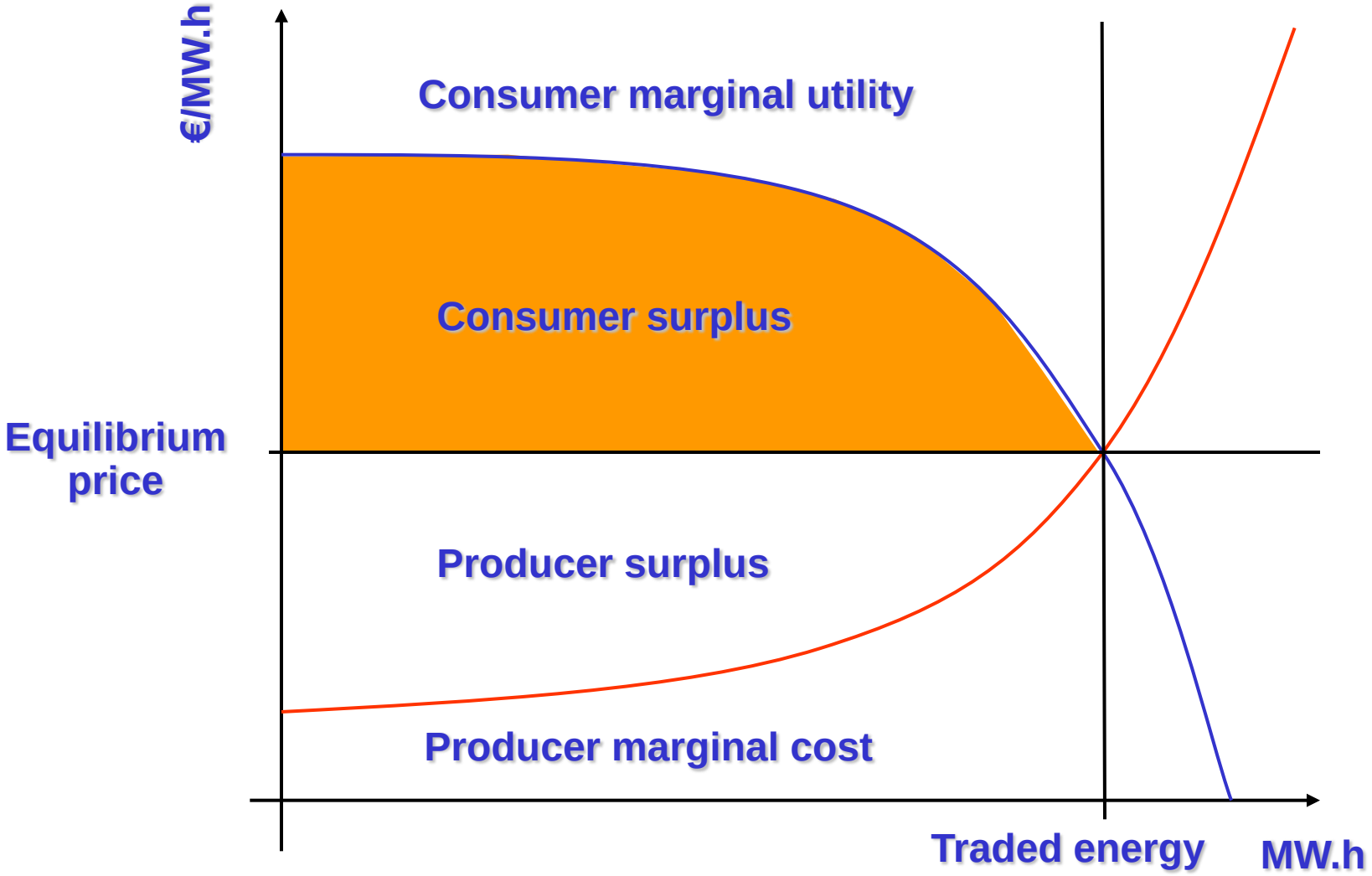
- Tariffs
  - In EU, made by national regulators
  - Basis : cost evaluation, tariff independent of customer location
  - Strength : cost recovery
  - Weaknesses :
    - About 25% of a TSO charges are grid losses
      - Price determined by market means : volatile and unpredictable
    - Lack of incentive signals
      - Allocation of annual costs to each timeslot ?
      - Spatial differentiation of tariffs ?

Revenue paradigms

- Market revenues :
  - Basis : Equilibrium market prices
  - Strength : give incentive to actors
    - equilibrium corresponds to social welfare maximization
  - Weakness :
    - Unsuited for a monopoly
    - short term nodal price does not allow full cost recovery.

T.S.O Revenue paradigms

- Marginal pricing theory :



Principle of long term nodal pricing

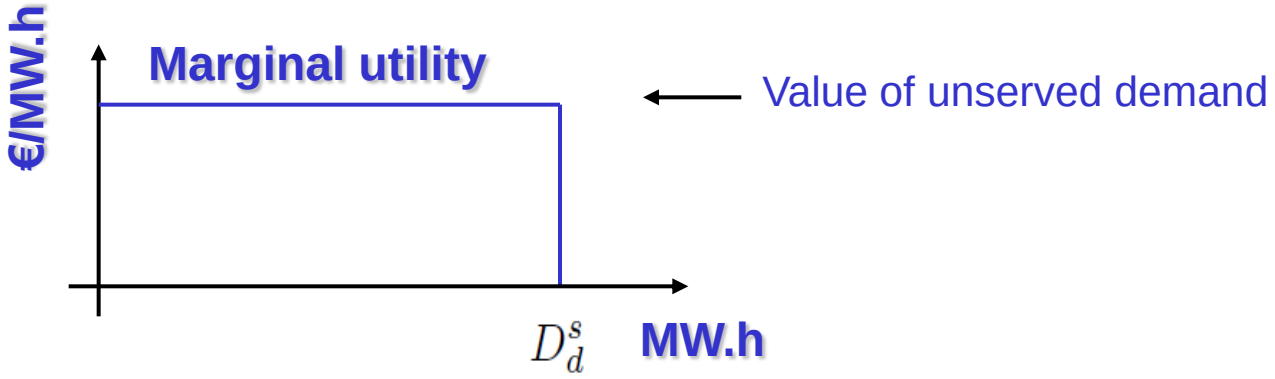
- Marginal pricing in transmission system :
  - How to define utilities and costs

Fixed line capacities	Variable line capacities
Short term	Long term ⇨ Development costs taken into account in equilibrium prices ⇨ **Cost recovery is possible**

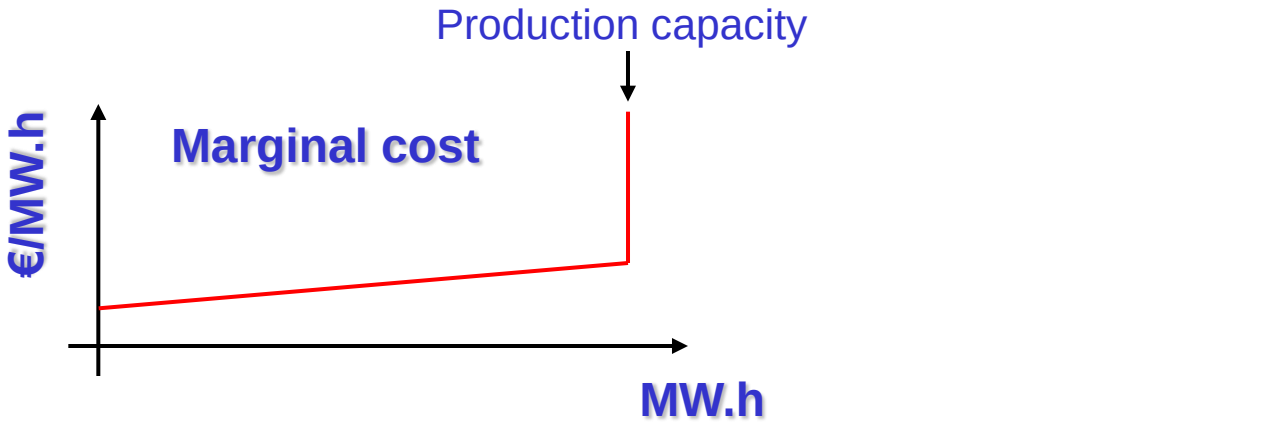
  - Constraint : Convex and smooth model
    - Interpretation of dual variables of optimal power flow problem as prices.
    - No focus on obtaining realistic values for primal variables (line capacities and flows)

Model

- Definition of marginal cost / utility functions (1/2)
  - Producers / Consumers
    - Utility of consumer d in situation s : D_d^s

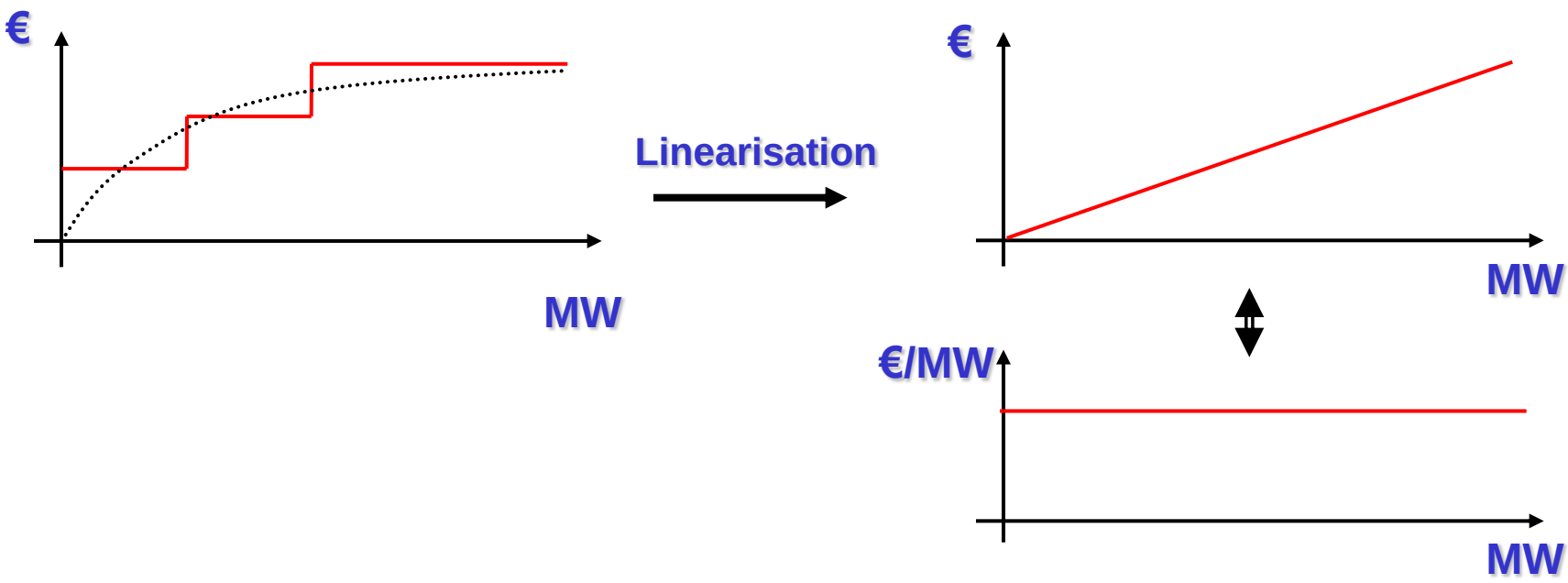


    - Marginal costs of producer g in situation s : $c_g^{g,s}(G_g^s)$



Model

- Definition of marginal cost / utility function (2/2)
  - Transmission system : marginal development cost
    - Corresponds to the annual rental cost of a line of a given capacity
    - Discrete and not concave

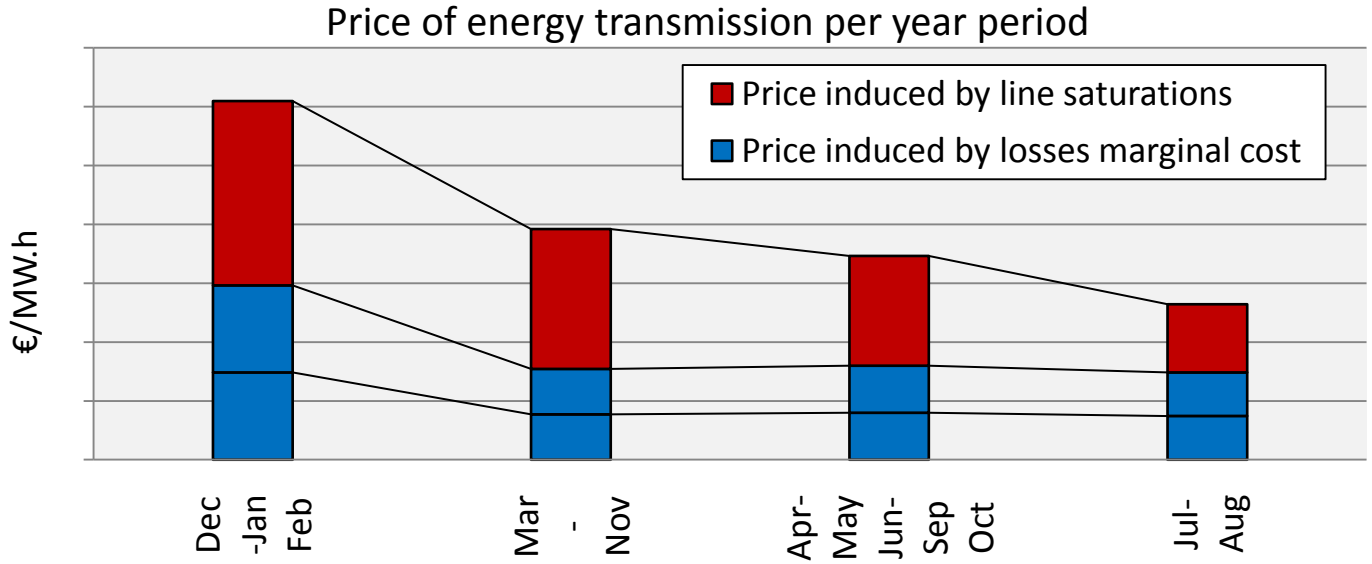


Model

- Optimal power flow problem :
  - One situation :
    - The network of developped lines is a tree.
  - Multi-situations (line capacities are developped once for all situations) :
    - The network of developped lines is not a tree, even without second law.
    - Each line is saturated at one or more situations. Its developpment costs is compensated at these situations (« peak load pricing »).
  - Losses :
    - Quadratic losses with resistance inversely proportionnal to capacity
    - Low impact on flows and capacities (+2%), but
    - High impact on prices (+20%)

Conclusion

- Long term nodal pricing is a promising tool to set tariffs :
  - Cost recovery appears to be possible
  - Spatial and temporal incentives are given to producers and consumers
- Indicative charts : First results (indicative data)
  - Stable results on 50 annual production/consumption scenarios
  - Focus on saturation costs
  - Spatial vs temporal analysis.



Conclusion

- TSO tariff has to cope with :
  - social welfare maximization, the objective of an efficient TSO (best service/best cost)
  - Political and social issue : no discrimination in utilities access, **energy conservation**
  - A stable tariff to recover volatile costs

- So much left to do :
  - Is this model politically & socially acceptable ?
  - Is the temporal signal adapted on the whole territory ?