THE ECONOMICS AND REGULATION OF NATURAL GAS STORAGE:

Ensuring Security of Gas Supply Across Europe

Florent Silve

Sciences-Po Paris – École Polytechnique

Technology Policy Graduate 2009

TMP Conference – University of Cambridge

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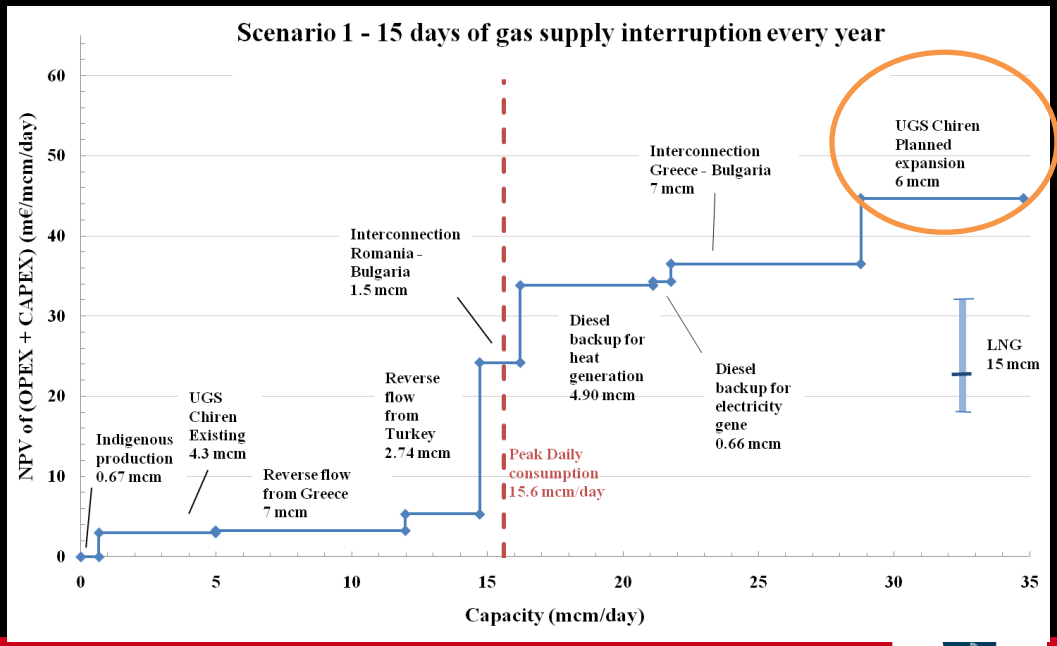
Why this research? The context

- **Research on the gas supply security in Eastern Europe at EPRG**
  - **Ex: case of Bulgaria**

Silve, F. and Noël P. (2010) "*Improving Gas Supply Security in Eastern Europe: The Case of Bulgaria*" . EPRG, University of Cambridge, mimeo.

Most cost effective way to reach a satisfactory level of SoS in Bulgaria?

- Regain of interest in security of energy supply issues
- EU directives



Aim of the research

Governments are often nervous about the market's willingness to supply adequate SoS, for ex. through suitable gas storage capacity and operation.

Reasons: market and institutional failures?

Research question:

How best to address and correct these failures without making things worse?
What policy or regulatory measures to incentivise appropriate investment in gas storage?

Structure:

1. **Gas storage in a *'perfect'* gas market.**
   - What role and operation for gas storage?
   - What mechanisms should be driving appropriate investment in gas storage?

2. **What potential externalities, market and institutional failures…**
   … could prevent well functioning market and could hamper adequate investment in storage?
   (analysis of currently existing frameworks of operation and regulation of gas storage in some countries)

3. **What potential policy and regulatory options?**

Why do we need and operate gas storage?

Storage as a flexibility tool

Short-run

- **Response to demand-side variations**
- **Response to supply-side variations**
- **Efficiency considerations**
- **Reliability requirements**

Medium-run/Seasonal

- **Response to demand-side variations**
- **Efficiency considerations**

Long-run: Low-Probability-High-Impact events

(Storage as a strategic tool)

What would a ‘perfect’ gas market be?

Perfect competition

Perfect foresight & perfectly rational agents

Perfect contracting

Perfect information

No transaction costs

Economic description of storage activity: an arbitrage

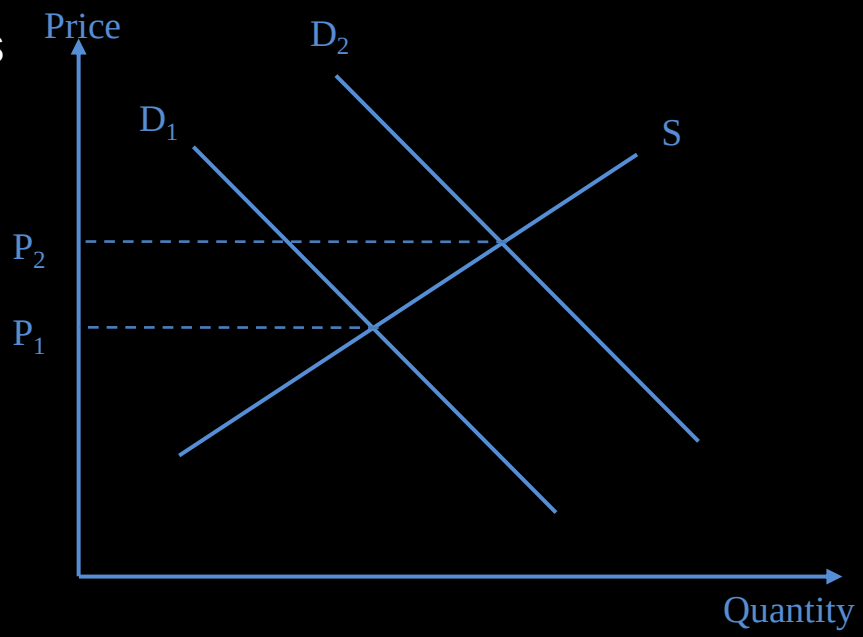
Objective of storage: prevent or reduce imbalances or inefficiencies, be they short-term, seasonal, or associated to low-probability-high impact events.

Without storage: we would be in a hypothetical situation (**conterfectual economy)** in which there would be 2-states.

State 1: without imbalances or inefficiencies

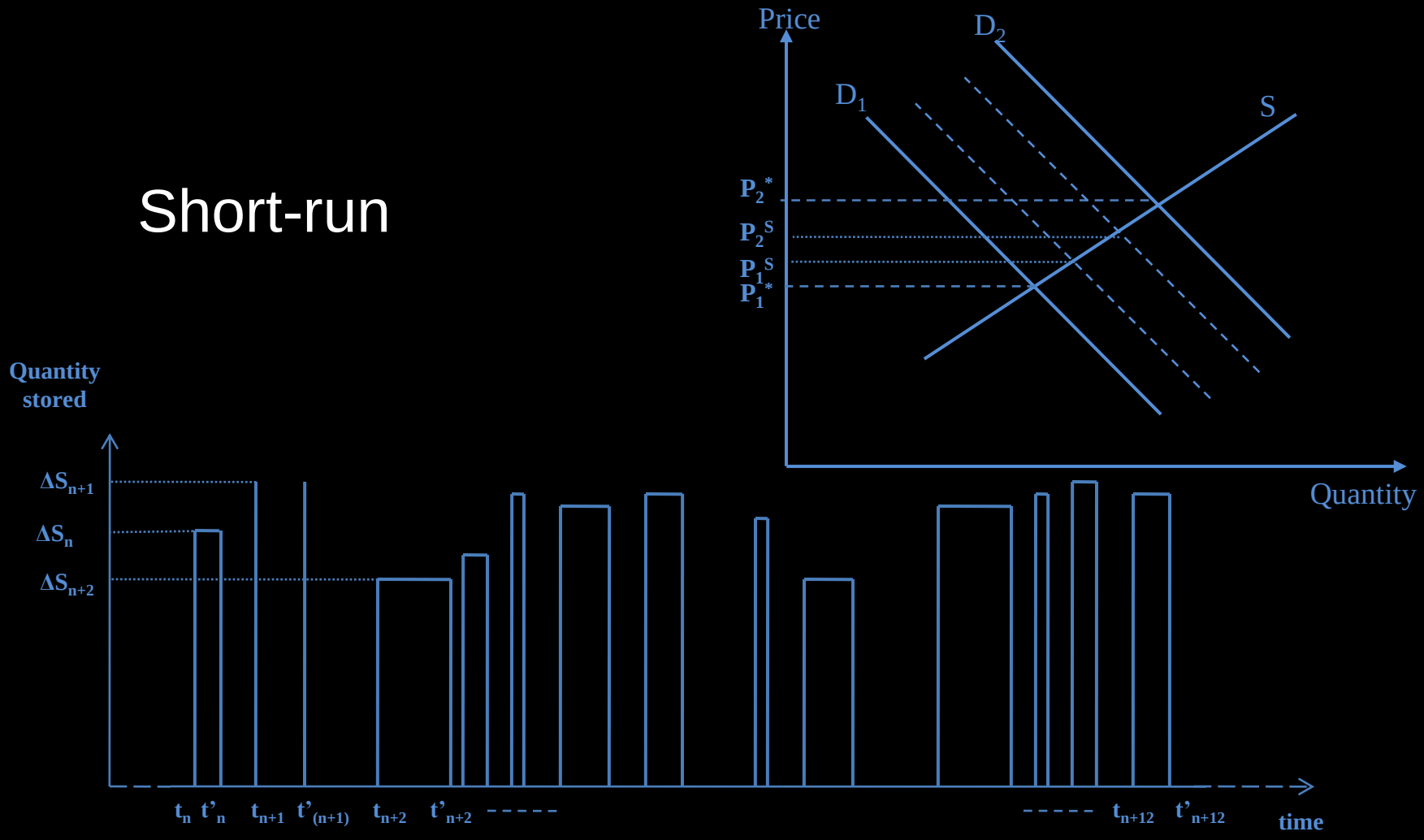
State 2: with imbalances or inefficiencies

Economic description of storage: Arbitrage tool between the 2-states in this hypothetical counterfactual economy.



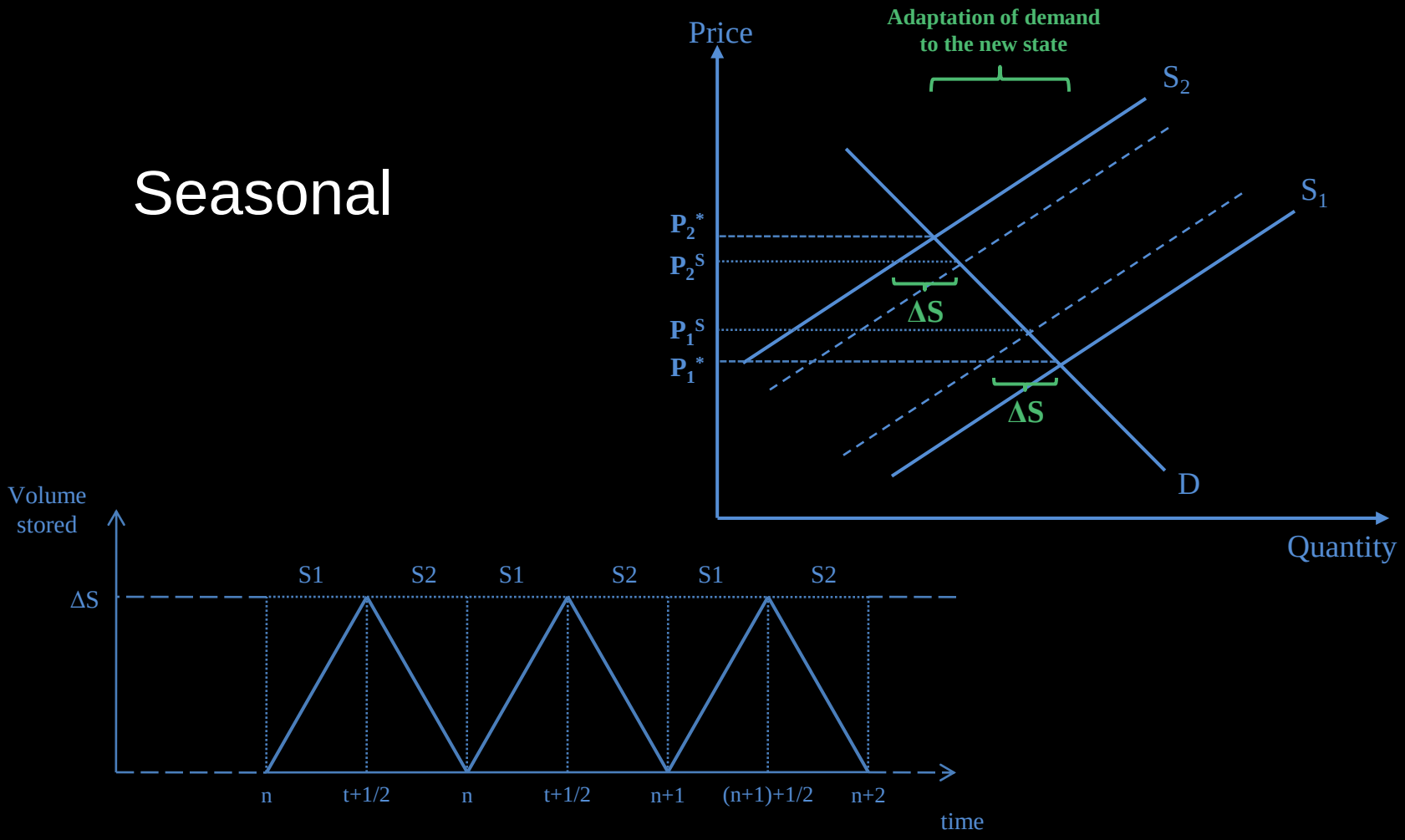
Economic description of storage activity: an arbitrage

Short-run



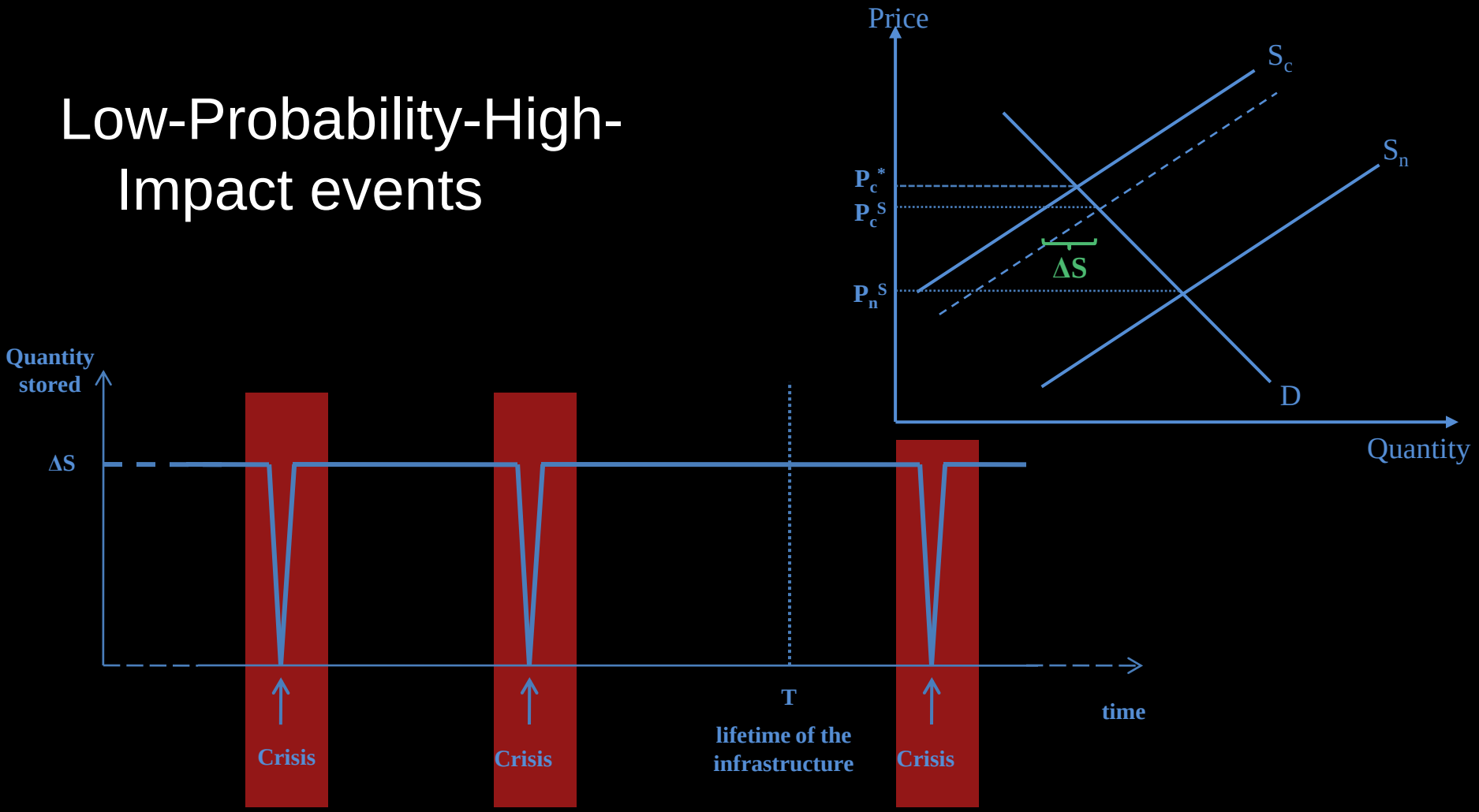
Economic description of storage activity: an arbitrage

Seasonal



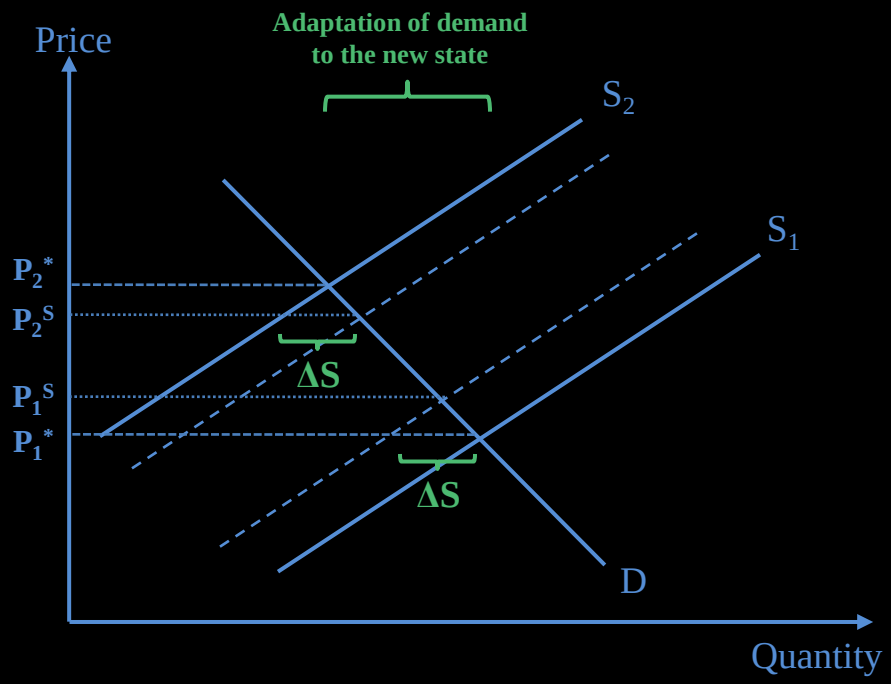
Economic description of storage activity: an arbitrage

Low-Probability-High-Impact events



Investment drivers in a ‘perfect’ gas market

Short-run

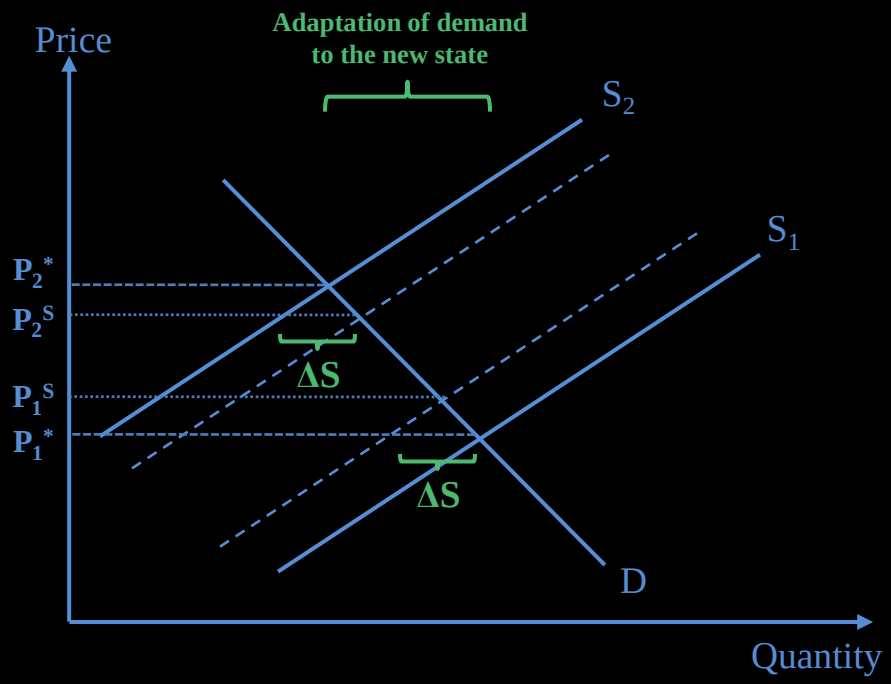


$$\Pi_{t=0} = \sum_{n=1}^{N} \left((1 - r.t_n).\left[(1 - r.dt_n) P_2^S(t_n^2) - P_1^S(t_{n1}) - c(t_n) \right].\Delta S_{t_n} \right) - I$$

Investment if $\Pi_{t=0} \geq 0$

Investment drivers in a ‘perfect’ gas market

Seasonal

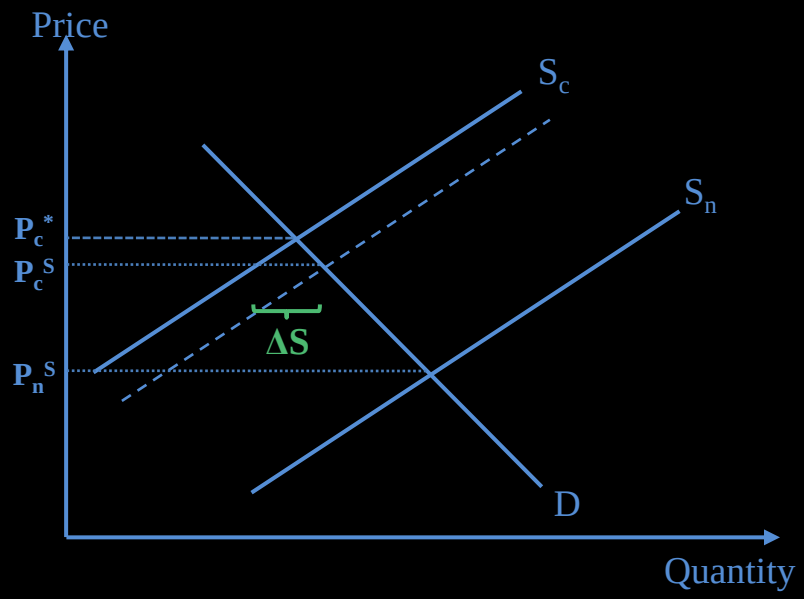


$$\Pi_{t=0} = \left(\sum_{n=1}^{N} (1 - r.n). \left[\left(1 - r.\frac{1}{2}\right) P_2^S \left(n + \frac{1}{2}\right) - P_1^S(n) - c(n) \right] . \Delta S_n \right) - I$$

Investment if $\Pi_{t=0} \geq 0$

Investment drivers in a ‘perfect’ gas market

Low-Probability-High-Impact events



$$\Pi_{t=0} = \left(\int_0^T (1 - rt).\lambda.\left(P_c^S(t) - P_1^S(t)\right)dt - c(t).dt \right) - I - P_1^S(t=0) + (1 - rT).P_1^S(t=T)$$

Investment if $\Pi_{t=0} \geq 0$

Externalities, market and institutional failures

Low-Probability-High-Impact event

Failure to predict λ?

Costs uncertainties?

Large irreversible investment:
hold-up issue?

$$\Pi_{t=0} = \left(\int_0^T (1 - rt).\lambda.\left(P_c^S(t) - P_1^S(t)\right)dt - c(t).dt \right) - I - P_1^S(t=0) + (1 - rT).P_1^S(t=T)$$

Financial risk sharing?

Scarcity price high enough?
Forecast?
Price cap?
Market power?

Others:
Planning process
Transaction costs
Public good aspects
Existence of Force Majeure clauses

Policy and regulatory options

- Building storage at public expenses
  - Averch-Johnson effect?
- Increasing penalties for imbalances or more stringent contractual obligations to deliver
  - Underestimation of probability therefore of penalty anyway?
- Obligation to contract for storage
  - What about more efficient substitutes?
- Capacity payments
- Capacity obligations
  - Substitutes? Implementation? Control? Tests?

Next steps and conclusion

- Further develop the identification and description of potential policy and regulatory options.
- Choose and use a clear set of criteria to assess the different options (impact on investment decision, cost and feasibility, potential side effects, interaction with other regulations...)

Florent Silve
MSc in Physics and Chemistry,
Mphil in Technology Policy

Economics and Public Policy graduate student
Sciences-Po Paris – École Polytechnique

florent.silve@cantab.net

entente cordiale
Scholar 2008