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CENTRE
INTERNATIONAL
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SUR L'ENVIRONNEMENT
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Decarbonation of electricity systems: When all new production will stand outside the market

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Issue of market pull deployment of low carbon technologies LCT

- Long and complex innovation chain for CCS, new nuclear, large scale renewables;
- They should cross the « death valley »;

→learning-by-doing should be expected from initial deployment of LCT after demo stage

→learning spill-over justify a policy intervention to trigger LCT deployment.

to be economically ready in case carbon price high

Uncertainty:

Numerous uncertainties surrounding the future competitiveness of LCT:

- on the cost and learning rate of LCT;
- on the costs of alternative technologies:
  - Uncertainty on climate policy and the price of carbon in the second period
  - Uncertainty on the price of fuel

Introduction

- Power sector key to ‘decarbonise’ the economy

  CCS , Nuclear and large sized enewables would displace coal-fired generation

  iand follow demand growthcountries

- Low carbon technologies in power generation :
  - capital intensive (large sized as well as low sized)
- Major low carbon technologies are still in the innovation process:
  - the problem of crossing the death valley
  - Old new technology need re-learning and radical safety improvement
- No adequation of present imarket regime of electricity system with characters of low carbon technologies
  - Need of subsidization to production or
  - Need of new sharing risk
  - Need of government monitoring of transition

Content

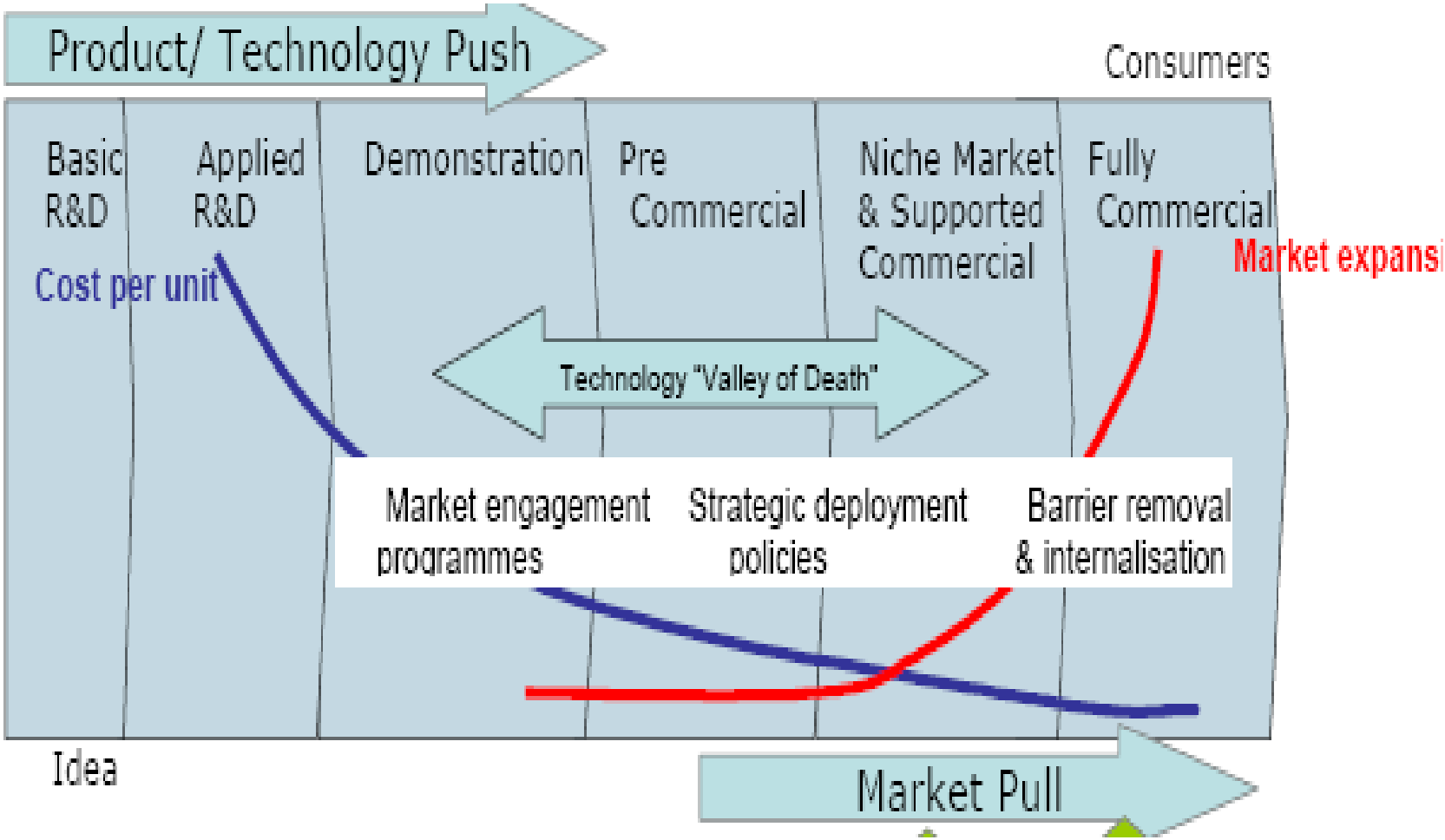
- 1. Market failures
  - constraints on learning on low carbon technologies
  - investment distrosion in mix
- 2. Answers
  - Arrangements for subsidization
  - Towards radical adaptation to market regime

1. Rationale to support low carbon electricity technology deployment

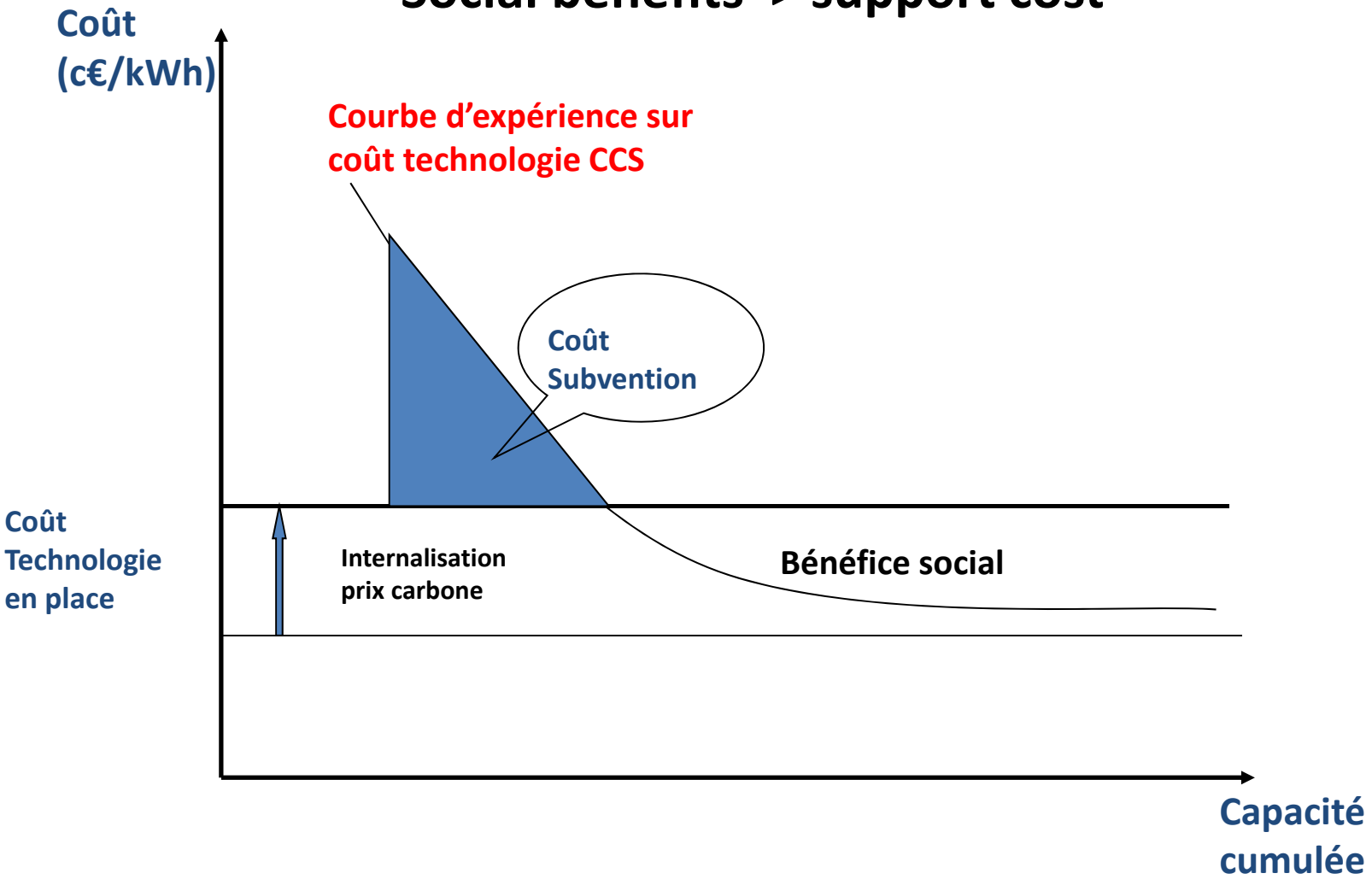
1. 1. Market failure in matter of deploiment of LCT

The market orthodoxy

- Market failure on knowledge:
  - Only financing RD&D
  - Technology push
- Market pull
  - The role of carbon price to make LCT competitive with incumbent carbon technology
  - Technology neutral orthodoxy
- BUT Death valley
    - long leadtime, capital intensivenss
    - Learning : too slow cost decrease


Product/ Technology Push
Consumers
Basic R&D
Applied R&D
Demonstration
Pre Commercial
Niche Market & Supported Commercial
Fully Commercial
Market expansi
Cost per unit
Technology "Valley of Death"
Market engagement programmes
Strategic deployment policies
Barrier removal & internalisation
Idea
Market Pull

Rationale of public support after the RD&D stage
Social benefits > support cost

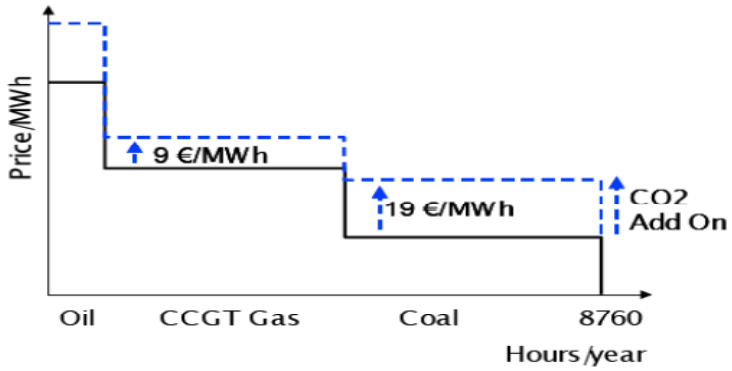


1.2. Supplementary risks in electricity market regime

- All the risks: technology risk, regulatory risk, price risk, volume risk, are borne by the investors, ot consumers
- Financial community preferred project finance to corporate finance:
  - because specific risk on elecmarket high risk premium
- Risks and price-making on electricity markets
  - Hourly price aligned on marginal projects
  - **Sum of hourly Infra marginal rent is supposed to cover huge fixed costs of low carbon** (LCT down in the merit order)
  - Carbon price add to uncertianty

- **The result : a strong bias in favor of low capital intensive CCGT which self hedges**

The inefficiency of carbon price signal in electricity market regime

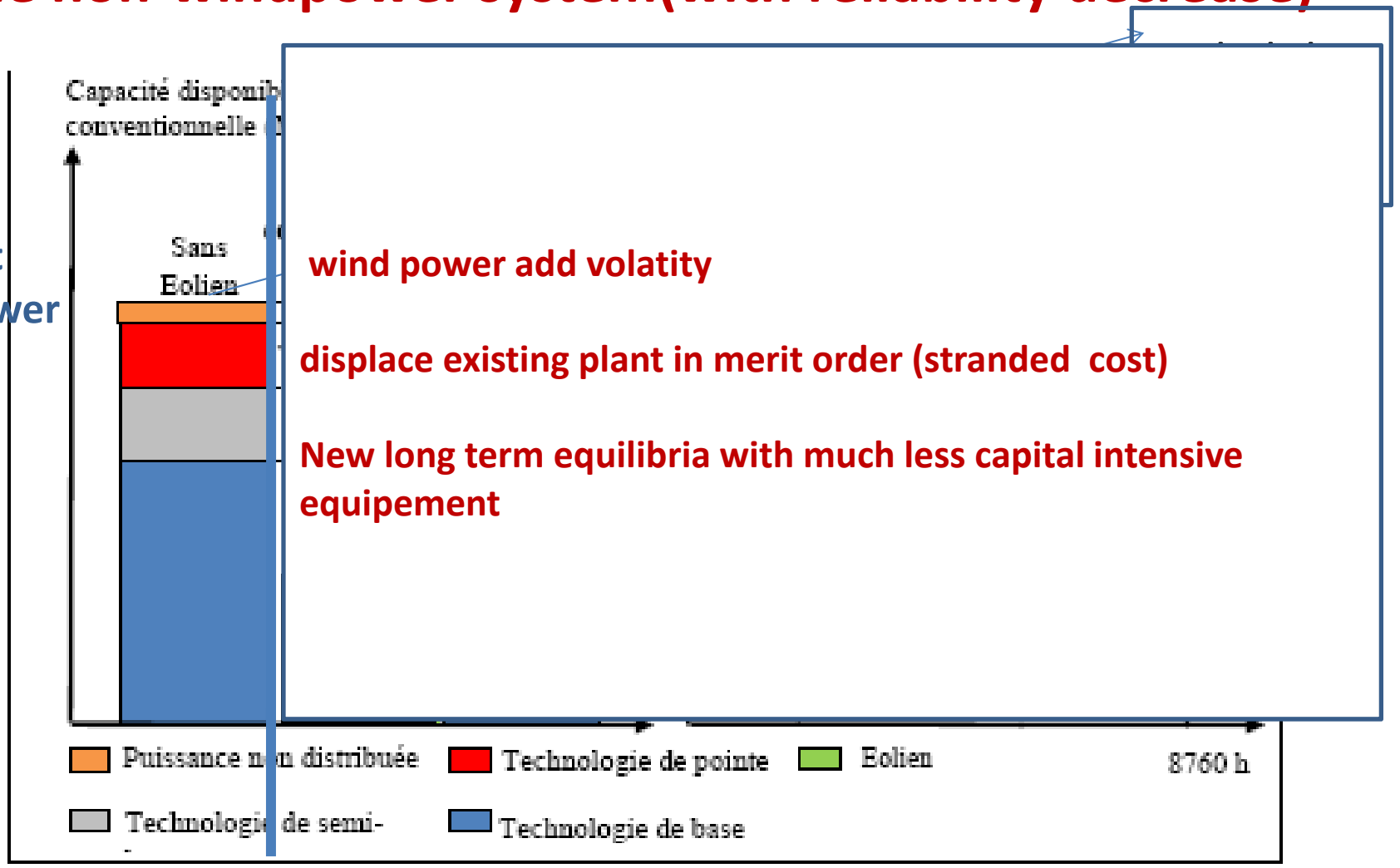


EU ETS price 2005-2008

- CO2 permit Price volatility
- Uncertainty on climate policy and the price of carbon in the Post Kyoto
- No way to ancitipate obsolescence of existing carbon equipment
- Uncertain competivness of low carbon option (CCS, nuclear ,wid offshore

Effect of subsidized development of windpower on the non-windpower system(with reliability decrease)

Without windpower

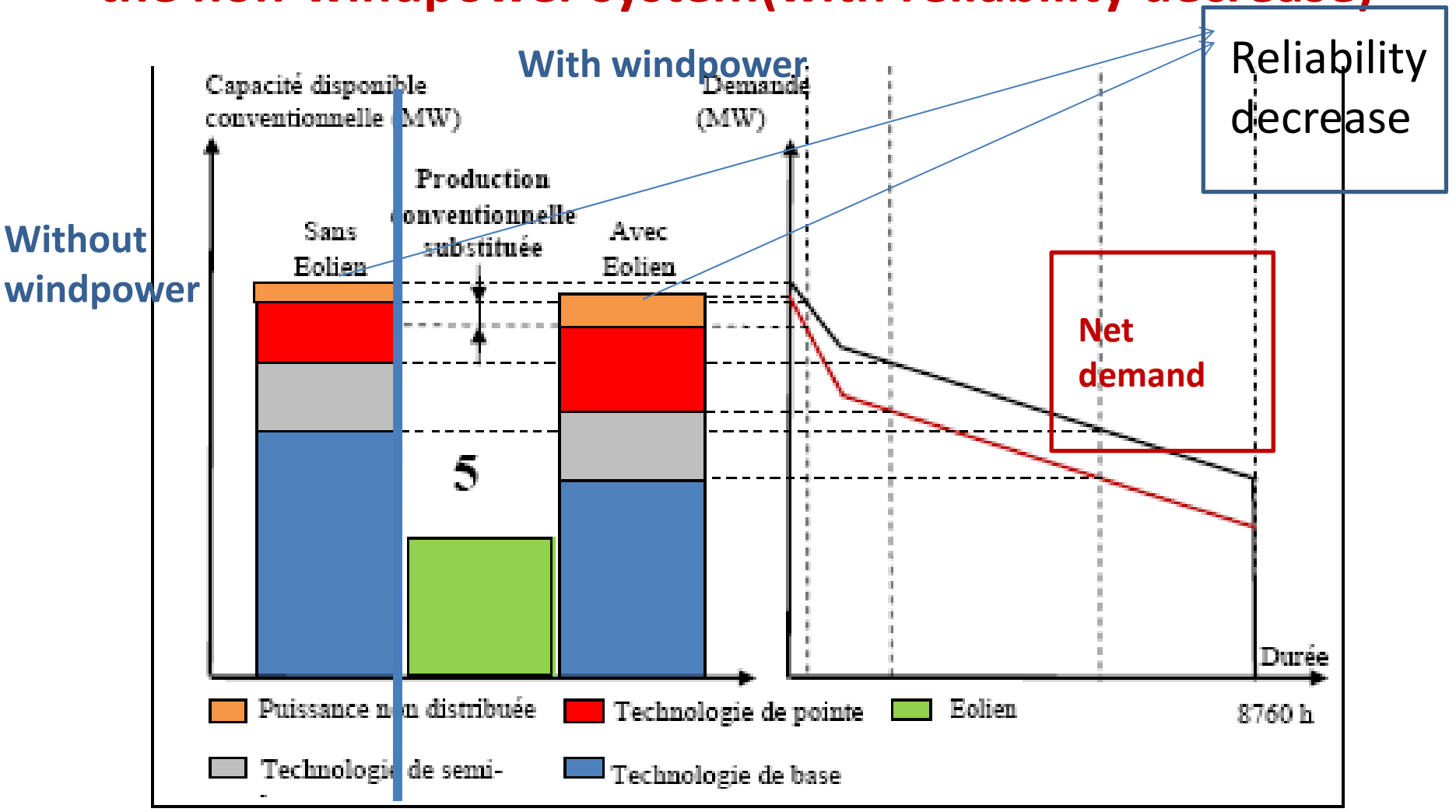


wind power add volatity

displace existing plant in merit order (stranded cost)

New long term equilibria with much less capital intensive equipement

Effect of subsidized development of windpower on the non-windpower system(with reliability decrease)



The Risks specific to new nuclear are magnified in market regime

- **Usual risks of electricity generation investment**
  - **Construction risks**
  - **Operating risks**
  - **Market risks in liberalised electricity markets**
    - Price risks
    - Volume risks

Specific risks of nuclear investment

Difficulty of siting and planning

Regulatory and political risks during construction

Risk of re-learning process

Risk of scarcity of manufacturing and E&C

Amplification of construction risks and **operating risks** (size, lead time, capital indivisibility)

Amplification of market risks:

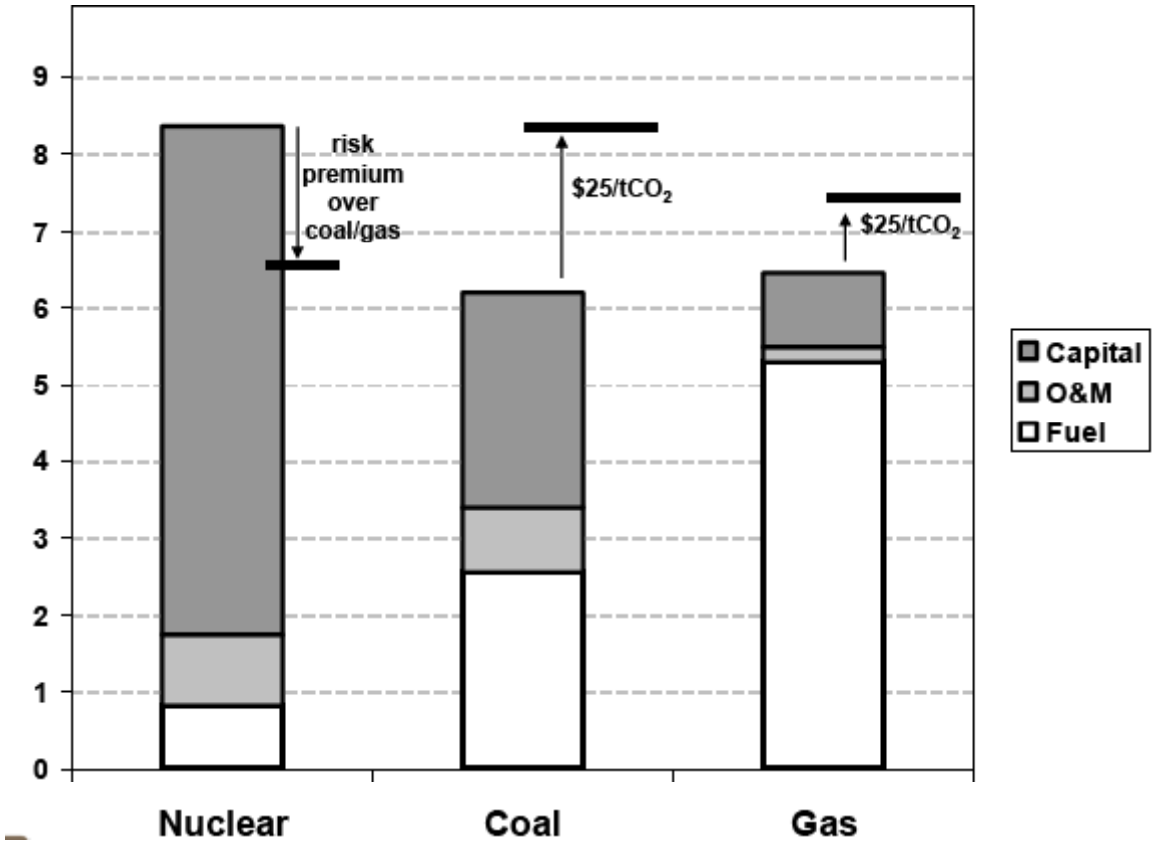
- No correlation between market prices and costs
- CO2 risk

2. New arrangements

- Only « deep pockets » could deliver in thos contexte of risks

2.1. Support could be done by a new risk sharing

Nuclear could be competitive if risk premium of 3% in loan could be suppressed,
(Source : 2009 MIT report update . Reference to 3500-3800 $/kW)



NB: Risk premium eliminated : nuclear cost decreases from 8.4 to 6.6 ¢/kWh and becomes competitive with coal and gas at $7/mmBtu), even in the absence of carbon charge.

Diverse policies of market engagement and deployment strategy

- Investment support:
  - Direct subsidy/tax credit
  - Subsidy by a dedicated trust fund (for instance for CCS)
- Mandate
  - obligation on carbon plantto be equiped by CCS from 201X or 202X (emissions standard on coal)
  - Low carbon portfolio obligation
- Subsidy to production: COST and RISK on State/consumers
  - Guarantee CO2price for CCS (option contract with government)
  - **Feed in subsidies (with obligation to purchase)**

2.2. Dramatic adaptations of market regime

- **From FIT or tender for renewable capacity**
  - Supplement to market price

  to Tender for all capacity
  - Type (and perhaps location) specified
  - Capacity continues to compete day-to-day

- **Working assumption that investment can be "de-risked" through greater public sector intervention**
  - Risks are shifted to the state but finally paid by consumers…
  - Which risks are best allocated to state / investor / operator

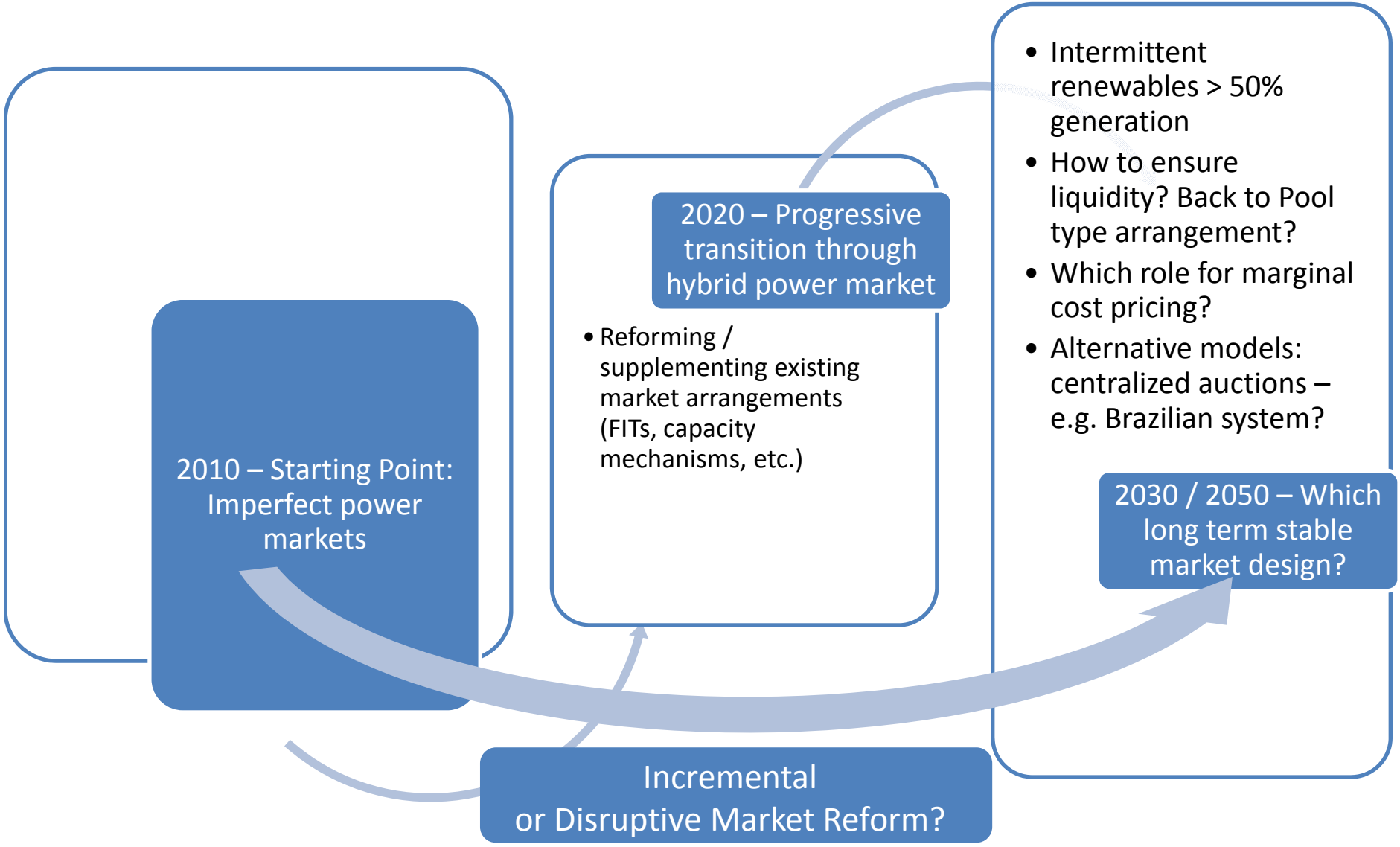
- **Technology neutral orthodoxy is de facto broke down**

- **Less and less market share for non supported electricity: an implicit paradigm shift**

UK: Pionneering in market reform, pionneering in contre- reformation (White Paper July2011)

- Low-carbon Generation Support: Fixed tariff by contract for differences (CFD): for large sized technologies
  - Generators receive wholesale price plus variable premium
  - Auctioning by technologies(Nuclear, CCS, windpower, bioelectricity)
  - Public agency for contracting
  - Cost shared between all consumers
- Carbon Floor Price via a tax:
  - Sets the generators tax as the difference between the EUA price & the target price.
- Others
  - Feed in tariffs from small sized
  - Emissions Performance Standard (EPS) on new coal plants
  - Etc.

The Transition Toward a Decarbonized Power System: Incremental Transformation or Disruptive Process? Soruce Fabien Roques, 2011



To conclude
How to leave blind ideology of market fanatism ?

- *Stan Laurel*: Shakespeare.
  Ollie Hardy: Longfellow.
  Ollie Hardy: What goes up the chimney?
  Stan Laurel: Santa Claus.

Problem in the EU:

- "We" have not yet finished the job of market inegration

Blindness about tension between objectives the so-called market competitiveness

- British are "honest" and pragmatic

- German do not mind at all about the electricity market directives:

  all their electricity will rapidly become out of the market (thanks to nuclear phase out)

  Everybody is supposed to admire the virtuous Germany: and to make like she: beautiful exemplarity :

  bad news for respect of CO2 objective

- French do not mind too much:
  - we have deep pocket verticalized companies

  But -problem of mimetism of public opinion with neighbour:

  presidential elections to next electotal cycles could be win with the help of nexisting 57 nuclear reactoirs

  if we vote for social democart like me, happy to see that

Annex

An example To invest in market regimes

Risks specific to CCS projects in the early roll-out

- **Usual risks of electricity generation investment**
  - **Construction risks**
  - **Operating risks**
  - **Market risks in liberalised electricity markets**
    - Price risks
    - Volume risks

Specific risks of CCS investment

Difficulty of siting and planning

Regulatory and political risks during construction

Risk of learning process

Amplification of construction risks and **operating risks**
(size, lead time, capital indivisibility)

Enormous complementary of investments in infrastructure
The cost and risk of uncoordinate access to transportation and storage
Acceptability of storage

Amplification of market risks:

- No correlation between market prices and costs
- CO2 risk

Offshore windpower projects risks

A. New learning : Offshore conditions are very different from onshore

- **Turbine**

Stronger winds >= 10 m/s

Large array turbulence intensity

- **Support Structure : technology of oil off-shore**

Deep water, increasing strengths requirements

Impact of waves and soil condition

- **The future : floatable structures (not yet technically mature)**

B. Grid connection

- Longer distance to connection point
- Higher electrical losses
- Unilateral installation (without supergird)

C. Installation

- Reduced weather window between shore-location
- Expensive equipment for building the pole