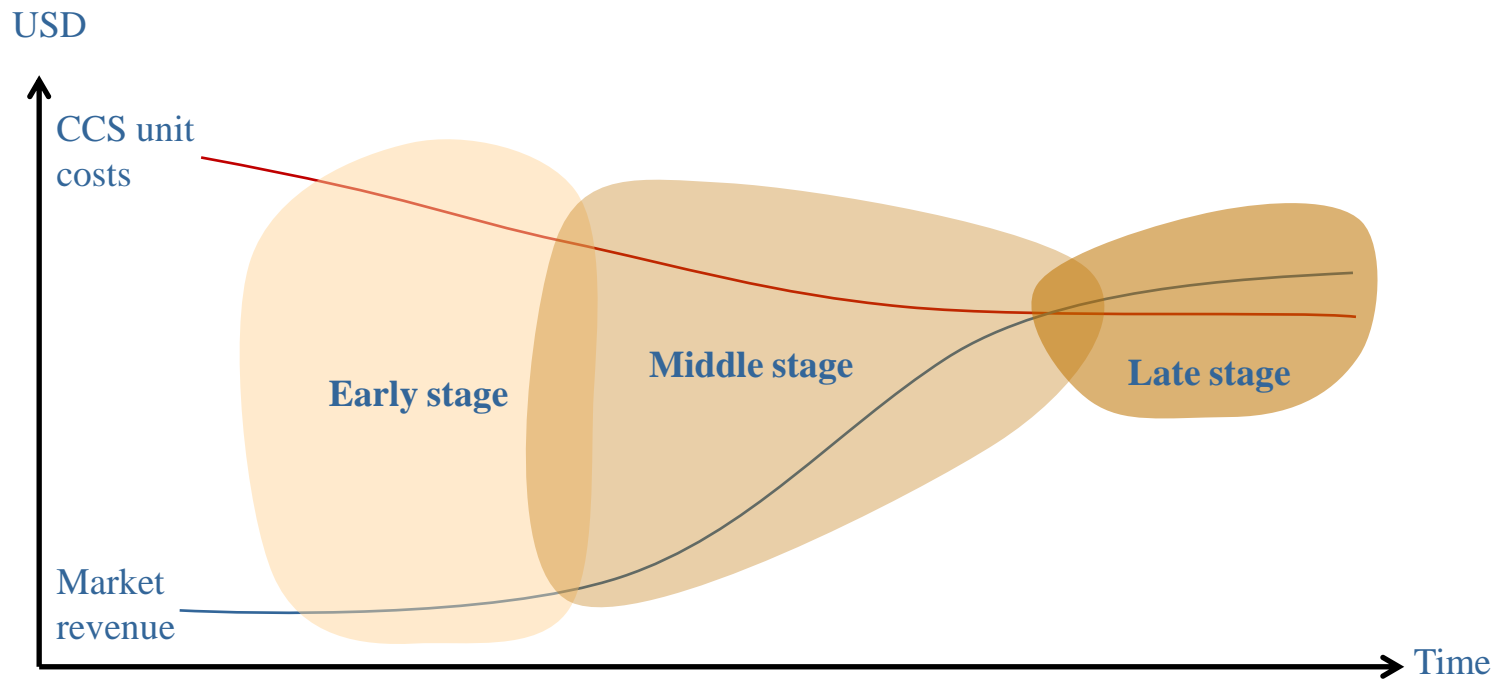


# From demonstration to deployment: support policies for CCS

Wolf Heidug

# The starting point: Economic characteristics of CCS technology will change with time



# Markets failures produce outcomes that are not socially optimal



## To intervene or not to intervene?



# CCS-relevant market failures

## ■ Externality

- ◆ Atmosphere is scarce resource - overused when not priced accordingly

## ■ Public good

- ◆ Underinvestment results when returns from technology learning can only be partially appropriated by investor

## ■ Imperfect information

- ◆ Difficulty of early investors to distinguish good from bad projects may hinder access to capital markets

## ■ Complementary markets

- ◆ Underprovision of CCS due to lack of certainty about the provision of transport and storage infrastructure

# Market failure as rationale for intervention

## Market failure

## Example policies

### Emissions externality

*Failure to internalise the cost of greenhouse gas emissions*

Carbon tax or emissions trading scheme

### Public good

*Failure to appropriate returns generated by investments in innovation*

Quantity-based instruments: feed-in tariff, portfolio standards

### Risk and capital market failure

*Underprovision of private capital resulting from imperfect information*

Provision of debt/equity, grants, investment tax credits, insurance

### Complementary markets

Undersupply due to dependency on complementary markets and coordination failure

Regulation

**Sorry for the jargon**

# Some criteria for good policy making

## ■ Effectiveness

- Is policy instrument able to achieve its objective?
  - ◆ Application across different sector
  - ◆ Strength of incentive to invest in abatement

## ■ Efficiency

- Does policy encourage least-cost abatement option?

## ■ Ease of application

- Informational and institutional requirements?

## ■ Political acceptability

- High political acceptability - low policy risk

# An economy-wide carbon price is the most efficient way to tackle the emissions externality

- **Either a carbon tax or emissions trading scheme can provide a price**
  - **Taxes provide more stable carbon price, making return on CCS investment more certain**
  - **political economy considerations have tended towards creation of trading schemes**



## Risk of policy failure is particularly acute in creating carbon price

- Investors may question whether carbon pricing policy will persist in the long term
- Other policy instruments, i.e. feebate, emissions performance standard may be used in cases where a sector-specific approach to controlling emissions is preferred

**Feebate**: carbon tax applied to emissions above certain baseline, combined with payments if emissions are below baseline

**Emission Performance Standard**: prescribes acceptable emission level per unit of output

## Purchasing knowledge

- High-risk of early demonstration projects suggests grant-funding may be best
  - but this is not sustainable in the longer run
- Feed-in tariff for CCS
  - a 'top-up' to the electricity price eliminates uncertainty due to variable fossil-fuel prices
- Portfolio standard
  - may support the development of CCS infrastructure
  - threshold effects
- CO<sub>2</sub> purchase commitment
  - Minimises risk of leakage/decline in industrial competitiveness

***Feed-in tariff:*** long-term contract between power producers and, distributors to sell electricity at fixed, pre-determined price

***Portfolio standard:*** obligation on electricity generators to use CCS to produce specified fraction of output

# Public sector instruments to overcome capital market failure

- In early stages of CCS, capital markets may be unwilling to provide sufficient capital
- Public sector can either
  - make direct capital contributions
  - provide risk mitigation instruments
- Financial Institutions may be better able to provide these instruments than governments themselves

# Steering the development of CCS infrastructure

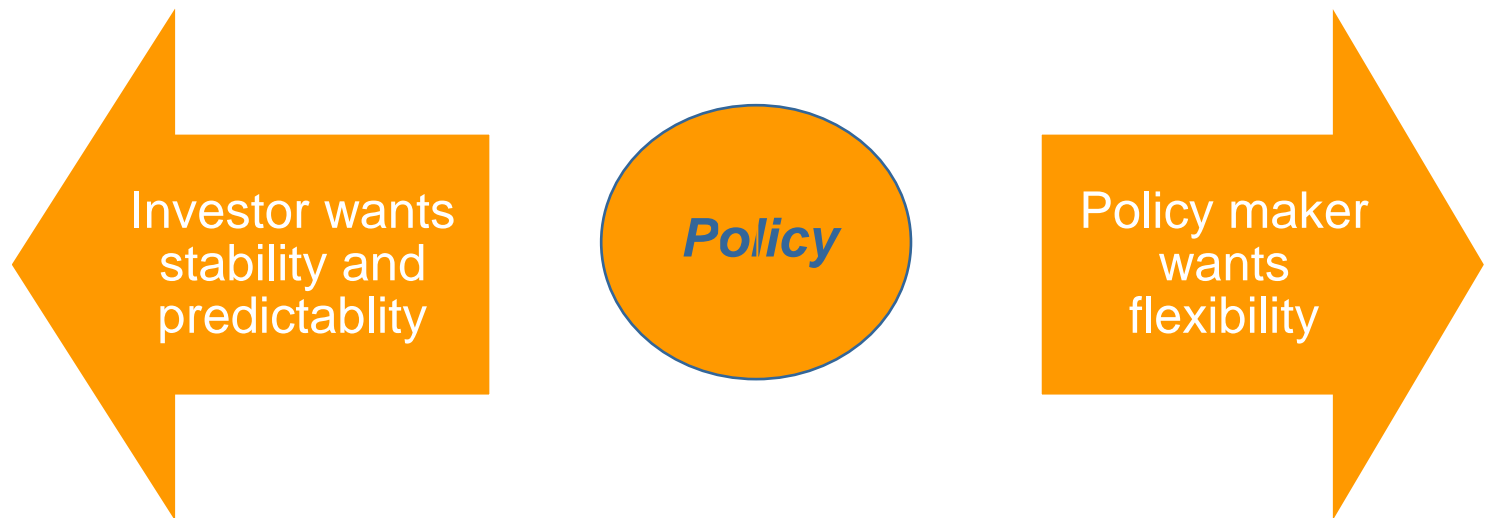
- Risk of stranded assets
  
- Governmental role in electricity transmission and distribution network provides model
  - Regulation, public supervision
  - Underwriting portion of fixed network cost

## Multiple policy objectives justify a suite of interventions

- as CCS development is affected by multiple market failures, multiple support policies can be justified
- no more than one policy instrument to tackle each market failure
- beware of policy interactions
  - If CCS is incentivized via emission trading, supplementary support (via CCS certificate scheme and others) may lead to a lower price on emissions covered by the ETS

# The policy dilemma

- change in the characteristics of CCS, and associated focus of incentive policy, creates a challenge for policy-making
  - on the one hand, want to be able to adapt and modify policy as technology changes or new information comes to light
  - on the other hand, the (perception of) changing policy may damage investment





# Policy gateways to reconcile flexibility with stability

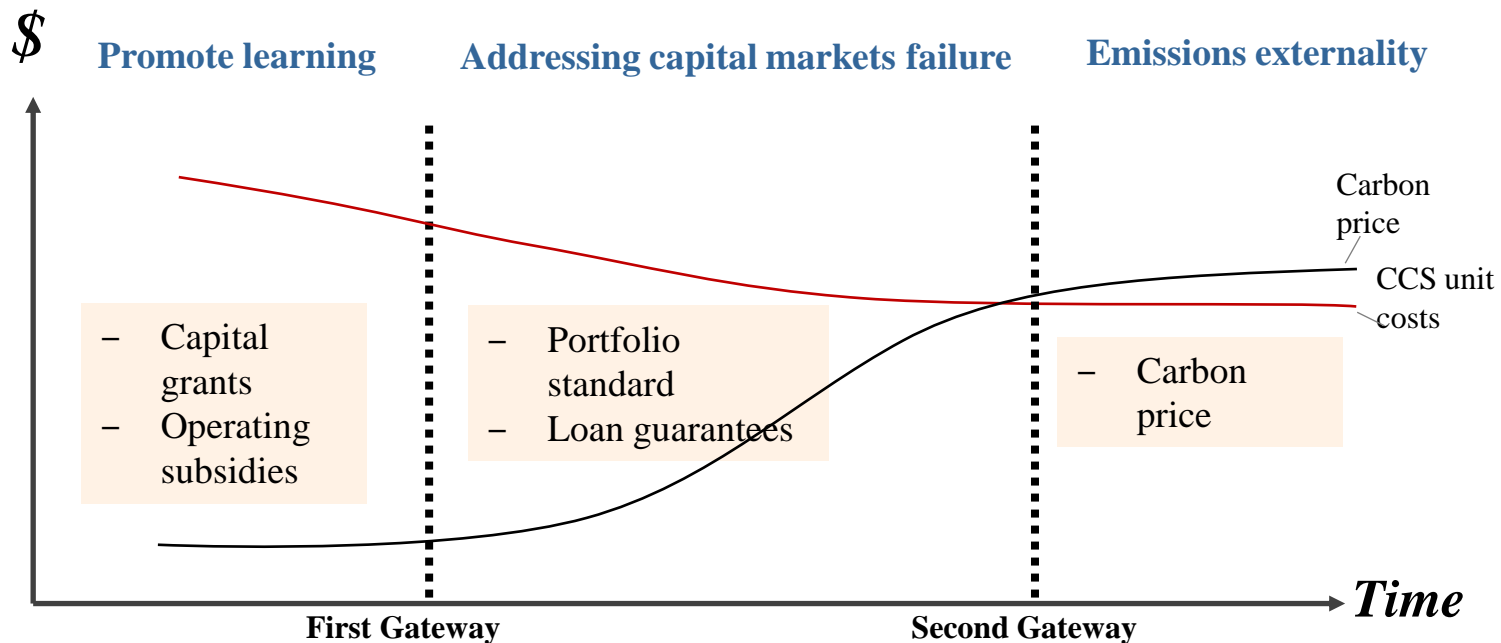
- **‘policy gateways’ might help overcome this challenge;**
- **gateways would consist of three components**
  - policies that will be used in each stage
  - criteria that will define when or if policy will move to the next stage
  - an outline of the reaction if gateways are missed
- **Protects government from overstretching resources, from imposing poor value for money, and lowers policy risk for investors**

# Policy gateways in action

**Technical demonstration**

**Single-sector deployment**

**Wide-scale deployment**



- Capital grants
- Operating subsidies

- Portfolio standard
- Loan guarantees

- Carbon price

- First Gateway**
- Technical feasibility
  - First cost threshold
  - Availability of storage space confirmed

- Second Gateway**
- Further cost reductions
  - Infrastructure development
  - Availability of storage space confirmed

*Time*

Carbon price  
CCS unit costs



# BECCS can create ‘negative emissions’ that can reduce atmospheric concentrations of CO<sub>2</sub>

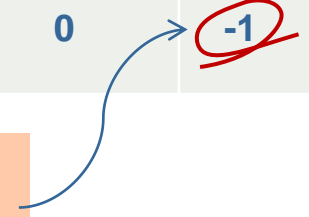
- This should be reflected in incentive policy
- BECCS is the use of CCS to capture emissions from biomass processing or combustion
- it has the potential to reduce atmospheric concentrations of CO<sub>2</sub>

- CO<sub>2</sub> sequestered from air as biomass grows is not returned to atmosphere
- may well be needed for climate stabilisation

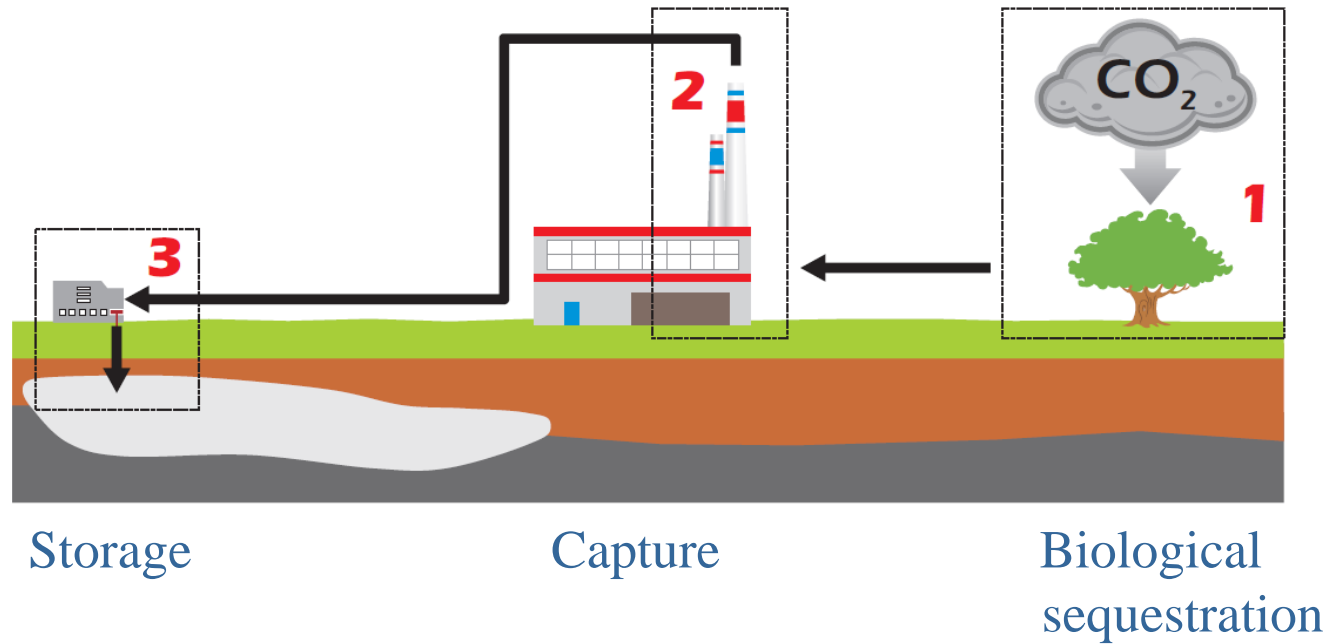
Stylised comparison of conventional CCS and BECCS lifecycle emissions

Process	CCS	BECCS
Biological sequestration		-1
Combustion	+1	+1
Storage	-1	-1
<b>Lifecycle emissions</b>	<b>0</b>	<b>-1</b>

Should be reflected as extra incentive



# Options for applying BECCS incentives



Providing incentive at capture allows use of same administrative infrastructure as for conventional CCS

# Incentivising CCS in the developing world

- IEA Roadmap anticipates 55% of CCS investment to 2050 to be outside of the OECD
- to incentivise this investment
  - carbon price may come through baseline and credit scheme (CDM and/or others)
  - most of public-sector support to come from developed countries (NAMAs, etc)
  - important role for IFIs in
    - ◆ providing concessional funds,
    - ◆ risk mitigation instruments (possibly tailored to risks unique to CCS i.e. environmental liability, stewardship of storage sites),
    - ◆ supporting development of market in carbon credits from CCS,
    - ◆ technical assistance



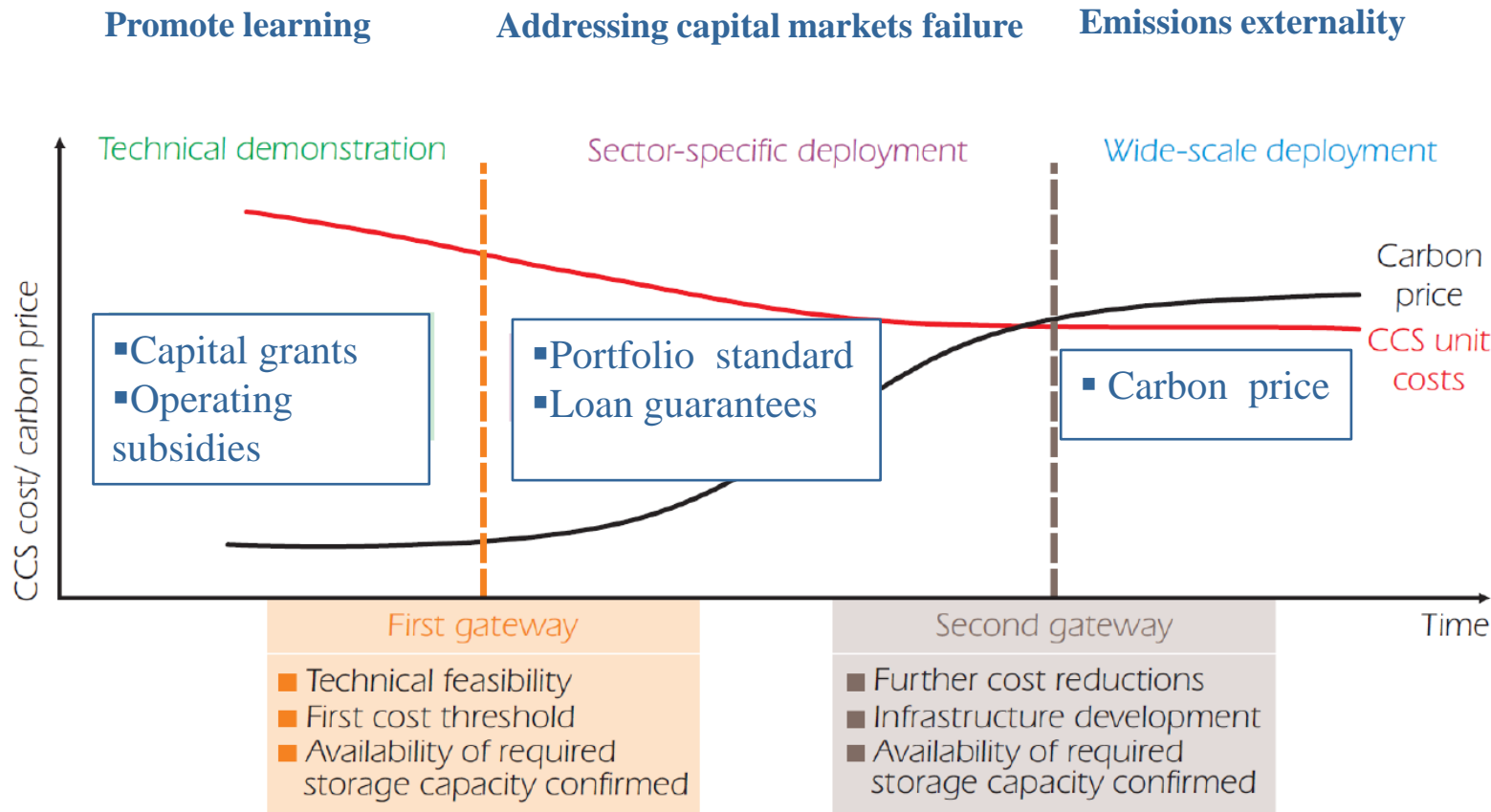
**Thank you**

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**CARBON CAPTURE  
AND STORAGE**

# Policy gateways in action



TECHNOCRATIC  
 POWER INDIVIDUAL  
 MARKET ANALYSIS MONOPOLY  
 MACROECONOMICS SOCIAL POLLUTION ECONOMIC  
**MARKET**

EFFICIENT  
 MARGINAL INTERNALIZING UNADDRESSED  
**FAILURE**  
 IMPERFECT RATIONALITY  
 PROBLEM

HEURISTICS NEOClassical  
 COST OPTIMAL ARGUE FISH TRANSFERABILITY GOOD  
 DISINCENTIVE SUBVERSION INEFFICIENT MONOPOLIES PUBLIC EXTERNALITIES  
 EFFICIENCY ECONOMISTS MONOPOLISTIC  
 INFORMATION FORMALIZATION COMMODITY  
 RIGHTS COMMON FORM MONOPOLISED  
 GOVERNMENT POLLUTERS ASYMMETRY RESOURCE  
 POLICY INEQUALITY  
 AGENT SOCIETY

**CARBON CAPTURE  
 AND STORAGE**