Impact of CO_2 Price Stability on Investment in CCS Technology

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http://www.kyos.com/consulting/investment-analysis

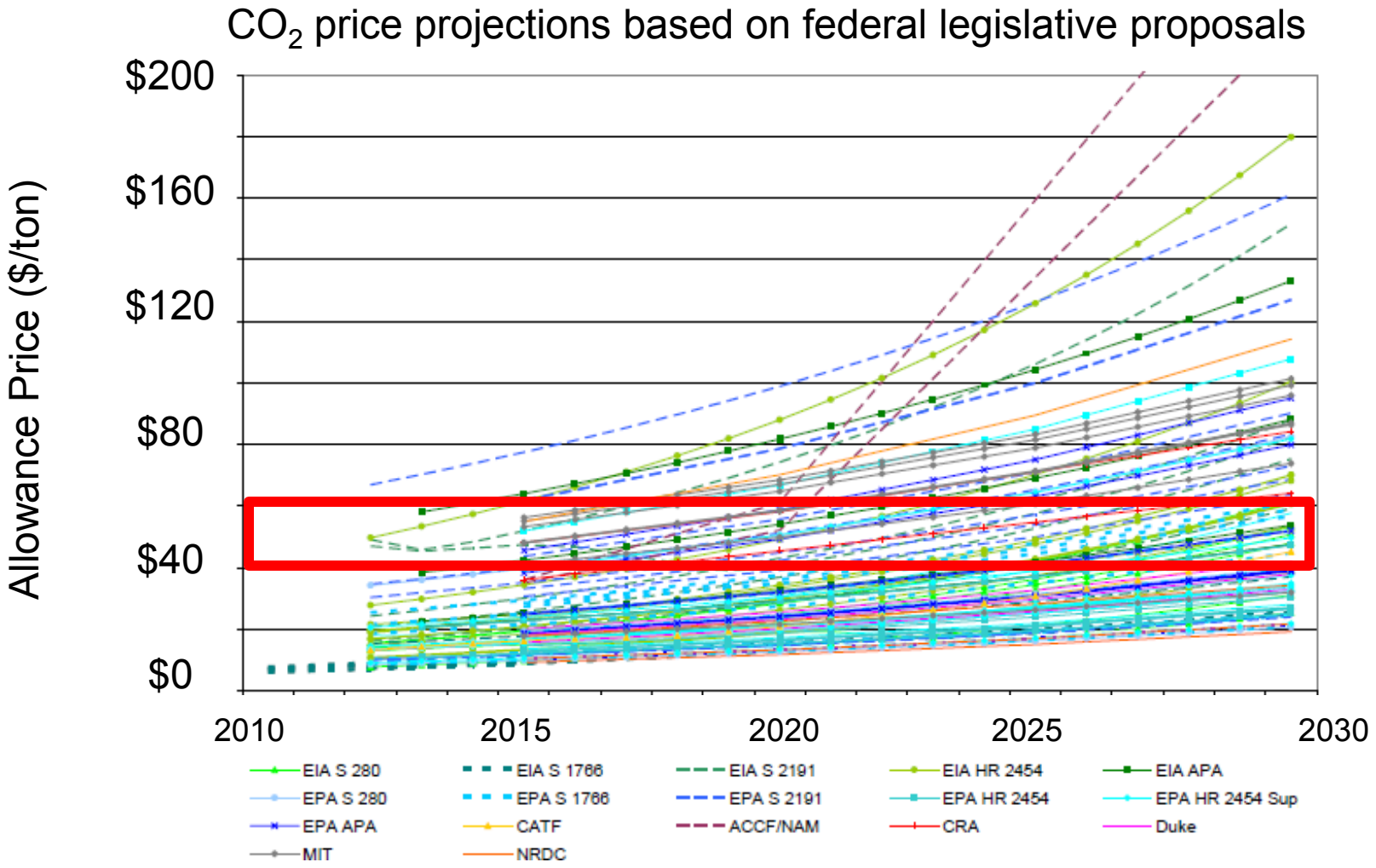
Motivation

- Student Project
- Move beyond CO_2 price level discussion
- Incentives to encourage technology deployment

Outline

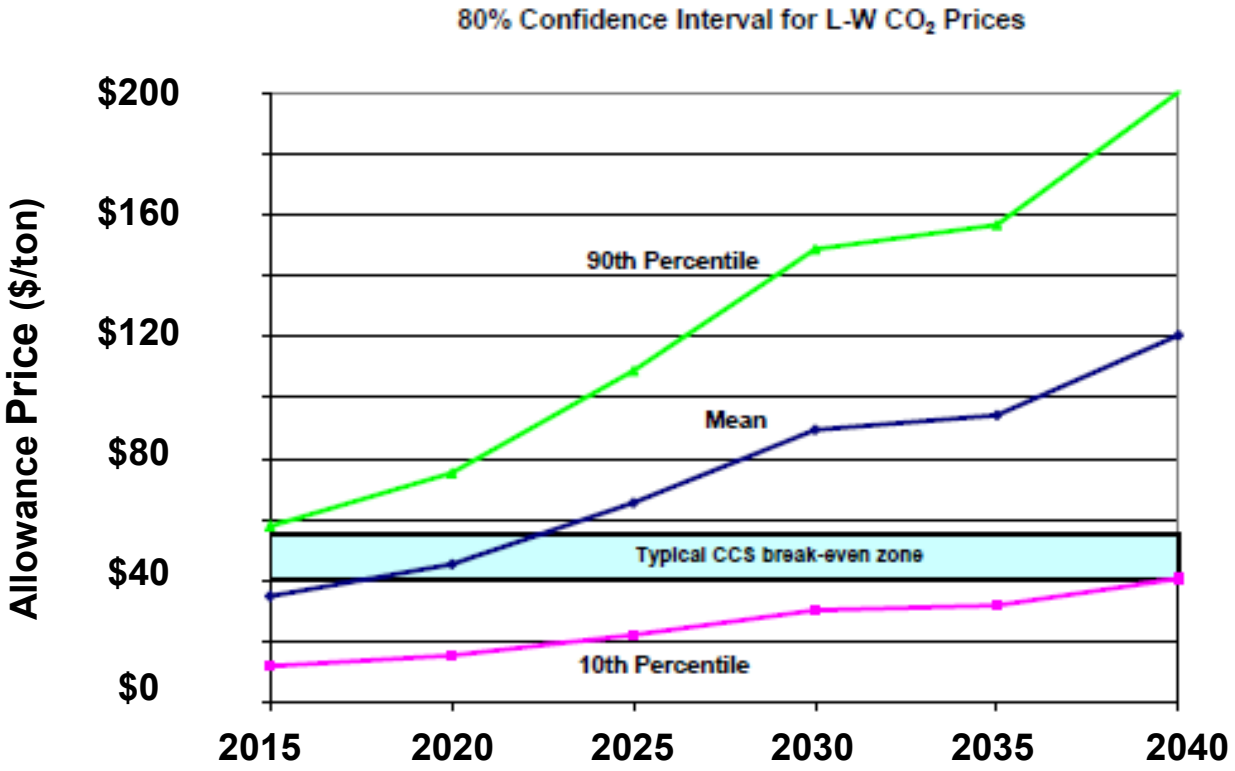
- Discussion of Price Variability and Volatility
- Decision tree model
- Investment with high and low price variability
- Reducing price variability and overcoming uncertainty

Varying Price Trajectories, Value in Waiting to Invest



Johnston L. et al. 2011 “Carbon Dioxide Price Forecast” Synapse Energy Economics.

CO_2 Price volatility



Investors look at 10th percentile price scenarios more than higher price estimates

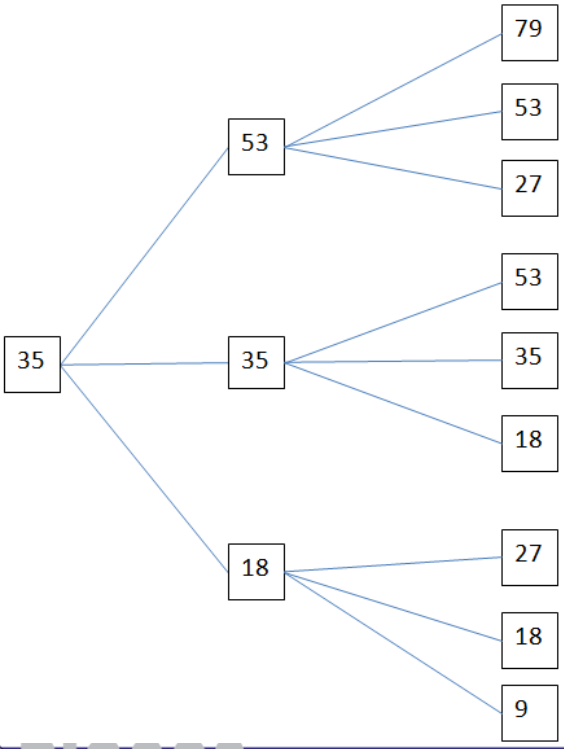
Conservative 10th percentile prices cross break even threshold too far in the future, delaying investment

Celebi, M., Graves, F. (2009) Volatile CO2 Prices Discourage CCS Investment" *Brattle Group*. Available at SSRN: http://ssrn.com/abstract=1338095

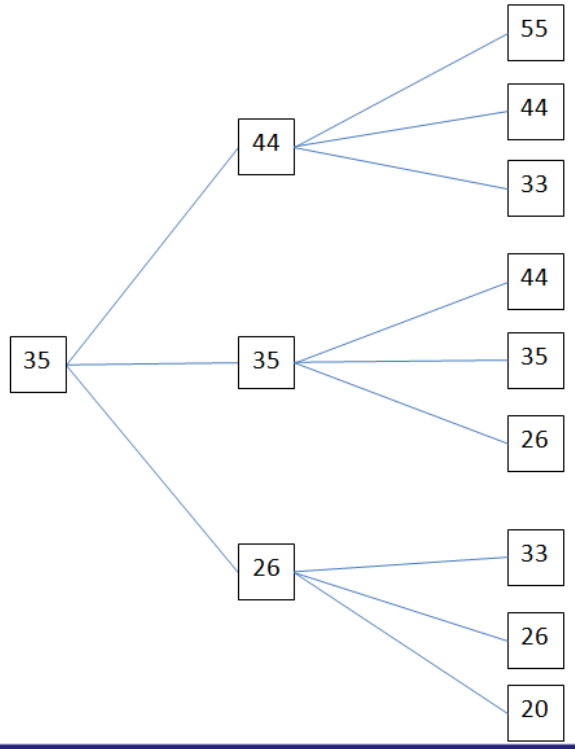
Model

- A multiple time point investment decision tree model
- Stochastic price distribution
- Solved through reverse induction

- High Price Variability – 50%



- Low Price Variability – 20%



Application to our case study

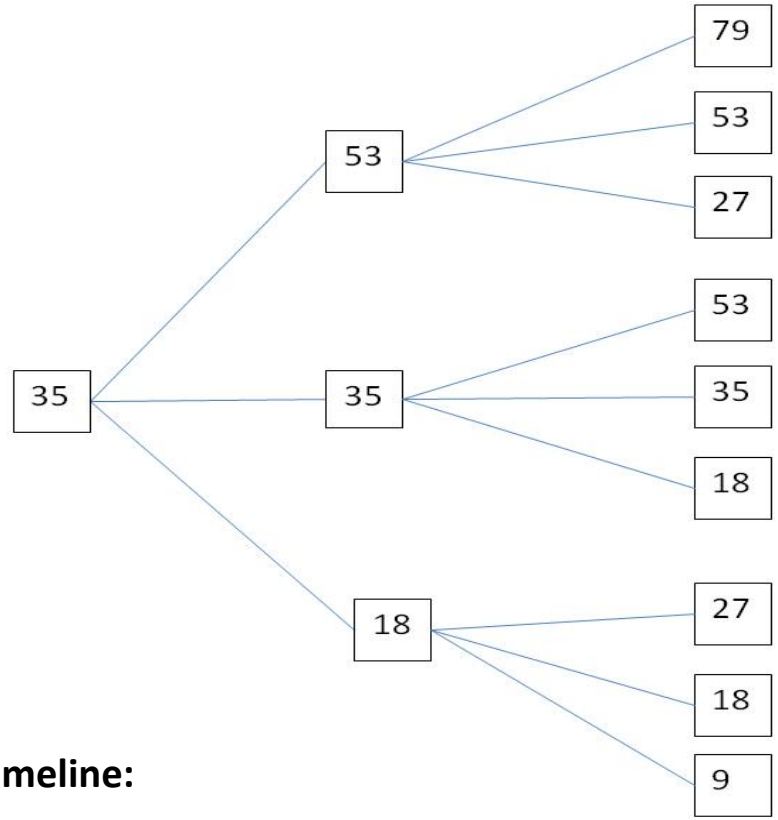
3 Sources: CO_2 is captured at 90% efficiency via amine post combustion capture

Shared 350 km pipeline with a 24 inch diameter – 13.5 mega tonnes per year

Sink shared by 3 sources

- Simple and insightful analysis to motivate discussion of a complex concept

Model



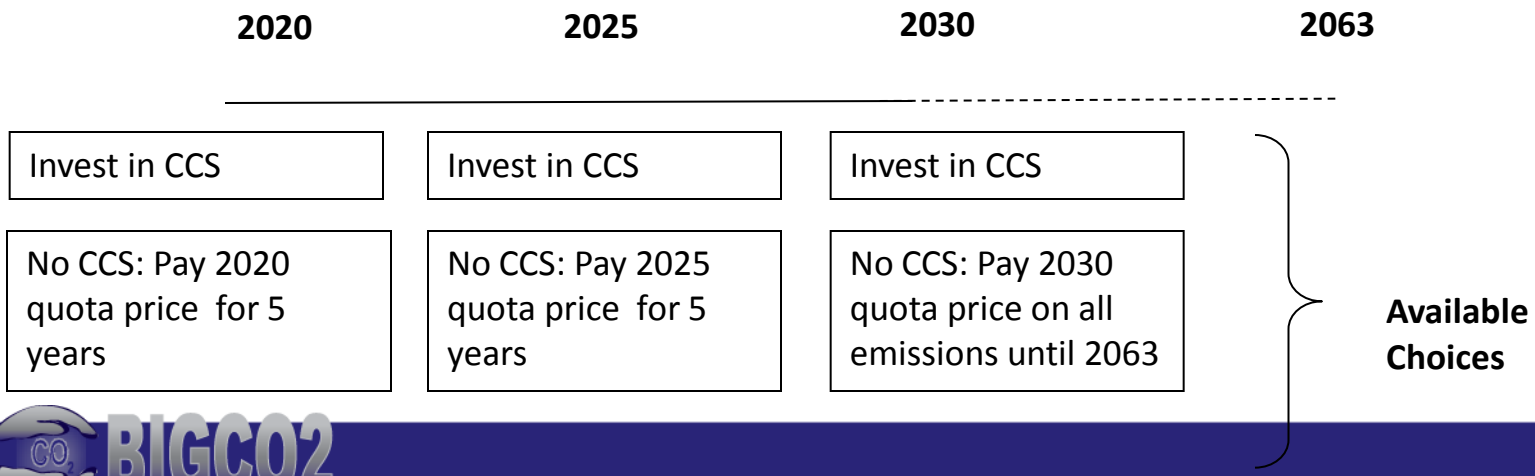
Invest in CCS:

Pay quota price for 3 years on all emissions (construction)

then on 10% emissions for 30 years

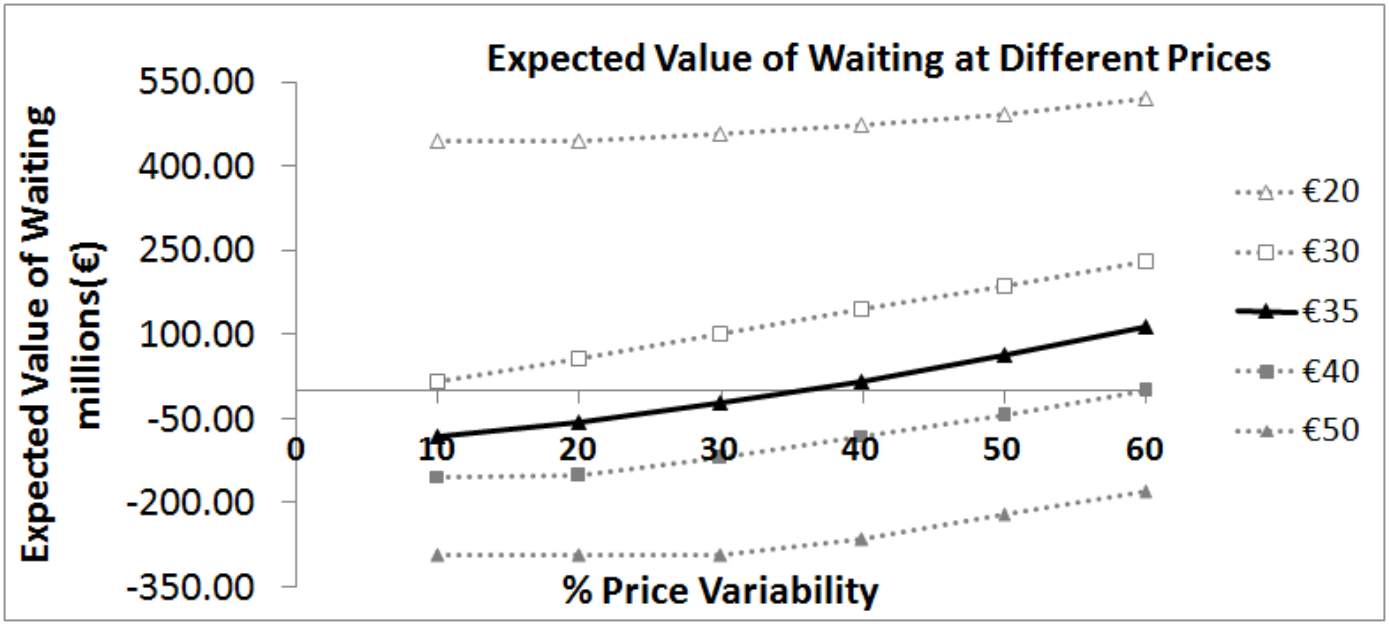
then on all emissions until 2063 after CCS is decommissioned

Decision Timeline:

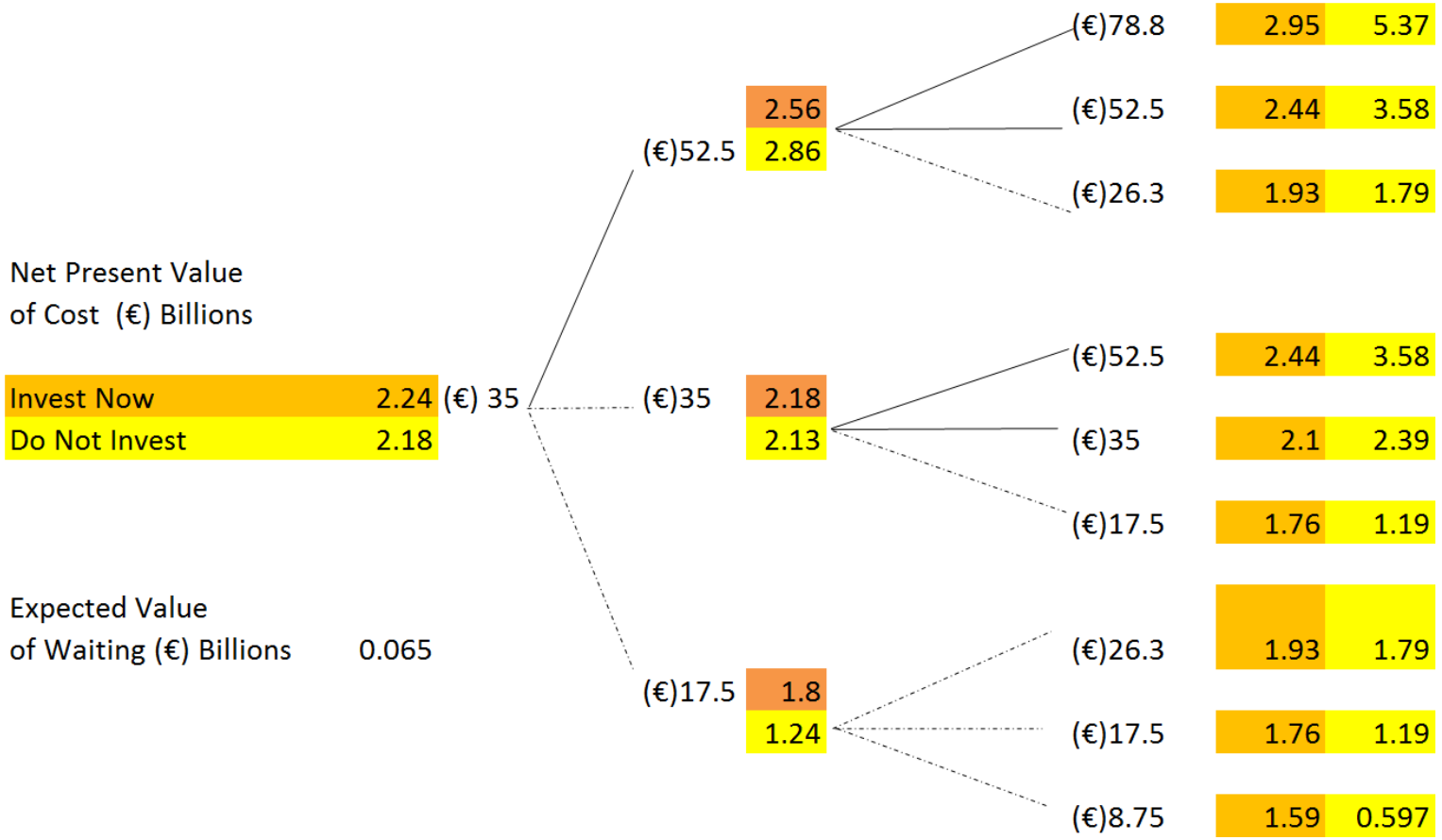


Expected Value of Waiting

- Net Present Value of Costs
- Difference between the cost of investing now and cost of investing later
- Similarities with option value

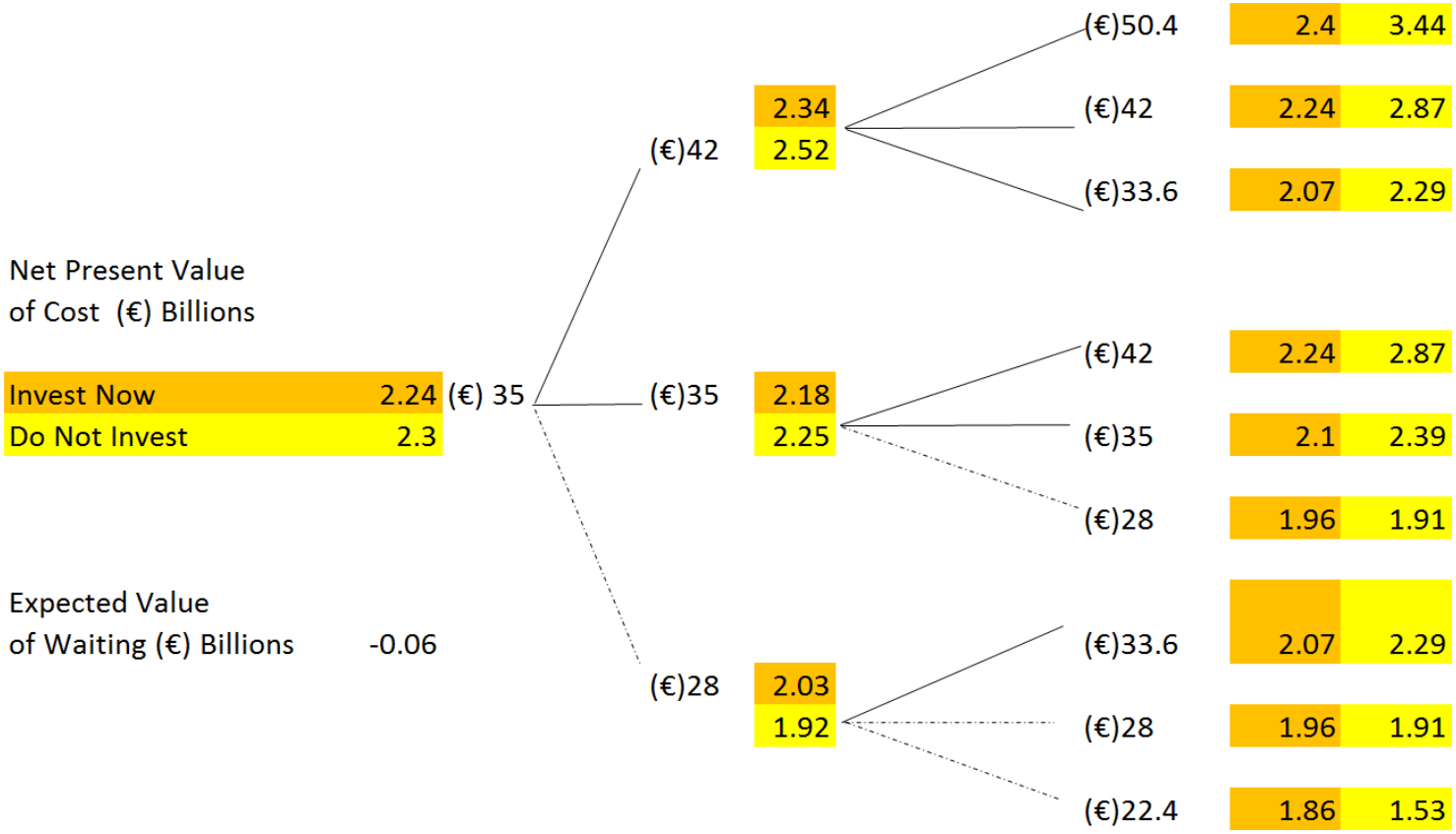


Results: High Price Variability



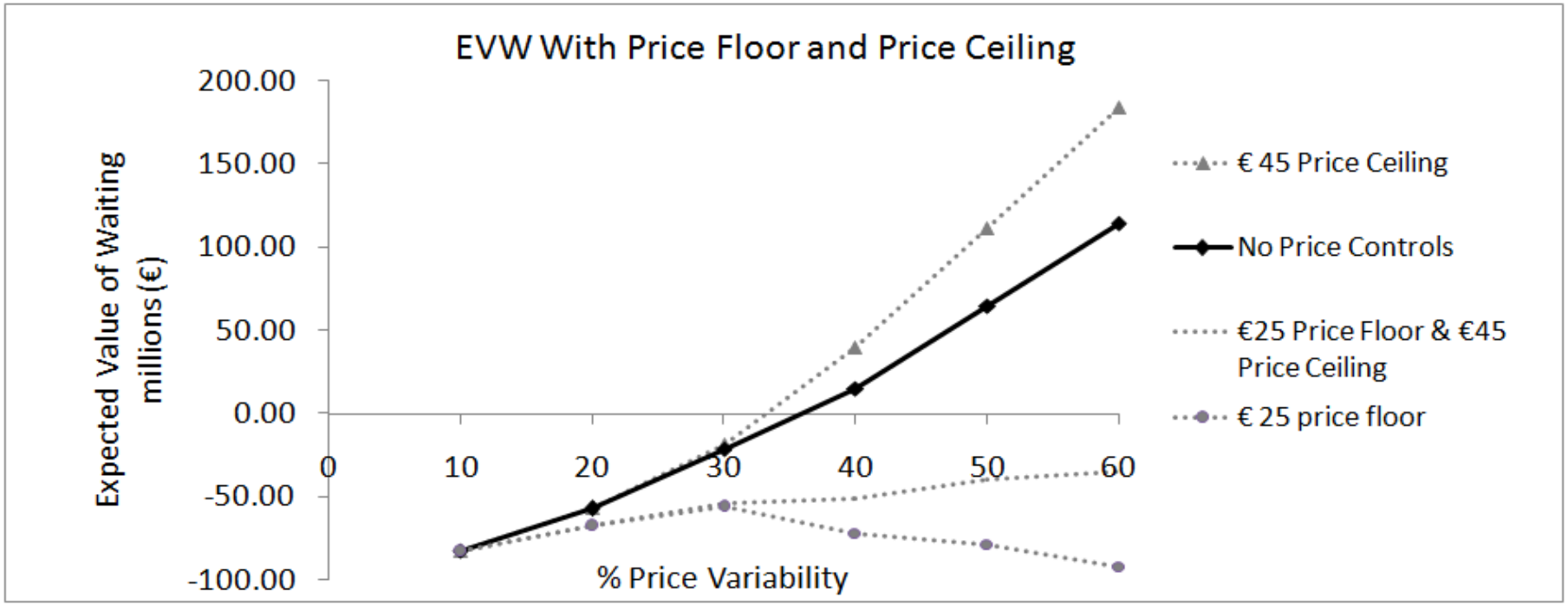
- With high price variability (50%), investment in CCS can be delayed by 5 to 10 years.

Results: Low Price Variability



- With reduced price variability of 20%, there is no incentive to wait with investment.
- Price stability helps to realize the technology on the market

Reducing Variability: Price Floor & Ceiling Mechanisms

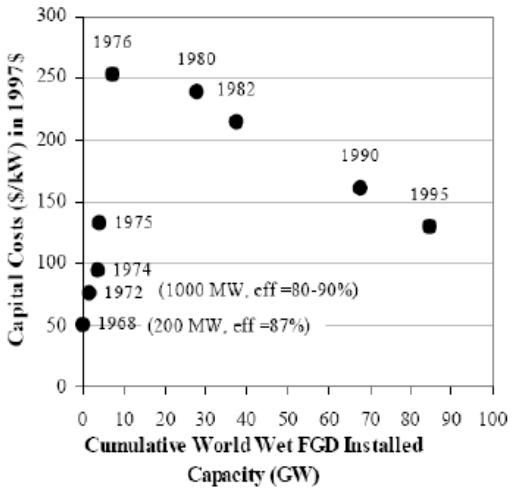


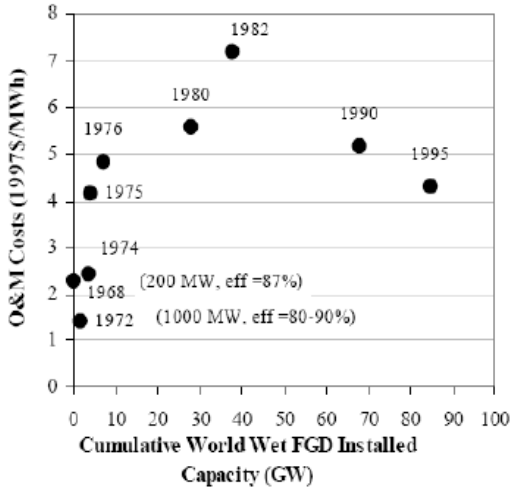
- Protection for the investor against low price outcomes
- Protection for the consumer against high prices
- No incentive to wait to invest.

Policies to overcome uncertainty

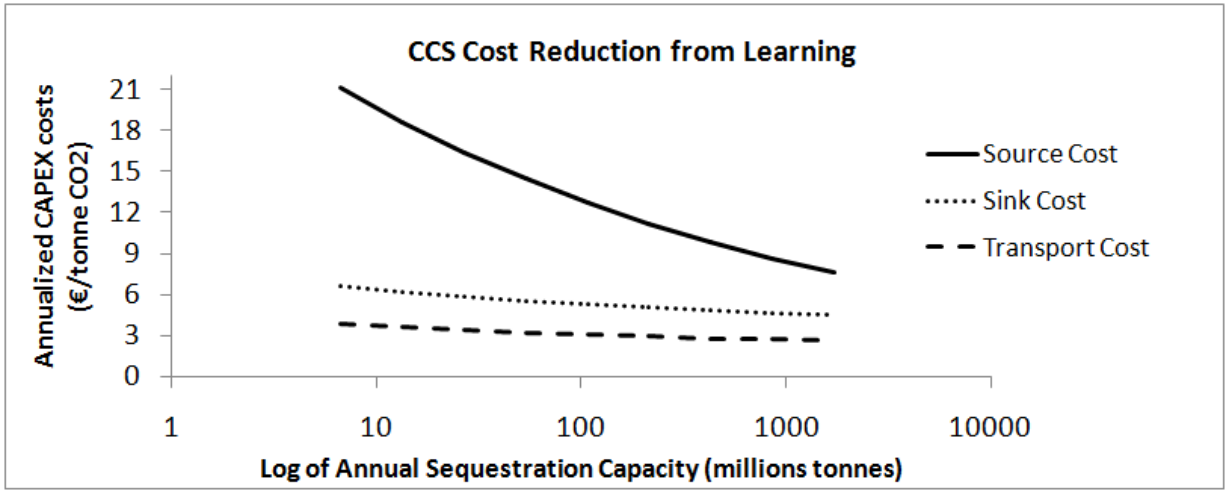
R&D	Pilot Projects	Commercial Deployment
Grants Investment tax credits Knowledge sharing institutions	Loan guarantees Limited liability Investment tax credit Carbon sequestration credits Innovation prizes Cost sharing Reverse auction Wires and pipes research fund	CO2 quota price guarantee Feed in subsidies Production tax credits Limited liability

Policies based on successes with SO_2 scrubbers





- 12% cost reduction for every doubling in capacity
- Long term CAPEX reductions upwards of 60% are plausible



Summary and Future Work

- High price volatility delays investment, better to wait and see
- Reducing price uncertainty can facilitate CCS technology deployment at lower prices & sooner
- There are policy incentives for each stage of technology deployment to further reduce uncertainty & as technology capacity expands, prices decline.
- Future work calls for expanding case study with new technology parameters, varying source/sink/transport ownership scenarios, and different price variability scenarios

Acknowledgements

- BIGCO2 project with partners: Statoil, GE Global Research, Statkraft, Aker Clean Carbon, Shell, TOTAL, ConocoPhillips, ALSTOM, the Research Council of Norway (178004/I30 and 176059/I30) and Gassnova (182070) for their support.
- Lee Spangler, Steve Holmgren and Scarlet Rierson at Montana State University, USA (Big Sky CO_2)
- National Science Foundation
- Jana Jakobsen, SINTEF Energy Research, Norway
- Metin Celebi, Brattle Group, USA