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Assessment of Market Penetration Potential of Hydrogen Fuel Cell Vehicles - A Study Using an Optimization Model

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Overview

Setup of the issue – the transportation sector

Tools

Sensitivity analysis

Results

Conclusions

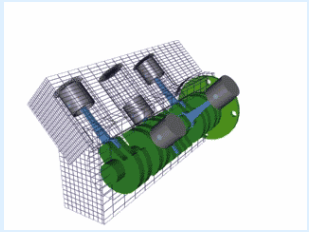
Setup

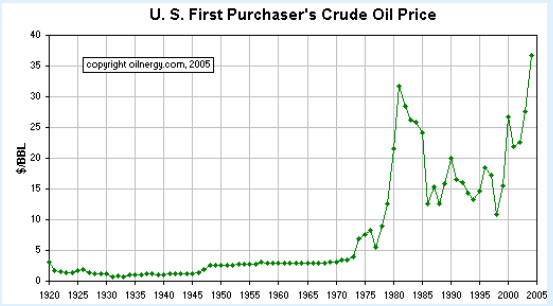
The technology

Oil prices

Security of oil supply

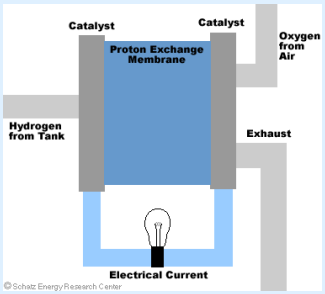
Environmental burdes





Expensive, relies on oil supplies and polluts.

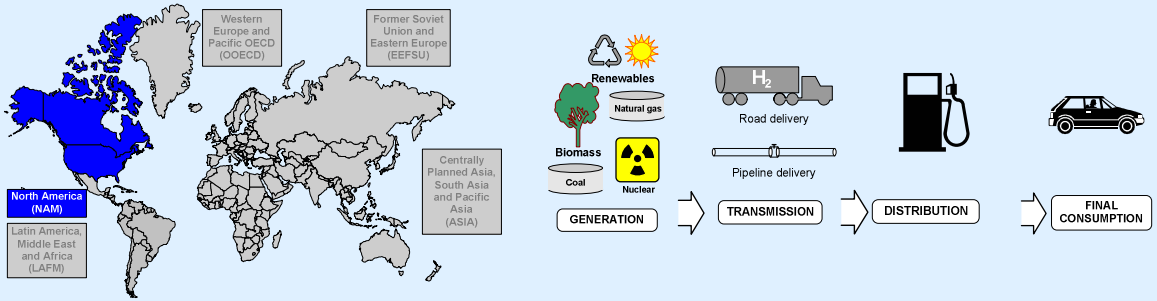
Is there another way?



Tools

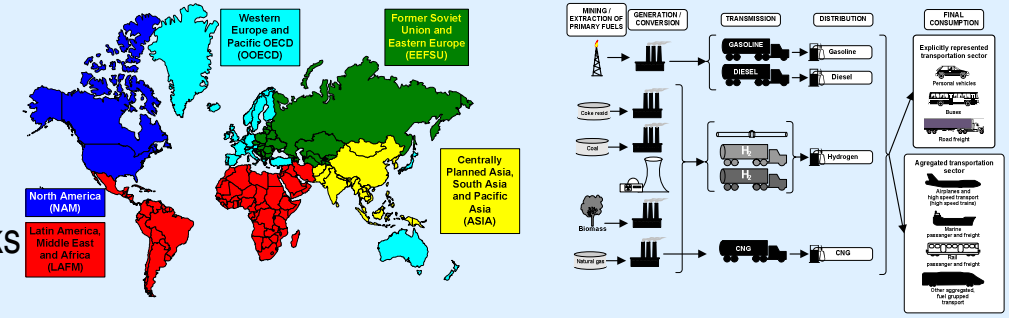
Stand alone

- 1 region
- 2000-2100
- only personal vehicles



Full scale

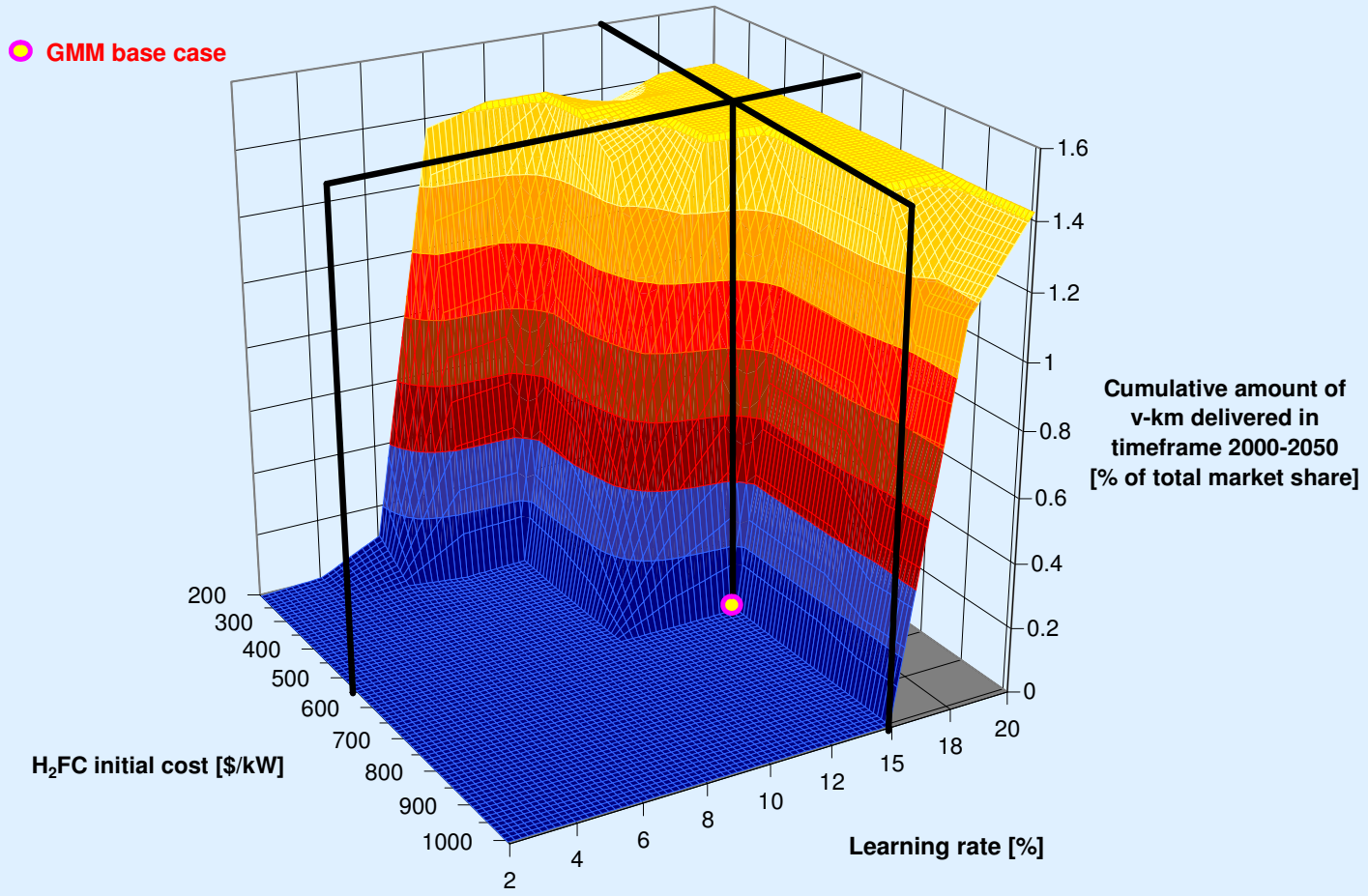
- 5 regions
- 2000-2050
- Personal vehicles, buses and heavy trucks



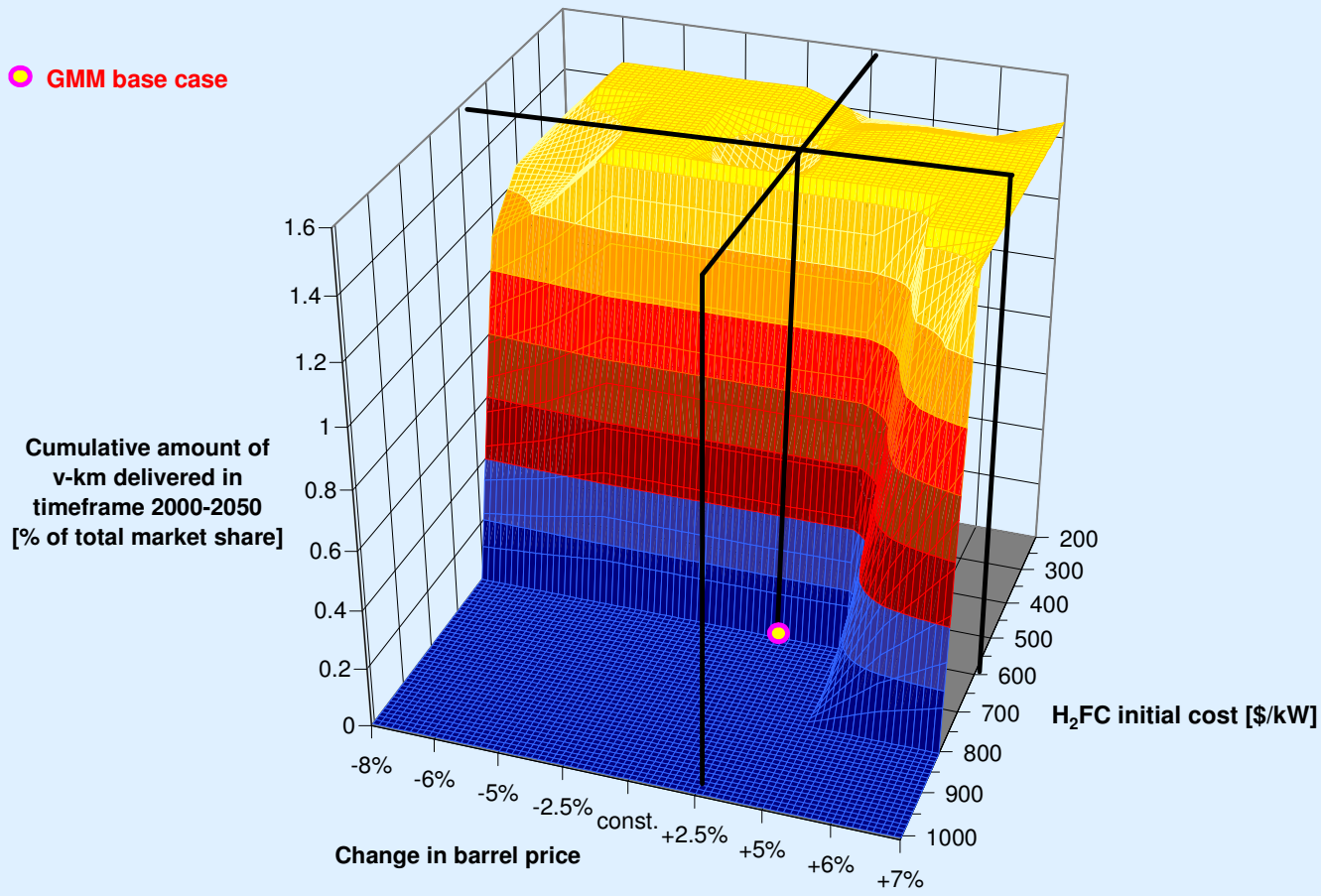
Sensitivity analysis

Parameter	Steady state	Variable
Price of fuel cells	600 US$/kW	200…1000 US$/kW
Learning rate	15%	2…20%
Initial number of vehicles	75,000	75,000…500,000 vehicles
Trend in oil price	+2.5% /decade	-8% … +7%/decade
Discount rates (fuel cells)	5%	2%...5%
Discount rates (H_2 infrastructure)	5%	2%...5%
External costs – CO_2	-	15…250 US$/ton CO_2
External costs – NOx	-	1,000…10,000 US$/ton NOx
External costs – SOx	-	1,000…10,000 US$/ton SOx
Demonstration vehicles	-	12,500…150,000 vehicles
Cash-back promotions	-	10…100 US$/kW

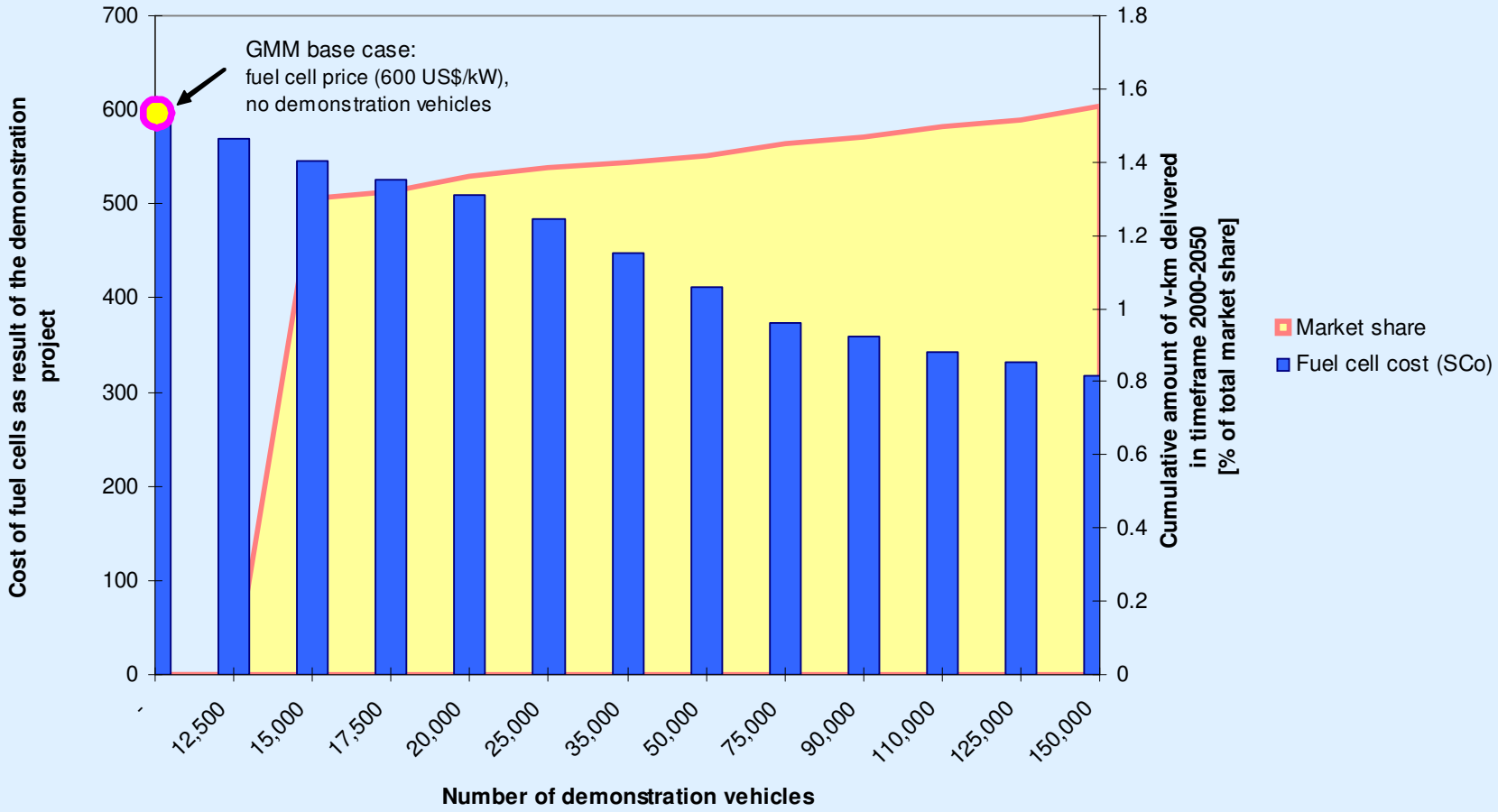
Results(1): Fuel cell price vs. Learning rate



Results(2): Fuel cell price vs. Oil price trends



Results(3): Demonstration projects



Conclusions

Key factors:

Price of fuel cells

Learning rates

Demonstration projects could act as a stimulating policy instruments

Full fledge infrastructure in long run

Factors of lesser importance:

Oil price trends

Environmental policies (CO_2, NOx, SOx)

Infrastructure development

ETL (endogenous technological learning)