Energy-Redefined

The Simulation & Optimization of Technology to Address Climate Change

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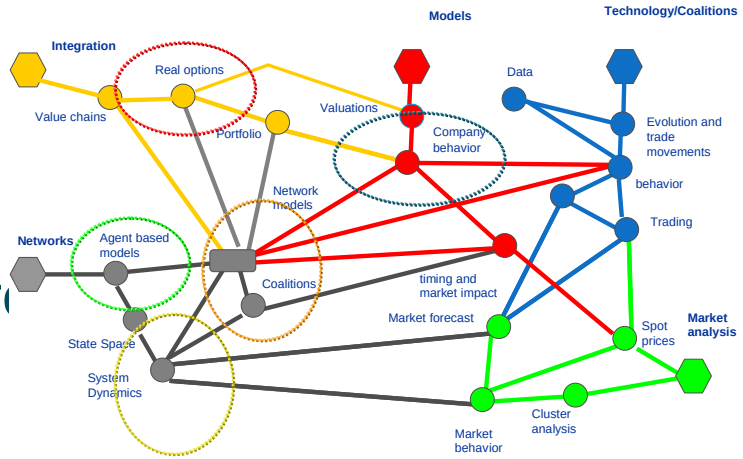
Abstract

- Climate change when coupled with the interaction of politics is an incredibly complex system. Optimization or control of such a system using conventional techniques is difficult and fraught with a myriad of issues. The paper will consider a number of models that the author has explored in Industry to help frame key questions in the current climate debate. This has involved consideration of policy, technology and the modeling of carbon emissions. The author's current approach uses a combination of methods including complexity approaches. Initial results from the model will be presented.

Some Thoughts from my Modelling

- Carbon, Technology & Politics are inextricably linked – but how do we represent them?
- No one right model – got to be fit for purpose (speed vs accuracy)
- Models to represent reality but they ar not reality !!
- Evolution of and volatility in prices/markets is an important driver of participant investment behavior
  - Actors are not homogenous – each company will view the world differently
  - Non linear – more than one equilibrium
- Key Factors but what are they?

Multitude of Approaches but which One Should we use?



Getting Factor X right !!!

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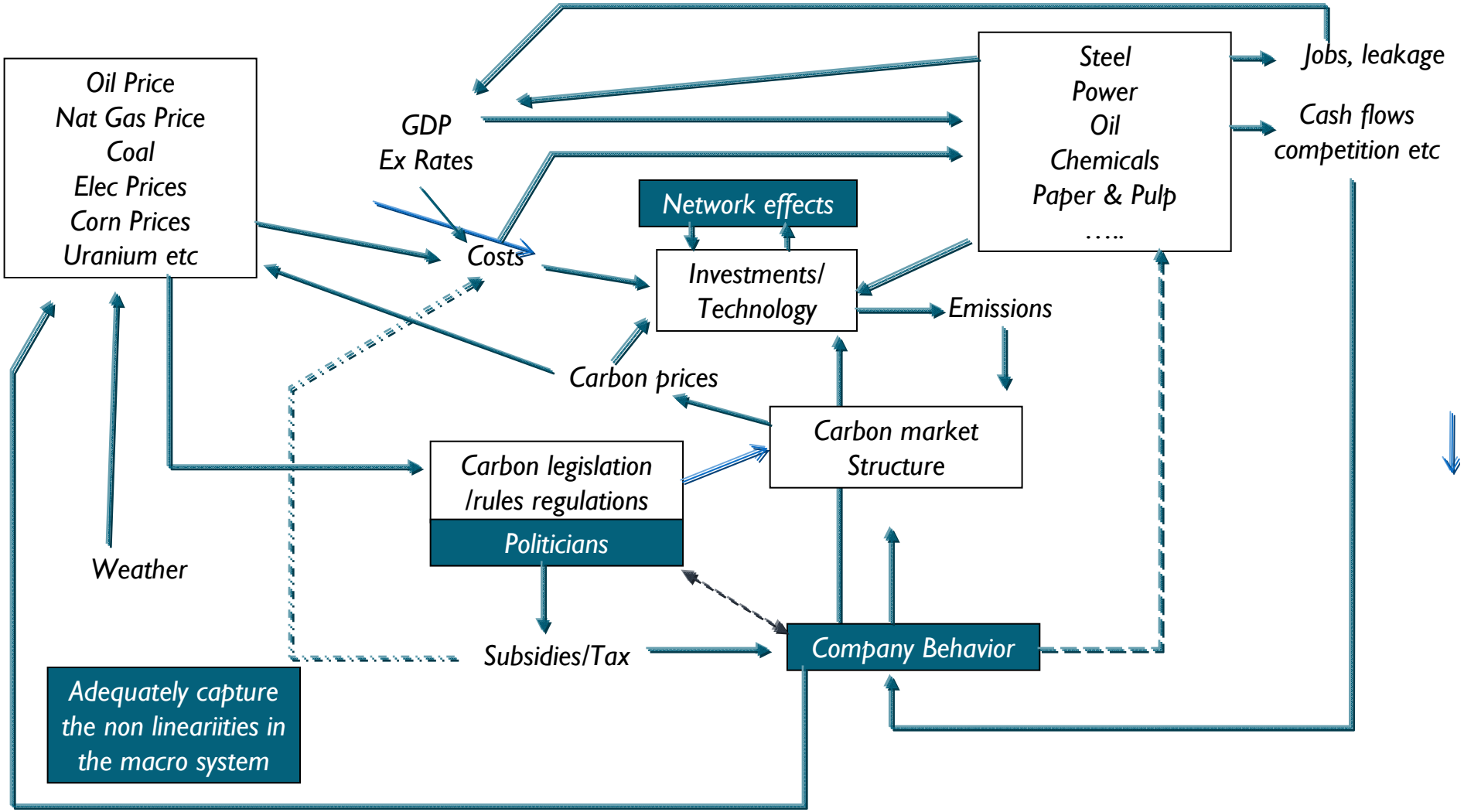
A Technology & Carbon Model



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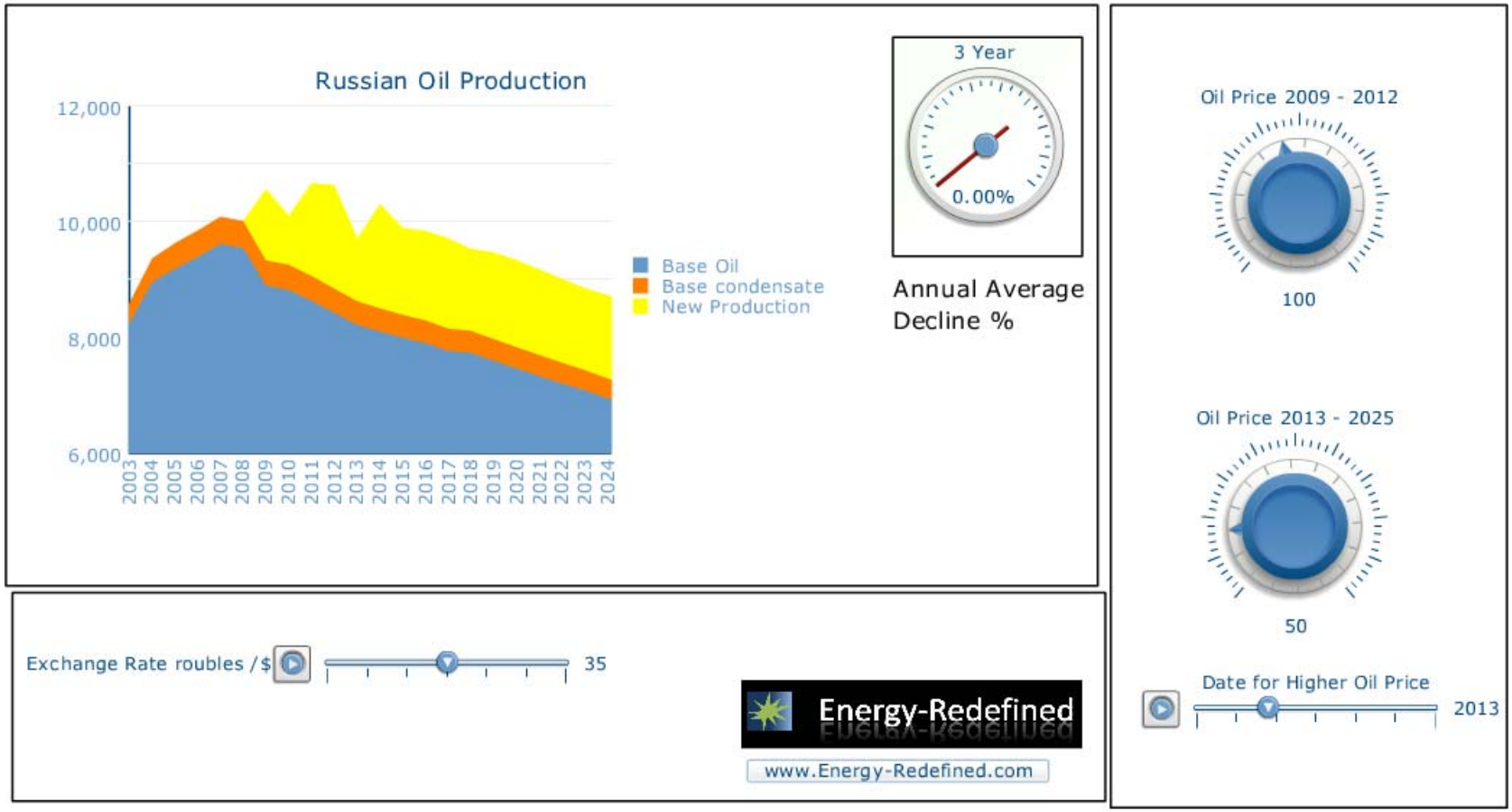
Non Linearity's Everywhere – Just One Component



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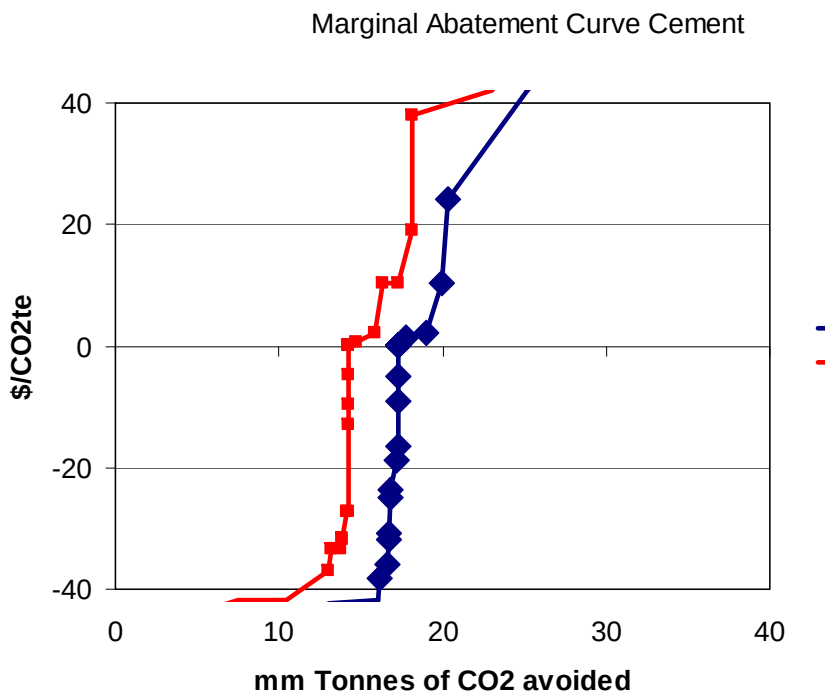
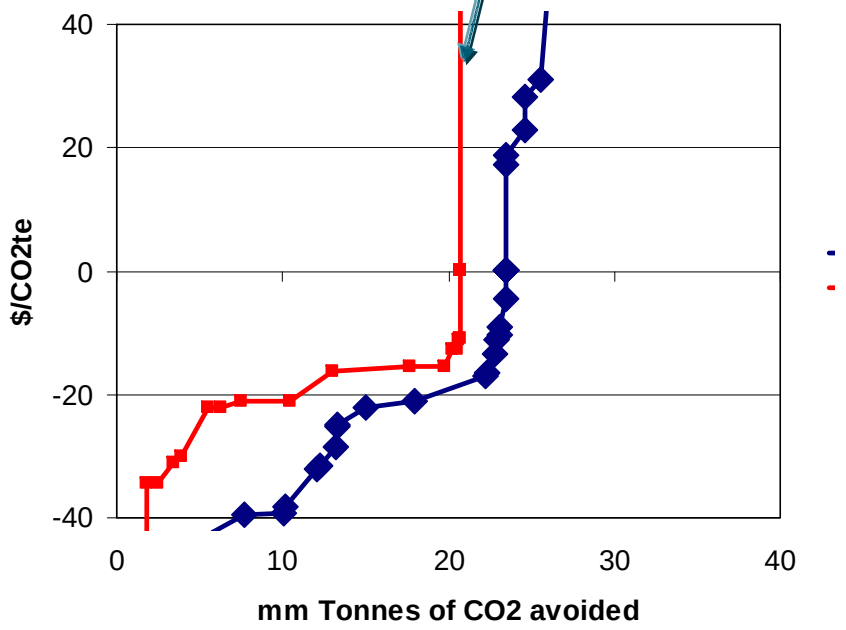
Industry and Behaviors affect MAC's



Company cash-flow constraint



Lower coal price & lower Clinker %

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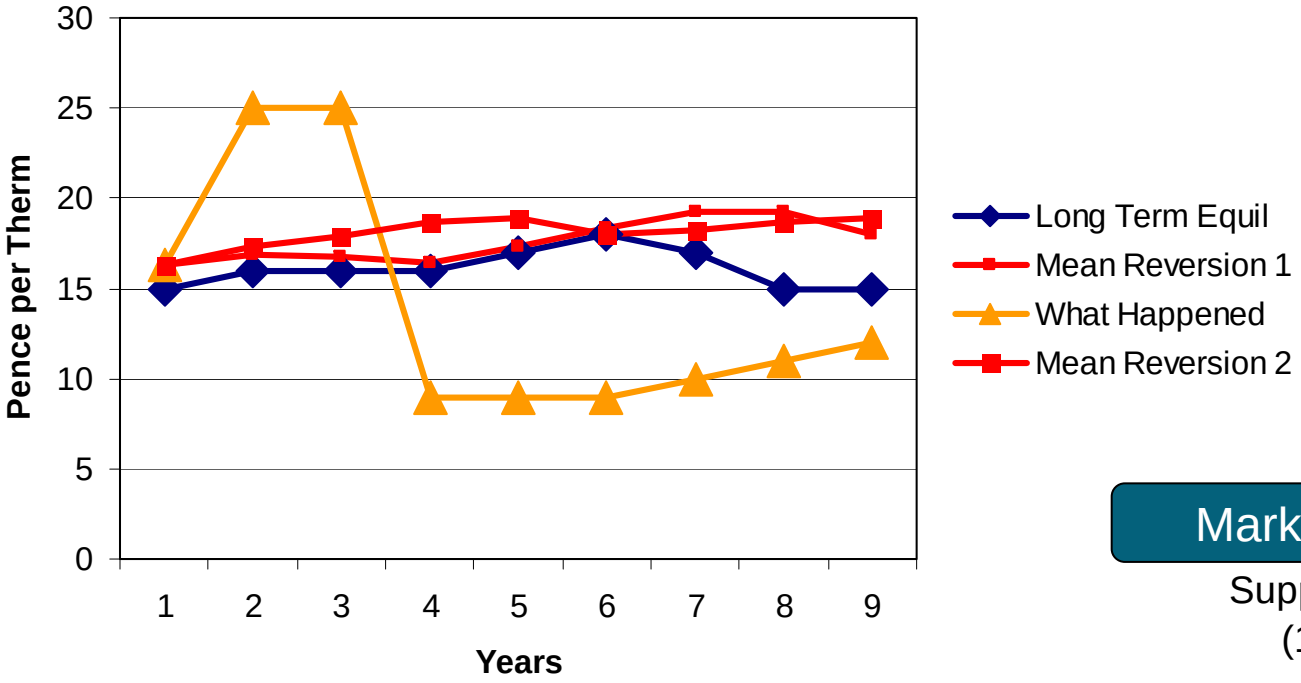
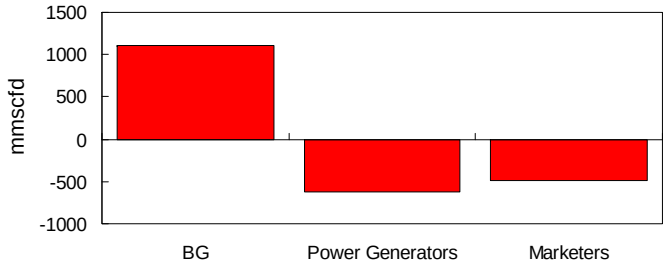
Long Term Equilibrium. What Supply and Demand



Market in Balance but …

Supply - Demand
(1998 only)



Price Volatility +70% -50% Important to model individual companies positions

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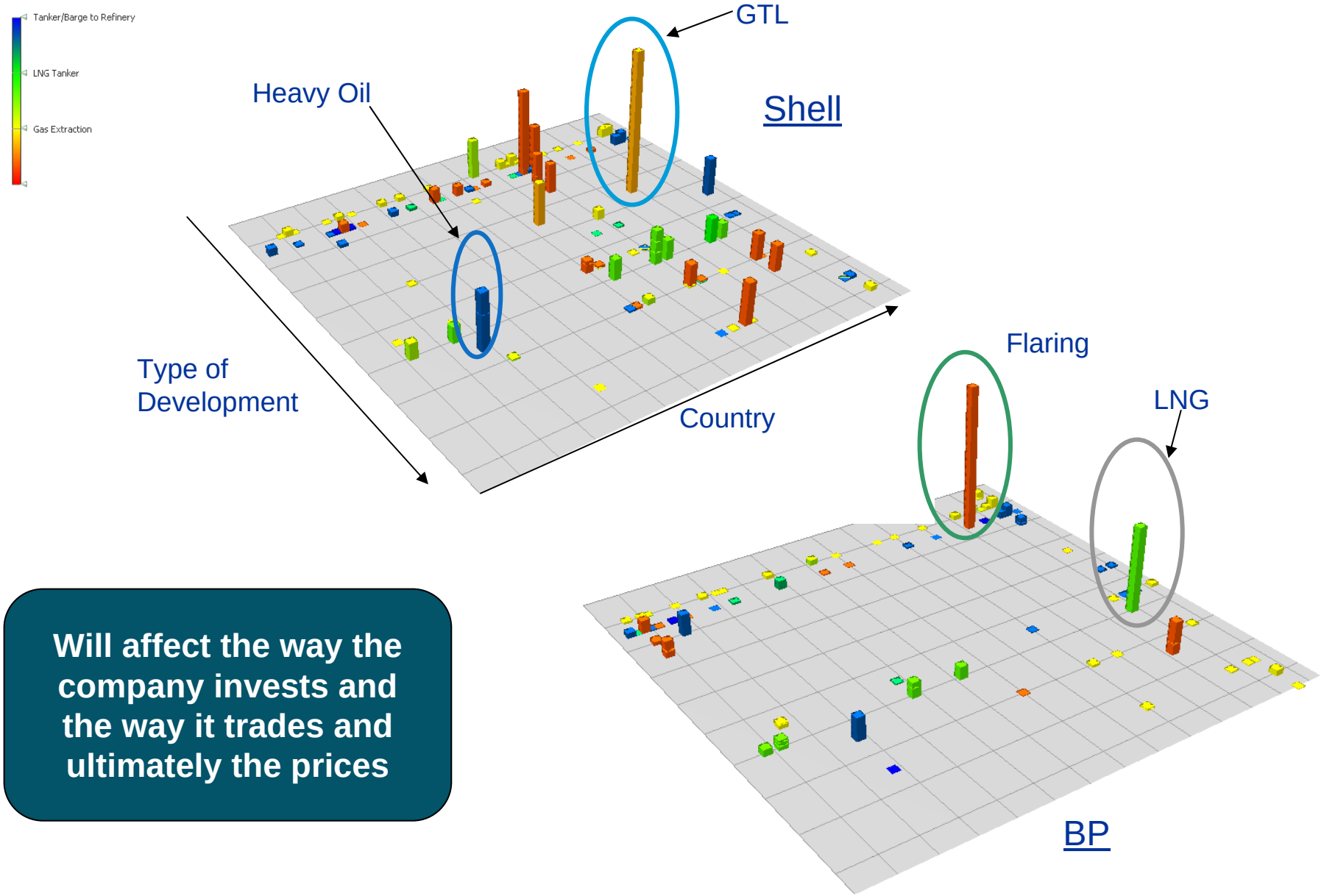
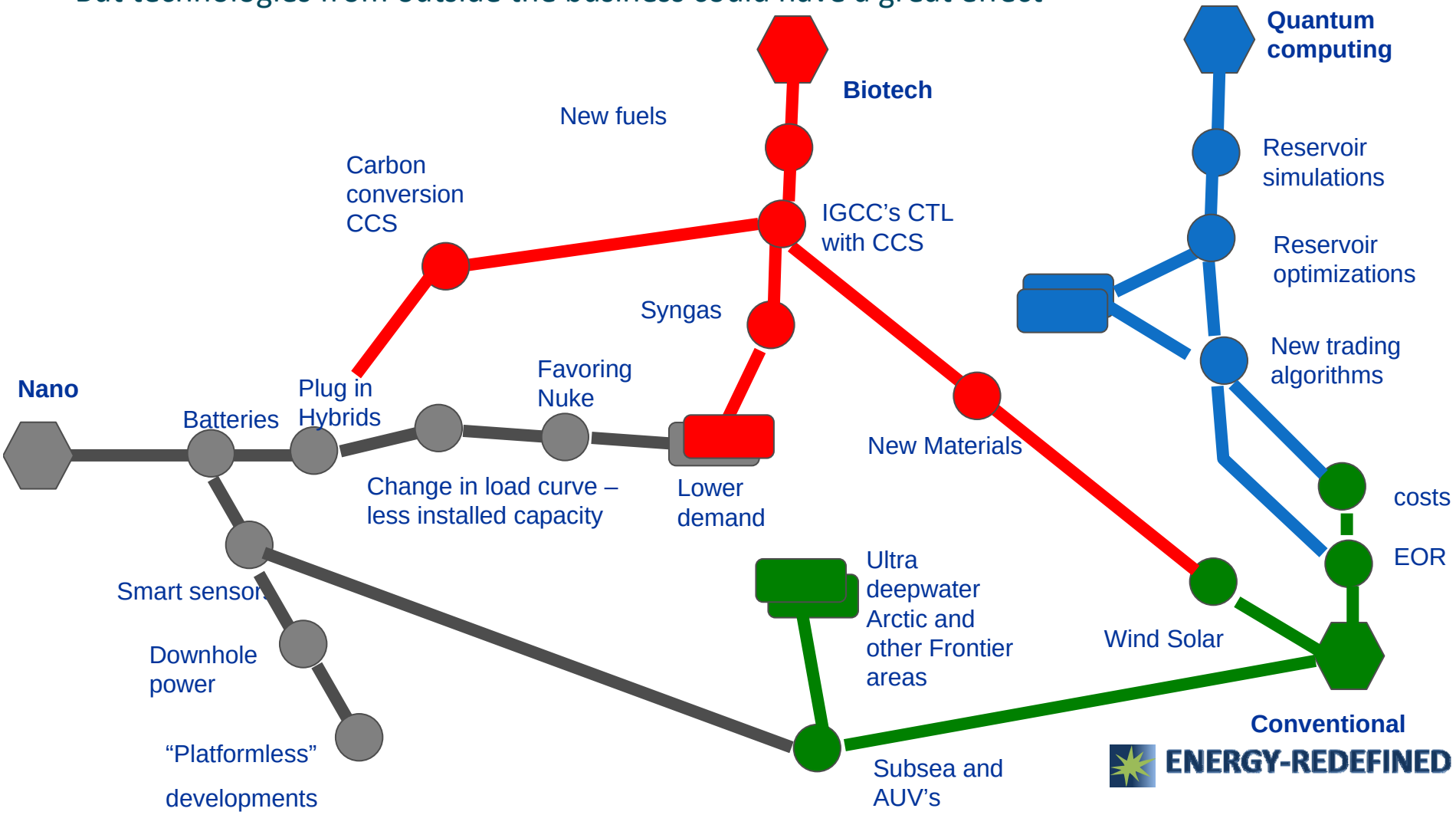
Areas of Focus is Different for Each Company – Oil Industry Example



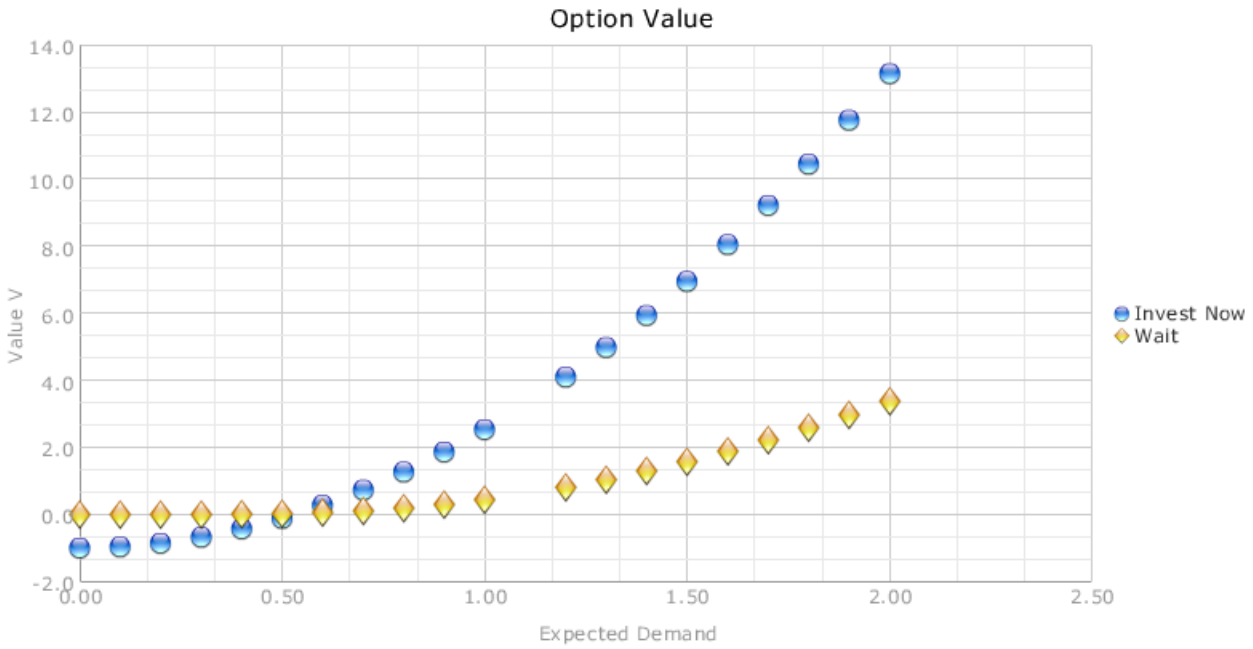
Will affect the way the company invests and the way it trades and ultimately the prices

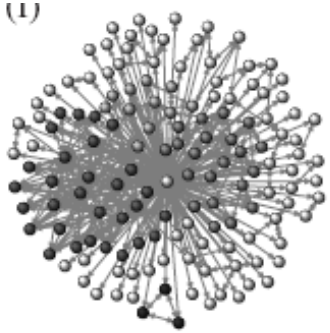
Other Technologies

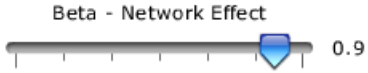
- Conventional technology mainly about costs and production efficiencies
- Focus of Technologists on incremental technologies
- But technologies from outside the business could have a great effect



Invest or Wait: The Effect of Network Effects.







Example option with Network Effect

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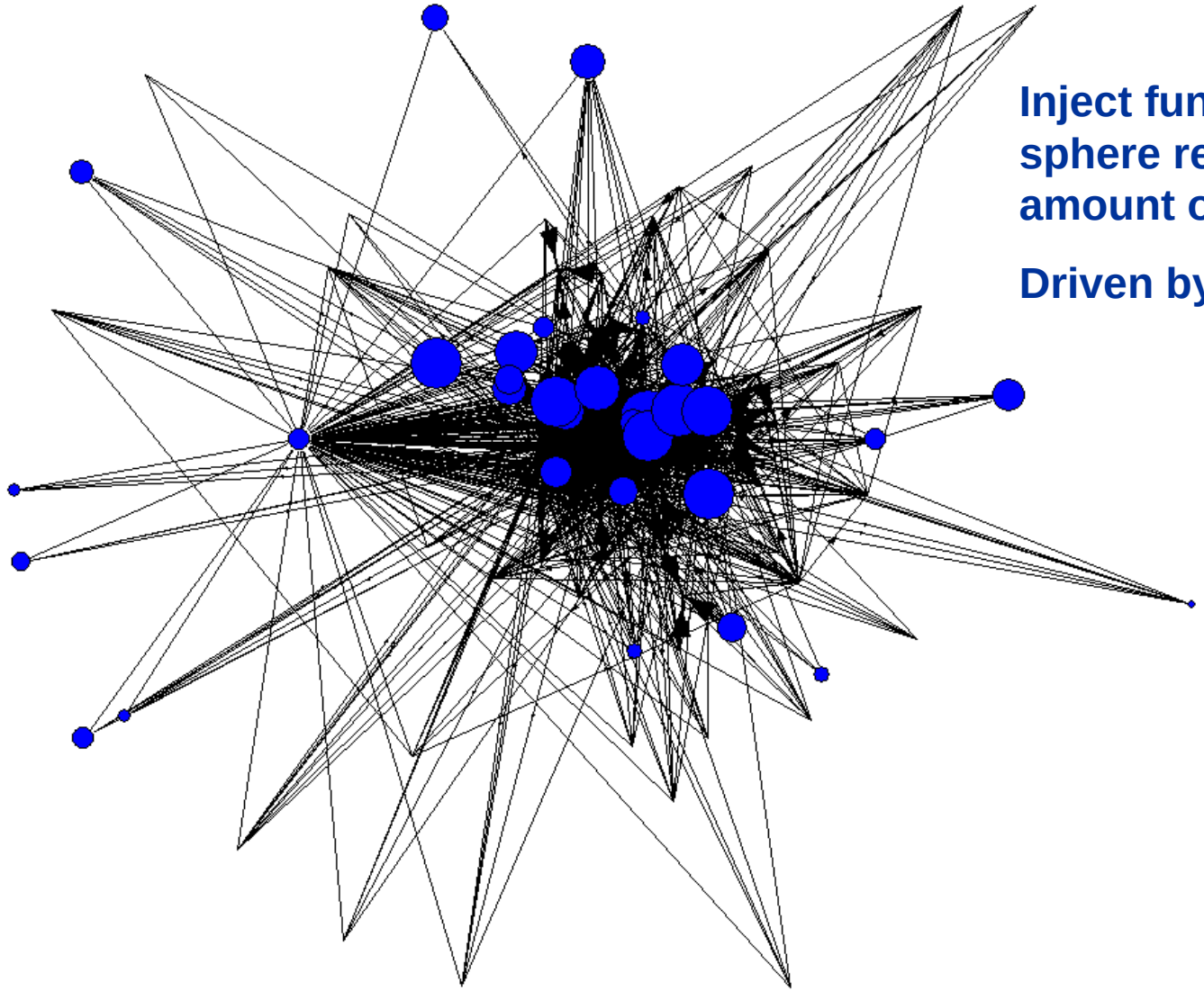
Specific Sector Energy Technology Interactions



Inject funding – Size of sphere represents amount of effort/funds

Driven by politicians?

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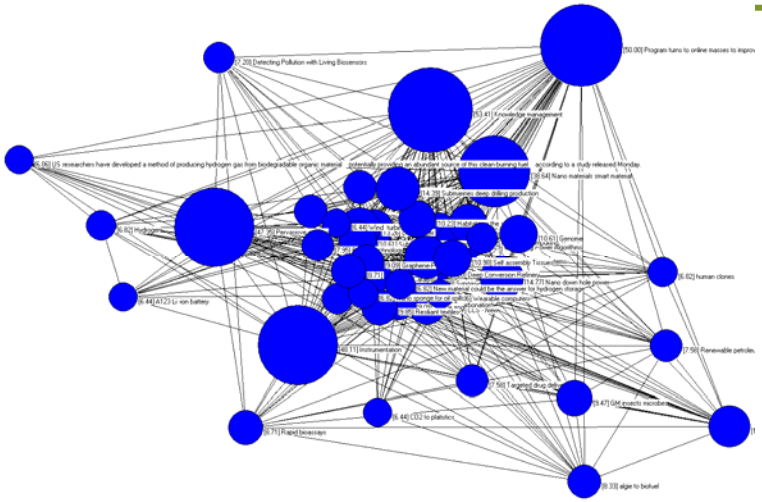
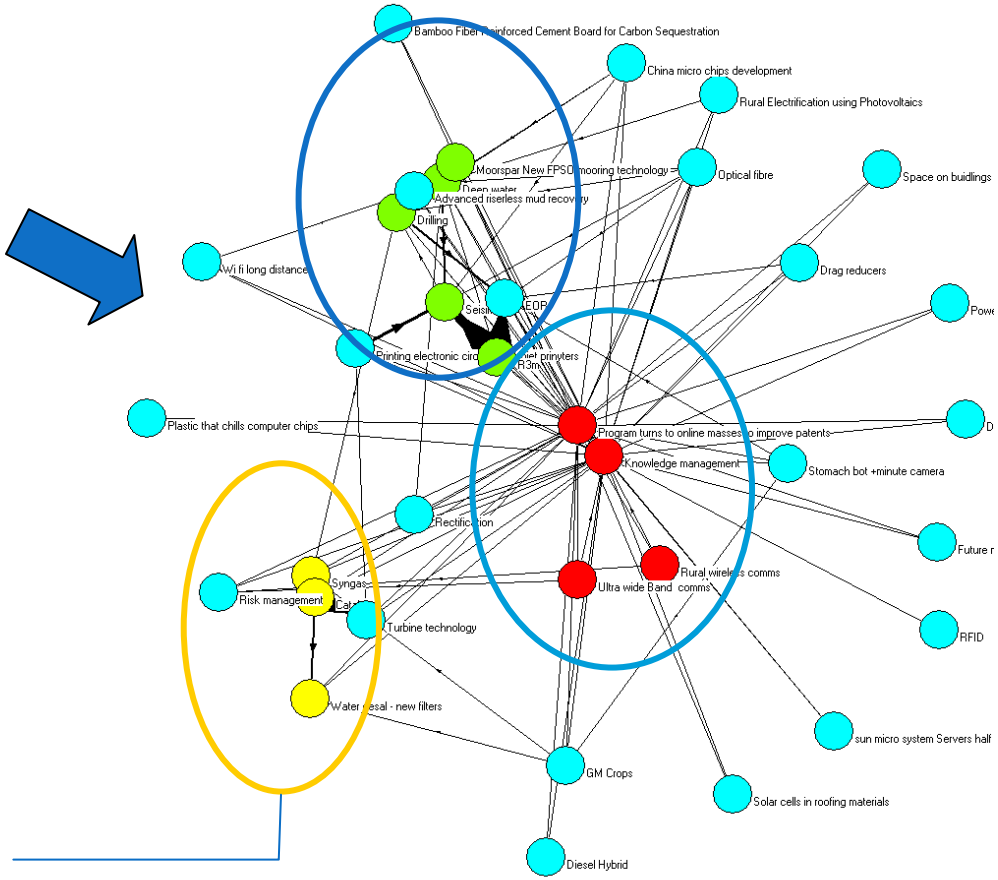
Where does that funding end up:





Impacts Technology network

Impacts carbon markets

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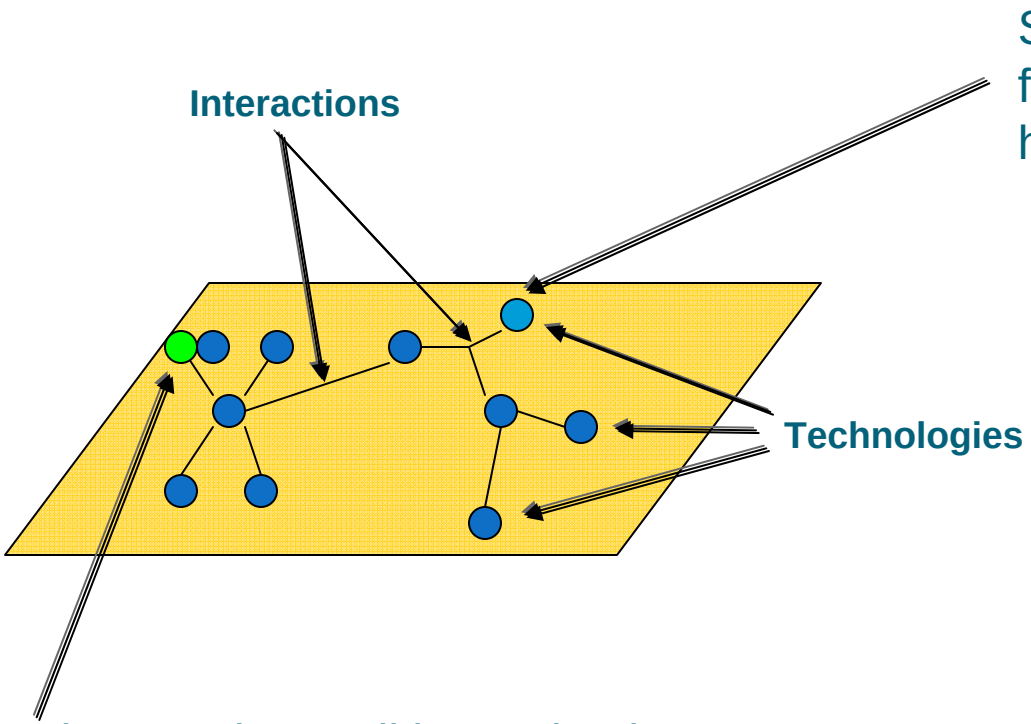
Technological Interactions



Stimulus and funding applied here

Under certain conditions stimulus permeates and cascades to here

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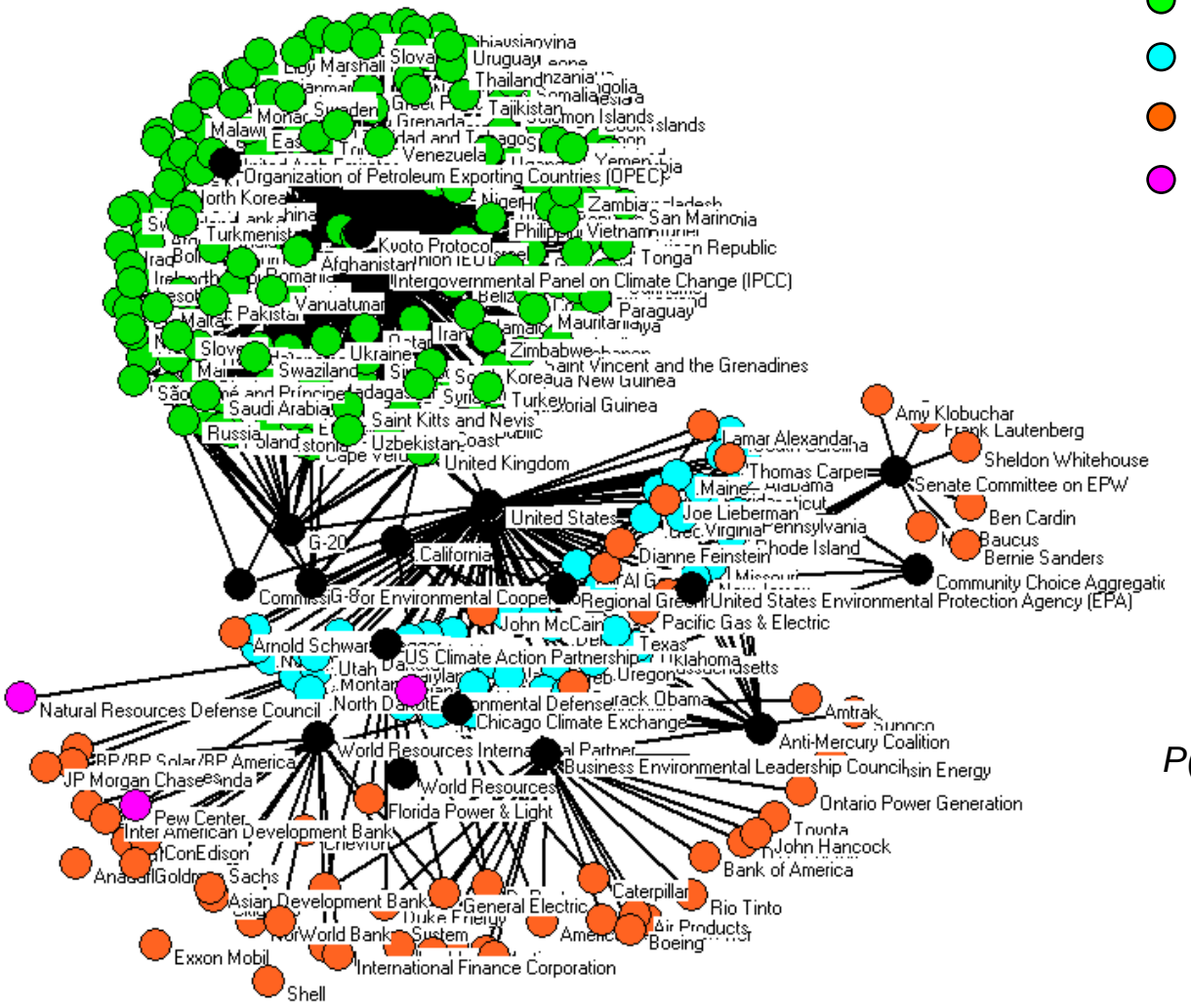
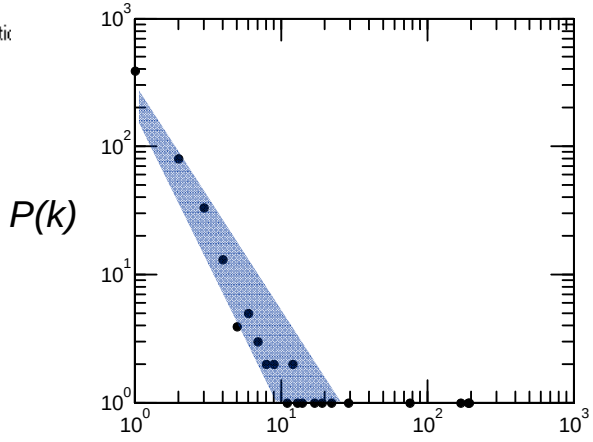
Evolution of the Network of Coalition of Interests - Politics



- National governments
- U.S. state governments
- Companies and individuals
- Organizations



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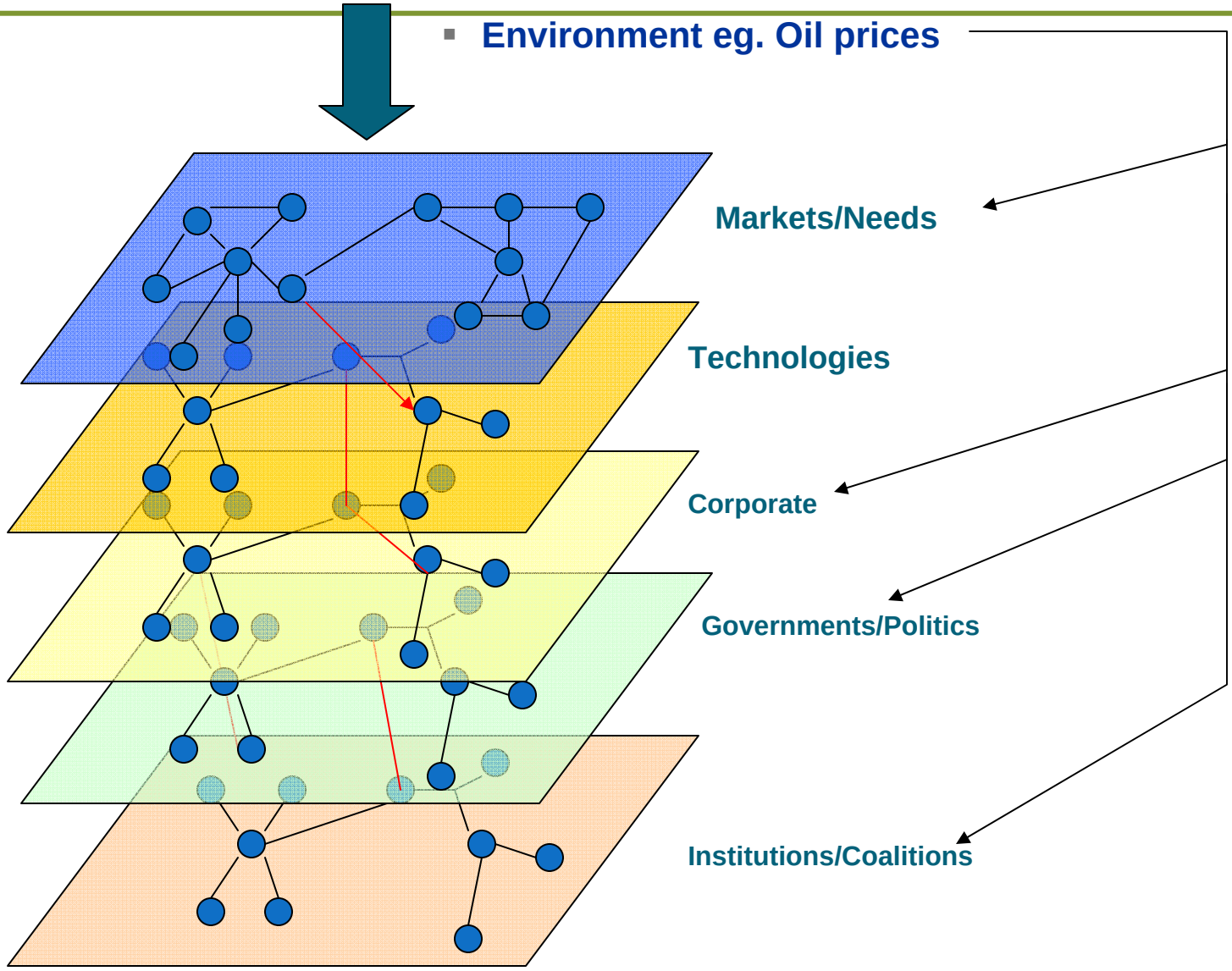
Networks Interact and Change due to other Interactions

- **Environment eg. Oil prices**



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Conclusions – Key Messages

- Externalities – really important – eg Network effects – leakage
- Lots of uncertainty in key data – Optimizing under uncertainty and multiple goals
- Path is important – Evolution /Non linearities
- Network Adapt
- Volatility and market structure greatly affect business decisions and participant behavior – ie path and prices
- Carbon Accounting – key issue – now in the hands of politicians

There is a lot of work to do

Thank You

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