



Emissions Trading and Incentives for Technology Development

EPRI-IEA-IETA GHG Trading Workshop
Session 7
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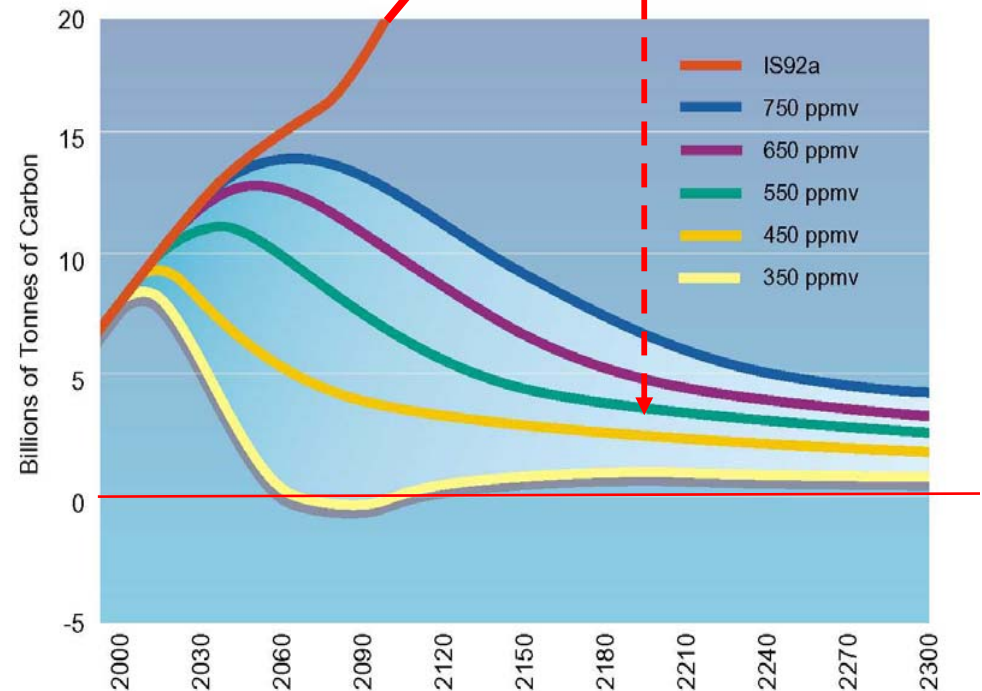
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Enormous Technology Shifts Are Required to Achieve Policy Goal of GHG Concentration Stabilization

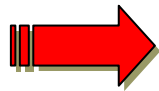
- **Policy goals**
 - Stabilize global temperature
 - Stabilize GHG *concentration*
- **Implications for emissions**
 - Ultimately, net **global** greenhouse gas emissions must fall by nearly 100% from their projected “business as usual” levels
- **To gain agreement on policies, energy must remain affordable, especially for poorer countries**
 - Current technology and evolutionary improvements cannot plausibly reduce global emissions to zero at acceptable cost
- **R&D to provide breakthrough technologies is needed**

Emissions Trajectories Consistent With Various Atmospheric CO₂ Concentration Ceilings



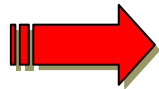
Important Conditions for Motivating R&D and New Technology Deployment

- **For both R&D *and* technology deployment decisions:**
 - Expectation that policy will remain in place over long time period
 - Firm understanding of CO₂ price levels into future (if policy is market-based)



IMPERMANENCE AND UNCERTAINTY ARE ANATHEMA

- **Also important for R&D:**
 - Certainty that investor will obtain/retain intellectual property rights
 - Expectation that carbon prices will remain high enough to repay the investment in R&D as well as motivate technology adoption



AND EMISSIONS MARKETS ALONE ARE INSUFFICIENT

EU's ETS: A Case Study in Poor Deployment Incentives

- Lack of certainty on CO₂ market prices
 - Lack of certainty on long-term presence of policy
- High prices but minimal advanced technology deployment

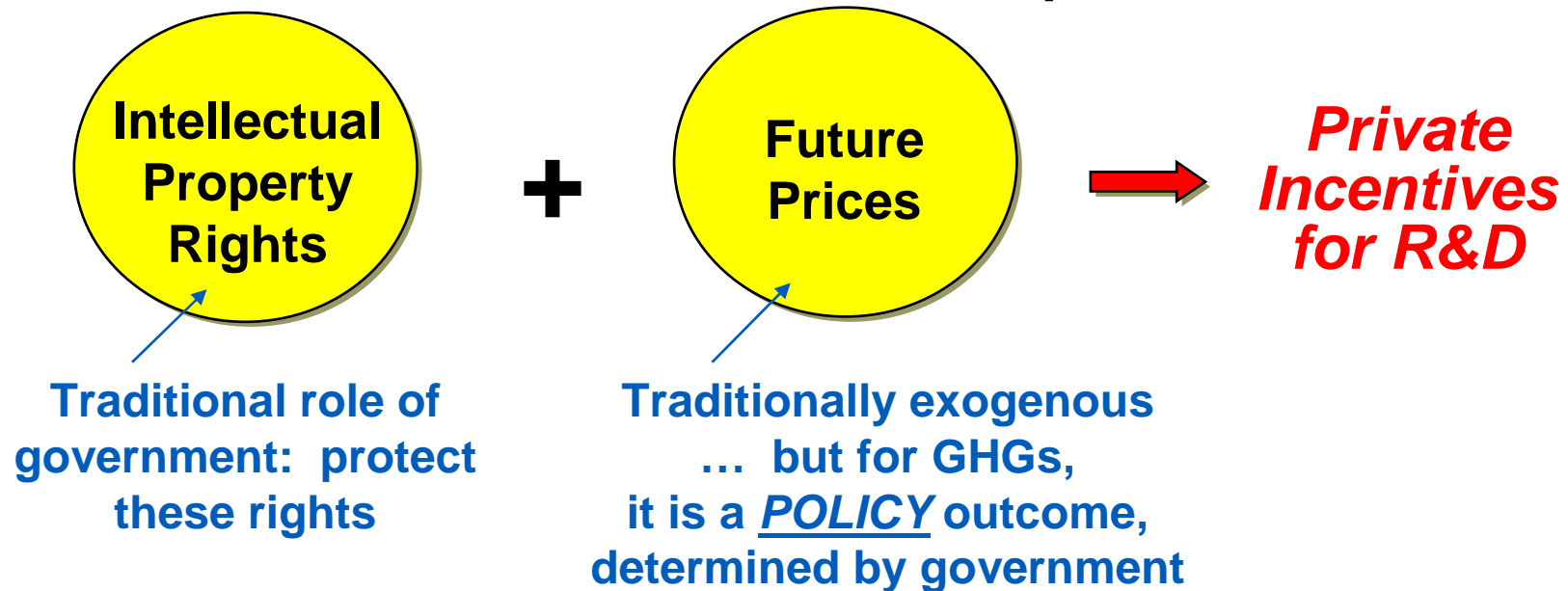


The Problem Is More General -- No Carbon Pricing System Can Provide Credible Incentives for Long-Term R&D

- **“Safety valve” and other approaches that directly target and manage the future course of CO₂ prices:**
 - Greatly reduce day to day price volatility
 - Greatly increase certainty on long-term evolution of CO₂ prices
 - Enable an emissions policy with greater political permanence
- **The above attributes would be very beneficial to decisions to deploy new technologies**
- **But these attributes probably do not provide sufficient incentives for the necessary types of R&D that will make near-zero CO₂ emissions an affordable outcome for the global economy**

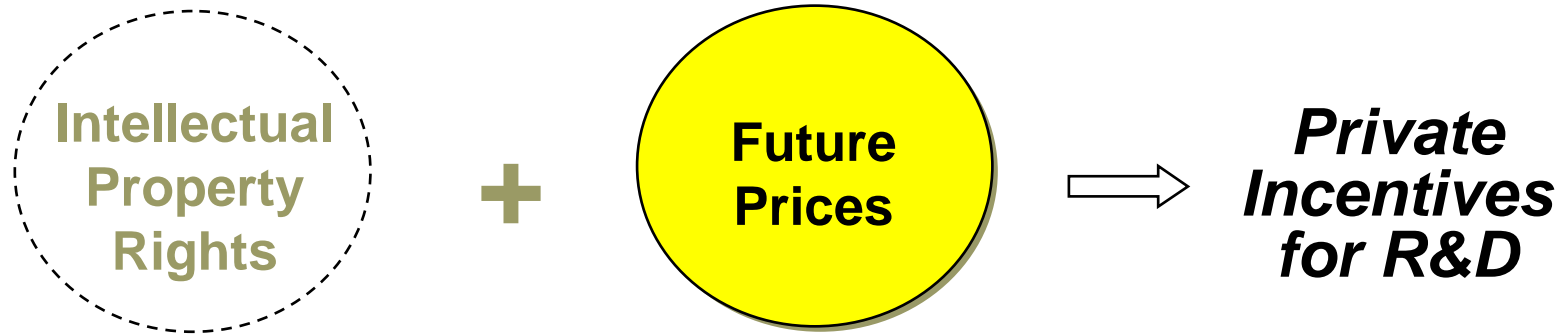
GHG R&D Faces “Twice” the Incentive Challenges of Traditional R&D

- Private sector R&D is motivated by profits to be earned from successful innovation, which has 2 components:



- Rights to intellectual property are not rights to a specific price level

Why Price Incentives Work Poorly for GHG-Related R&D



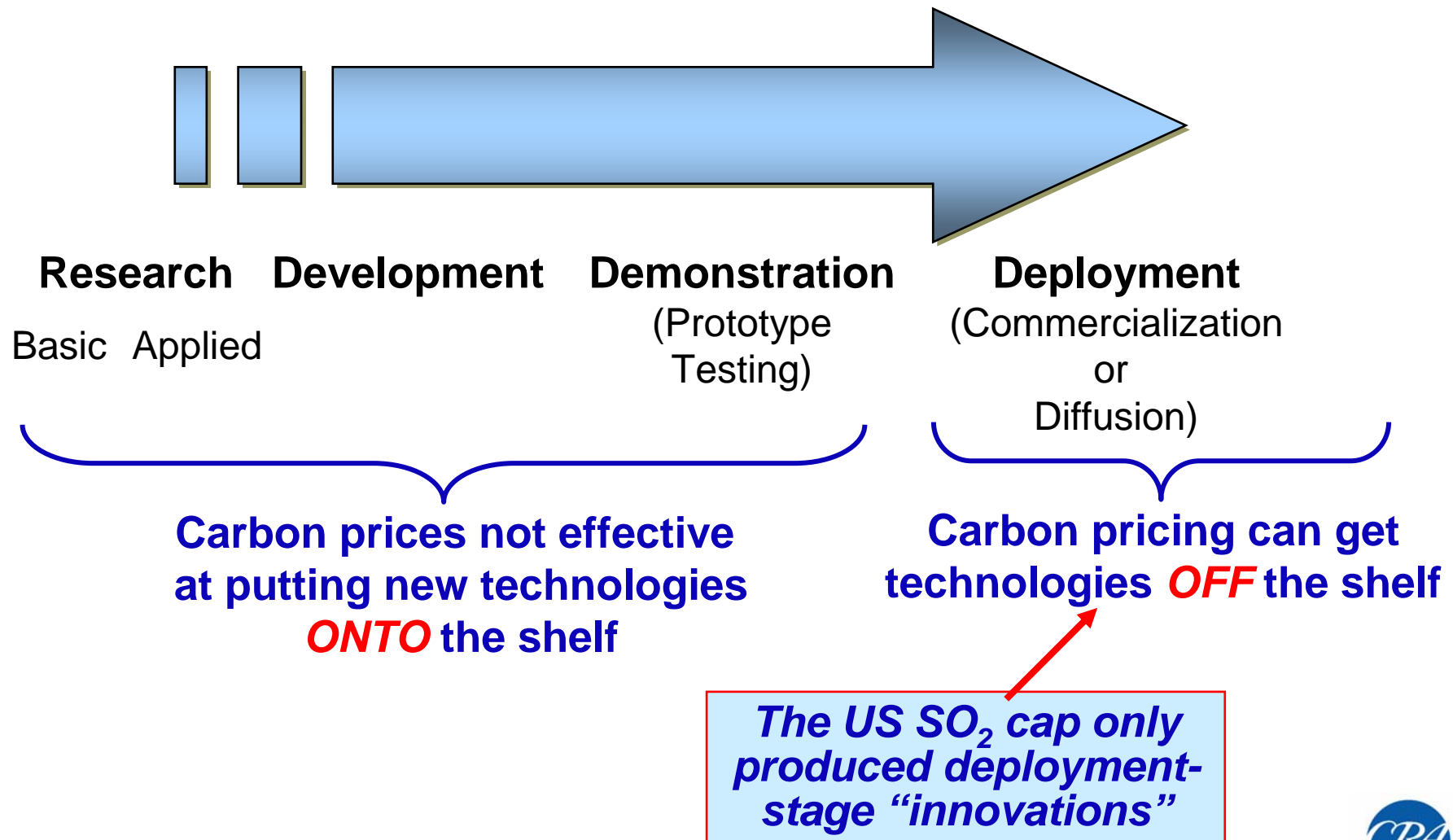
- **For GHGs, price reflects a *policy choice*, not a physical scarcity**
 - Announced carbon price must be high enough that the investor expects to profit from *developing* the technology
 - Once the technology is developed, the carbon price only needs to cover costs of *using* the technology to bring about adoption
 - Since high carbon prices have other undesirable economic impacts, the optimal choice is to surprise the inventor by *reducing* the announced price *after* the technology is available
- **Therefore, a future carbon price sufficient to make R&D on climate technologies profitable is inherently *not credible***

GHGs Pose Challenges to the Intellectual Property Rights Part of the R&D Incentives Equation Too



- **Impossibility of patenting the kinds of scientific advances required**
- **Integration of many incremental innovations**
(“cumulative innovation”)
- **Very long time frames for potential payback**
(may exceed period of patents or credible licensing terms)
- **Need for global deployment**
(transfer to all countries without reducing intellectual property rights protection will be difficult)

CO₂ Pricing Is a Poor Device to Motivate the Kind of R&D that Is Needed to Stabilize GHG Concentrations



A Painful Conclusion

- **The great merit of market systems is getting government out of decisions about how to reduce GHG emissions**
- **Now we have to put government back into the business of R&D**
- **Challenge is to do so in a way that**
 - Builds on the ability of carbon pricing to stimulate the adoption of new technologies
 - Does not turn into an excuse for subsidizing *deployment* of new technologies – which the market can sort out perfectly well when there is a price on carbon
 - Enables the private sector to make the choices, bears the risks, and gain the rewards from R&D

Governments Should Concentrate On Providing Credible and Irreversible Incentives for Private Sector R&D

- **Traditional incentives subsidize cost of research *inputs***
 - Tax credits for R&D
 - Research grants or contracts to businesses and universities
 - Direct funding for government laboratories and other research facilities
- **Alternatives emulate what emission pricing cannot do – reward *outputs* of research based on their contribution to reducing emissions**
 - Have a number of advantages over traditional incentives
 - Can take different forms
- **Prizes are the clearest example of a reward for outputs -- success in R&D**
 - Prizes put the incentives, decisions, and risks in the right place
 - How can that be done across the board for R&D?

Other Issues In Designing R&D Policy Compatible With Reliance on Carbon Prices for Technology Deployment

- **Alternatives to IP to reward innovation**
(e.g., prizes, contests ?)
- **Role models for successful government funding of basic research**
(e.g., Defense Advanced Research Projects Agency ?)
- **Incentive-compatible schemes for public-private partnerships**
(e.g., matching funds ? -- but not subsidies)
- **Global spillover problems for publicly-funded R&D**
(e.g., international R&D collaboration ?)
- **Incentives for global deployment/technology transfer**
(...?)

Little is understood; little has been discussed

We urgently need answers to these questions – we don't avoid them by creating an emission trading system



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