



Resolving the Green Paradox: It's *economics*, not *altruism*

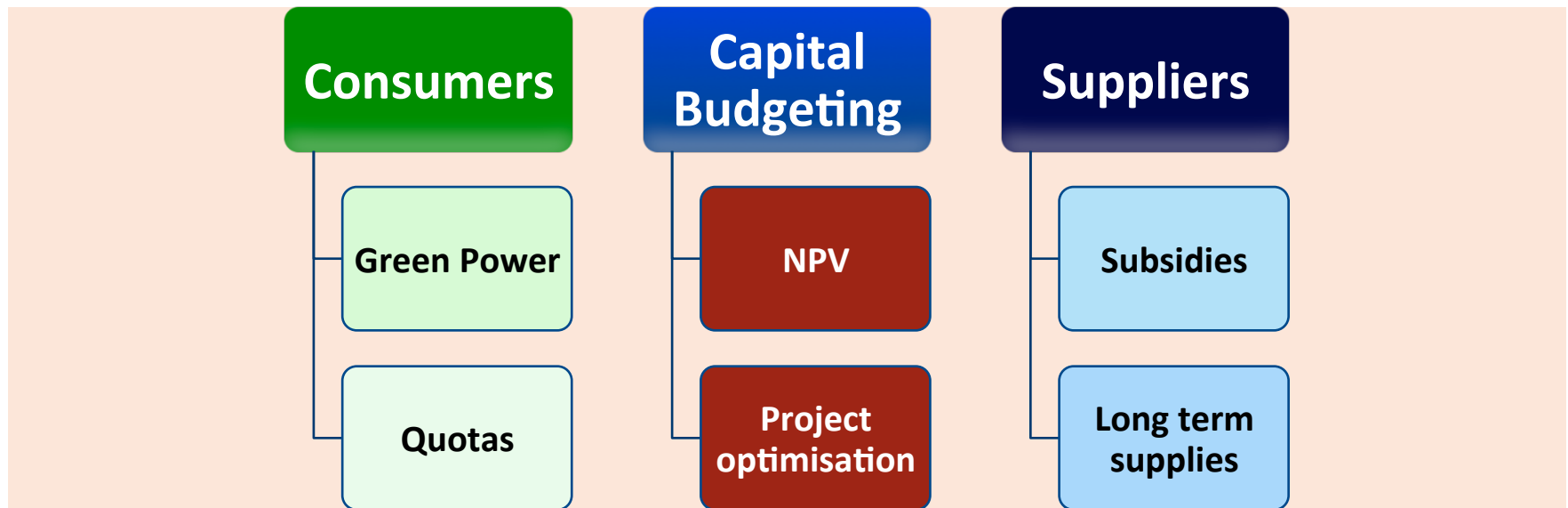
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Asian Clean Energy Forum, Asian Development Bank
June 19, 2015, Manila, Philippines

The Green Paradox: Why choices contradict preferences

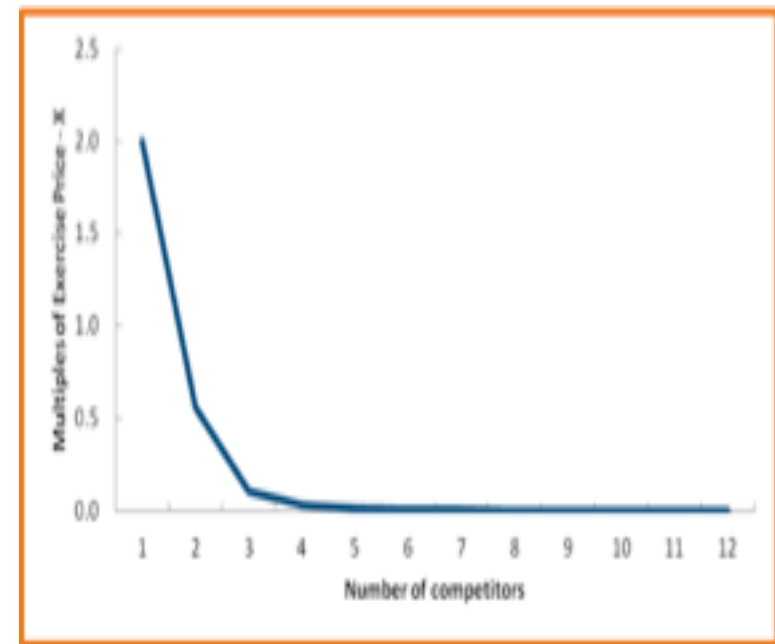


Cash flow certainty rewarded, subsidies “secure” revenues
Prefers “proven” coal and gas technologies while penalises renewables
Result: “Green” products a niche market, subsidies encourage rent-seeking

Why subsidies fail – Energy market is dynamic, not flat

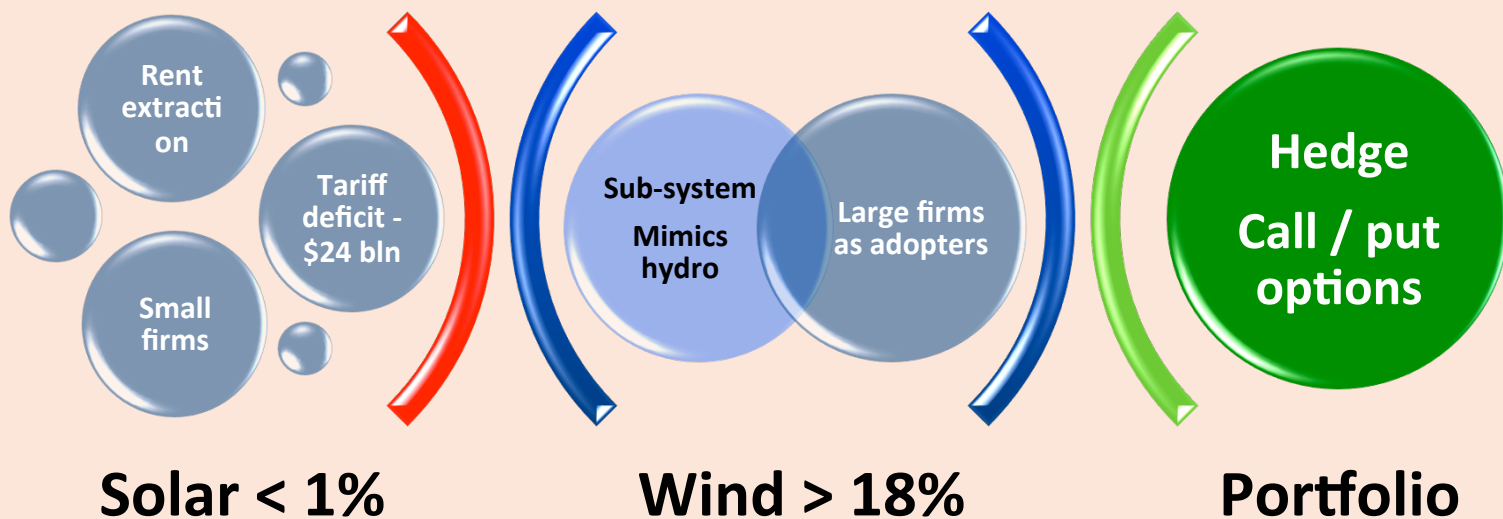
Oil Price Scenarios - \$70.00 / bbl median price		14,00	42,00	56,00	70,00	84,00	98,00	126,00
System Power Price	Ps	0,0285	0,0459	0,0546	0,0633	0,0720	0,0807	0,0981
Grid Price Parity Subsidies as Multiple of Power Price								
Distributed Generation - Baseload	x	0,08	-	-	-	-	-	-
Hydro - Baseload	x	0,17	-	-	-	-	-	-
Distributed Generation - Mid-merit	x	0,33	-	-	-	-	-	-
Hydro - Mid-merit	x	0,53	-	-	-	-	-	-
Geothermal - Baseload	x	0,70	0,05	-	-	-	-	-
Biomass - Baseload	x	1,21	0,37	0,15	-	-	-	-
Onshore Wind - Mid-merit	x	1,25	0,40	0,18	0,01	-	-	-
Geothermal - Mid-merit	x	1,35	0,46	0,23	0,06	-	-	-
Biomass - Mid-merit	x	1,93	0,82	0,53	0,32	0,16	0,04	-
Offshore Wind - Mid-merit	x	2,86	1,40	1,02	0,74	0,53	0,36	0,12
Flat Plate PV - Mid-merit	x	4,46	2,39	1,85	1,46	1,16	0,93	0,59
Power Tower PV - Mid-merit	x	4,86	2,64	2,06	1,64	1,32	1,07	0,70
Parabolic Trough PV - Mid-merit	x	5,03	2,74	2,15	1,71	1,39	1,13	0,75

Notes: Oil prices are used as proxy for fuel prices. The multiples are calculated by dividing the implied subsidies by the prevailing system power price.



Technology “champions” fail because of obsolescence
Varying power prices make grid price parity calculations indeterminate
Subsidies reverse “learning curve effects”
Energy markets and firms are not created equal

Spain: Three lessons in energy economics



Solar PV failed while wind power succeeded. Why?
Size and operational flexibility key to gaining portfolio benefits
Clue: Capex is *exercise price* to acquire *expected payoffs*

What are you acquiring when investing?

500 MW	MWh Annual Production	Payoffs - PV Cash Flows		Capex - Exercise Price		Risk-adjusted Net Value
	CCGT 3.942 GWh Index strategy	High	\$ 617,25	High	\$ 457,28	\$ 159,98
		Low	\$ 617,25	Low	\$ 457,28	
	Onshore Wind 1.489 GWh Call / Put options	High	\$ 2.280,17	High	\$ 1.102,64	\$ 697,41
		Low	\$ 981,06	Low	\$ 1.030,50	
	Solar Thermal 876 GWh CSR?	High	\$ 987,47	High	\$ 2.522,53	\$ -1.265,70
		Low	\$ 223,29	Low	\$ 1.070,00	
	Solar PV 964 GWh Offgrid markets	High	\$ 1.506,48	High	\$ 1.781,85	\$ -215,21
		Low	\$ 665,87	Low	\$ 787,50	

Source of raw data: EIA and author's calculations

This is what you could get
under uncertain power prices
for each technology

What you pay to
acquire payoffs

Adaptive strategy: Aligning preferences and choices

	Feed-in Tariffs - FiT	Floor and cap	Delegated despatch	Subsidies re-alignment
Objective	Develop renewable energy capacity	Introduce incentives and penalties to integration	Centralise despatch to reduce supply intermittency	Reduce tariff and budget deficits
Technical	Marginal capacity	Mandatory output forecasts > 10 MW	Pooling of wind farms capacity > 10 MW	Compulsory pooling of renewable energy > 10 MW
Regulatory	Preferential despatch	Fault-ride through capability optional for wind farms	Mandatory connection to delegated despatch centre > 10 MW	Fault-ride through capability for all renewable energy
Economics	Subsidies dependence; fixed revenues	Price flexible upside; Pricing signal to investment	Transparent pricing and capacity bidding	Volume limits to subsidised supplies; surplus paid at market prices
Legal	RD 2818/1998	RD 436/2004	RD 661/2007	RD1565/2010

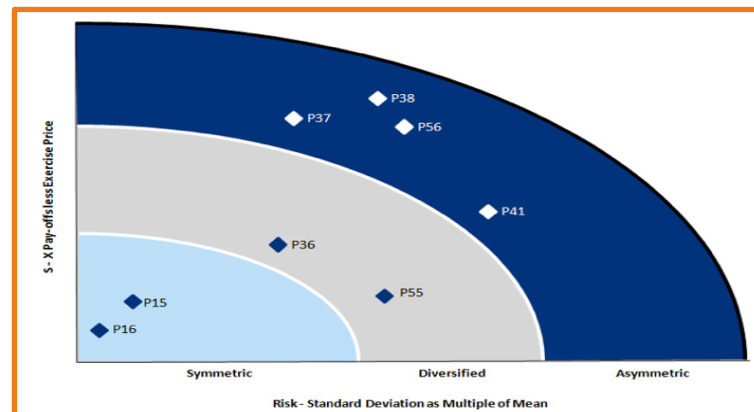
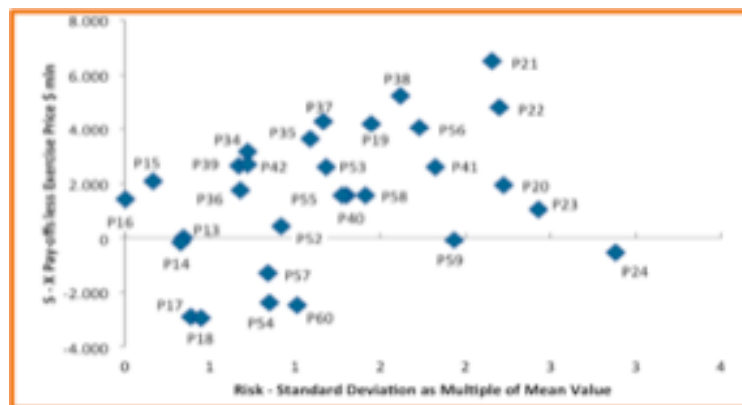
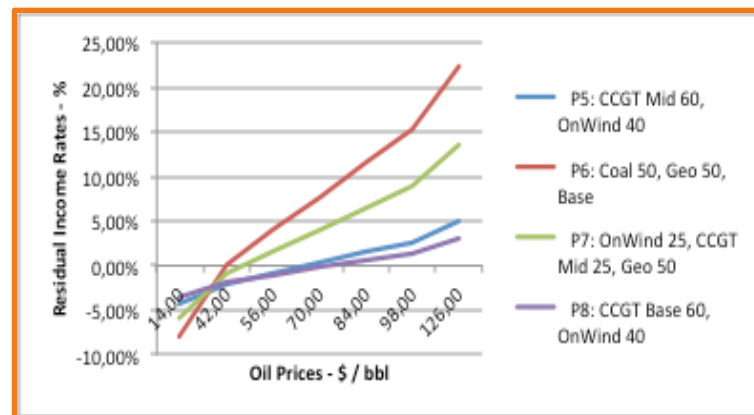
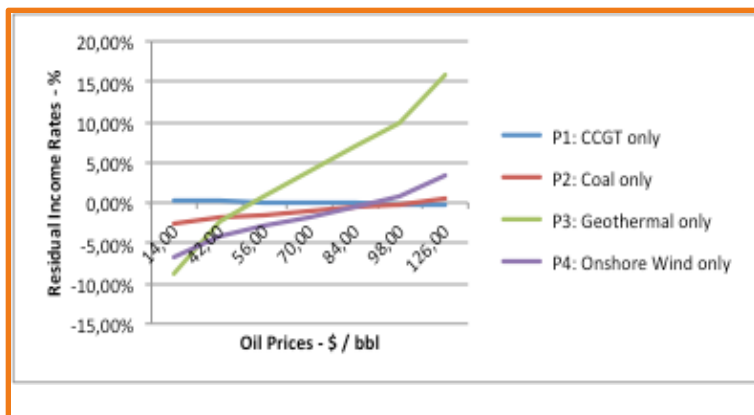
Pragmatism, operational flexibility, adaptive responses shape firm's strategy

Technology advances broaden choices to suppliers

Consumer choices exercised indirectly: Fixed price vs variable price contracts

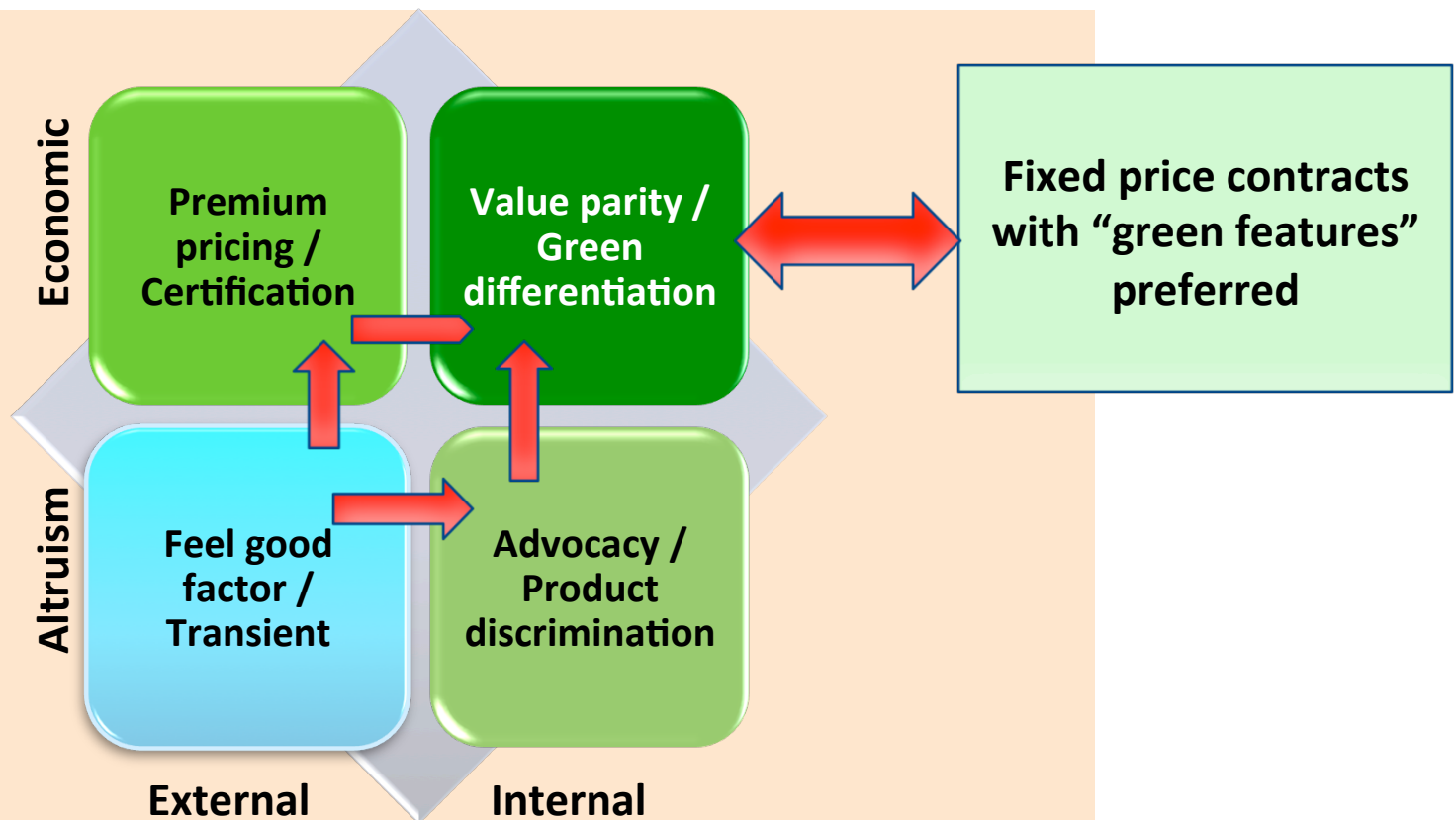
Source: Renewable Energy Law and Policy Review, September 2012

Response: Portfolio expands supply options



Source: Journal of Applied Corporate Finance, April 2015

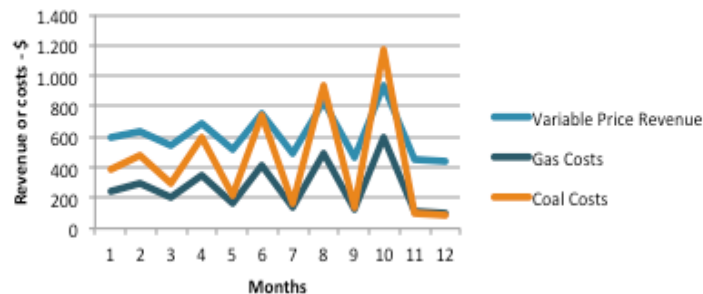
“Green” consumers: It’s business and personal



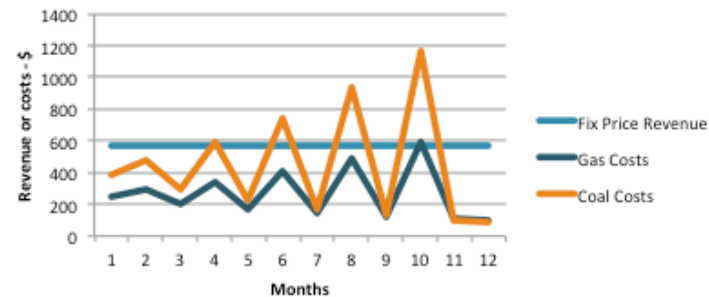
Source: IESE Insight, First Quarter, 2011

Fixed Price Offer: Making renewables economics work

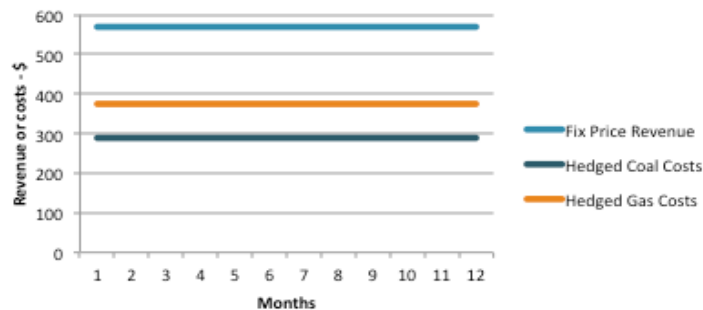
Variable Prices and Costs



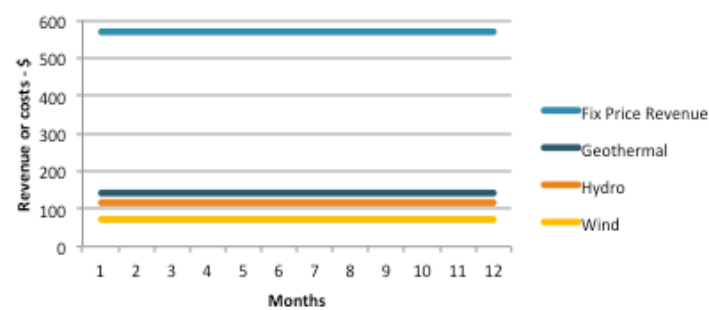
Fixed Price and variable costs



Fixed Price and Financial Hedge



Fixed Price and Physical Hedge



Some lessons for Asia

