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DB Climate Change Advisors

How Transparency, Longevity and Certainty in Public Policy Can Drive Investment

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http://www.dbcca.com/research

Passion to Perform

May 14th, 2012

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Introduction to DBCCA

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Deutsche Bank Climate Change Advisors: An overview

DBCCA was formed in 2008 as a global in-house climate change research team

- An investment industry thought-leader on a broad range of climate change dynamics, with representatives in the US, UK, and China
- International research group (NYC, London and Beijing) has published more than 35 whitepapers and research notes since October 2007
- DBCCA also supports multiple business channels and climate change investment teams across the DB Group, and briefs the firm's clients on the topic of climate change investments

DBCCA research team has access to a wide range of expertise

Expertise in multiple climate change-related sectors and industries

Coverage Research Areas

- Clean energy
- Energy efficiency
- Climate policy
- Power markets
- Agriculture
- Water
- Sustainable investing

Coverage Asset Classes

- Asset allocation trends
- Public equities
- Private equity
- Infrastructure
- Bonds
- Commodities
- Real estate

Coverage Geographical Regions

- US
- Europe
- China
- Developing countries

Note: “Coverage Asset Classes” refers to the types of asset classes or markets (e.g. private equity markets, public markets) that DBCCA research covers

DBCCA Published Research: 41 and counting…

Investing in Climate Change Series: 2008, 2009, 2010 and 2011
February 2011
January 2010
October 2008
October 2007

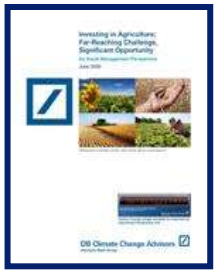
GET FiT Plus
April 2011

GET FiT Program: Global Energy Transfer Feed-in Tariffs for Developing Countries
April 2010

Infrastructure Investments in Renewable Energy
September 2009

United States Building Energy Efficiency Retrofits: Market Sizing and Financial Models
March 2012

Climate Change: Addressing the Major Skeptic Arguments
September 2010



Investing in Agriculture: Far-Reaching Challenge, Significant Opportunity
June 2009

Natural Gas and Renewables in the US
October 2011
November 2010

Paying for Renewable Energy: TLC at the Right Price - Achieving Scale through Efficient Policy Design
December 2009

Global Climate Change Regulation Policy Developments: July 2008-February 2009
February 2009

UK Offshore Wind
November 2011

UK Renewable Energy Investment Opportunity
April 2010

Global Climate Change Policy Tracker I, II, III & IV
April 2012
July 2011
March 2010
October 2009

20 Research Notes

http://www.dbcca.com/dbcca/EN/investment_research.jsp

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Role of Asset Managers

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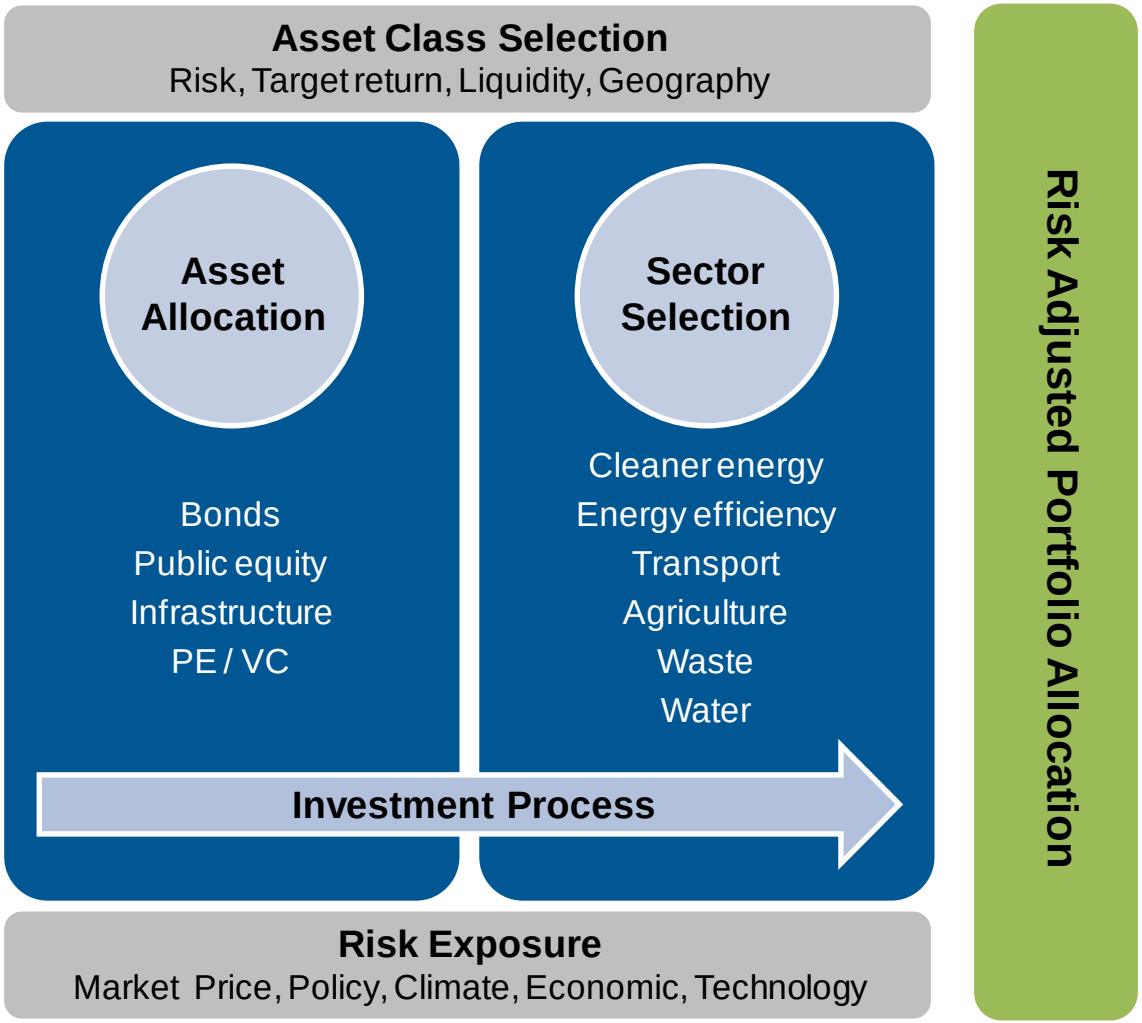
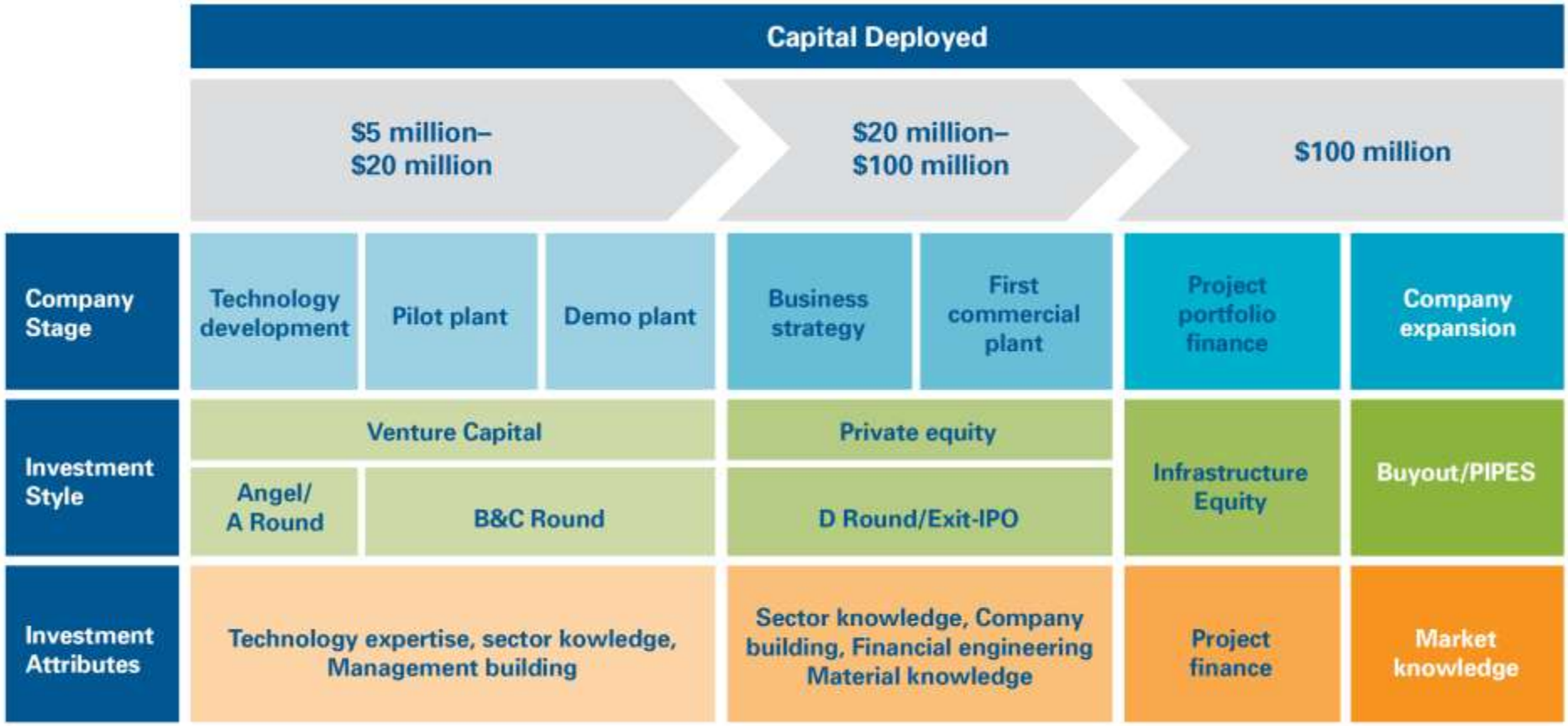
Illustrative risk adjusted portfolio allocation



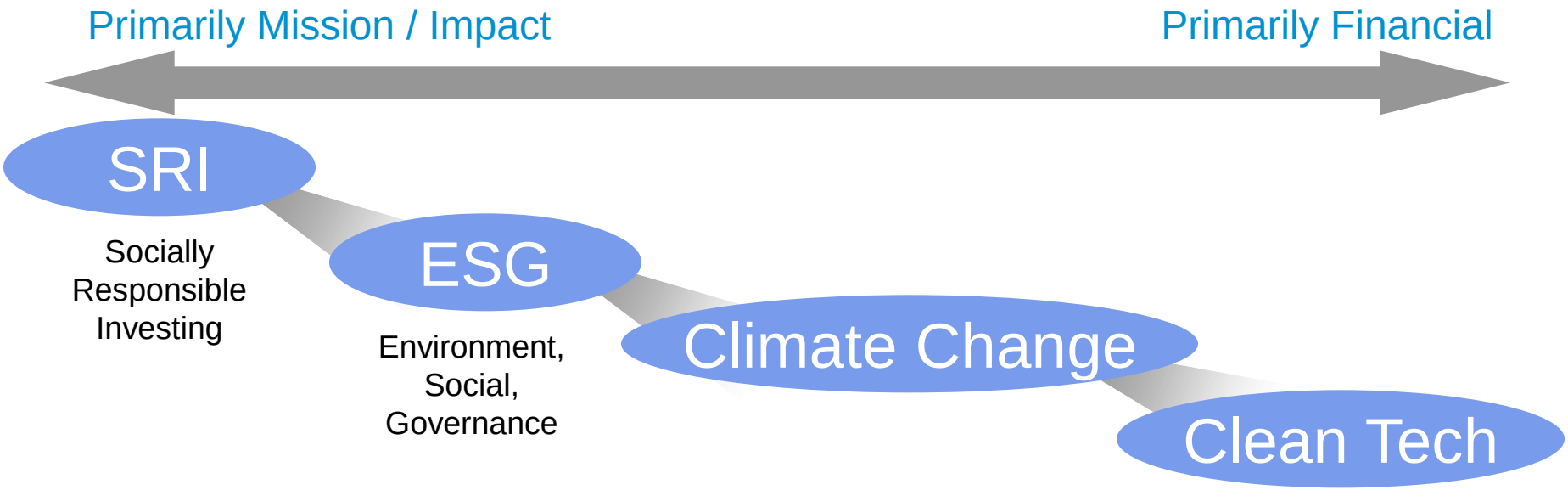
Source: DBCCA Analysis 2011

Investment spectrum for the private market climate change universe



Source: Hudson Clean Energy Partners

Universe supports multiple investment mandates and is becoming increasingly mainstream



Types of Investors

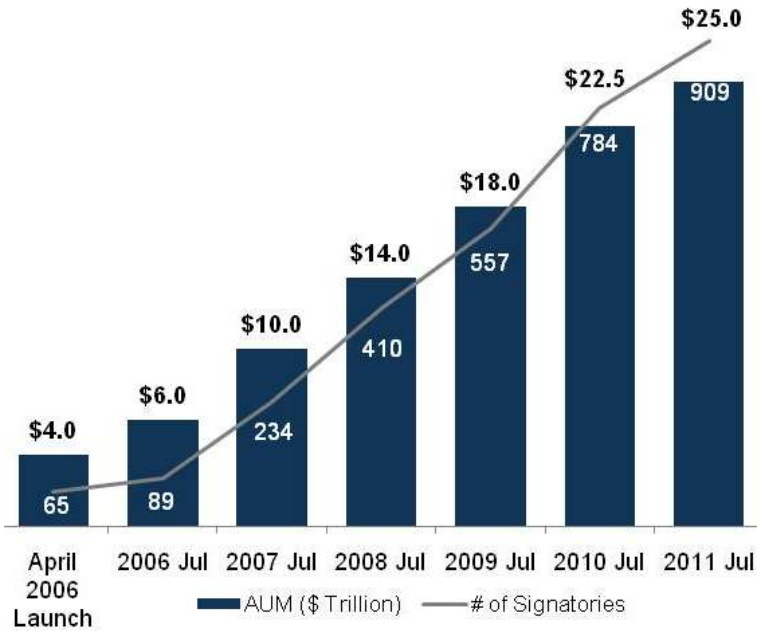
- Asset Managers / Owners
- Insurance Companies
- Pension funds
- Endowments and Foundations
- High Net Worth Individuals and Families
- Corporations
- Sovereign Wealth Funds

Increasing commitment from investors

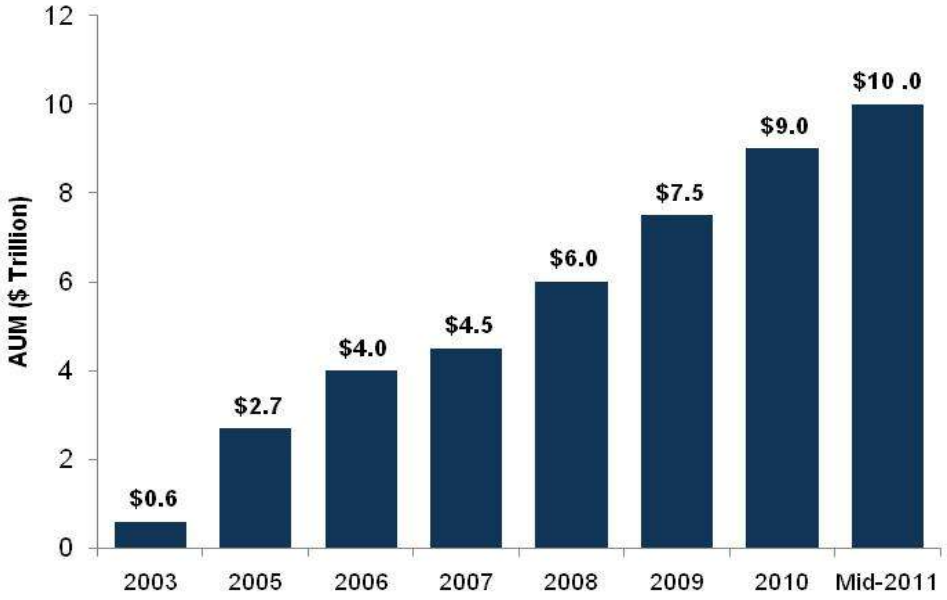
UN Principles for Responsible Investment (UN PRI)

Investor Network on Climate Risk (INCR)

Assets under management (AUM) and number of signatories growing substantially



Note: As of July 2011. Source: UN PRI, 2011



Note: As of July 2011. Source: Ceres INCR, 2011

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Opportunity of Investing in Climate Change

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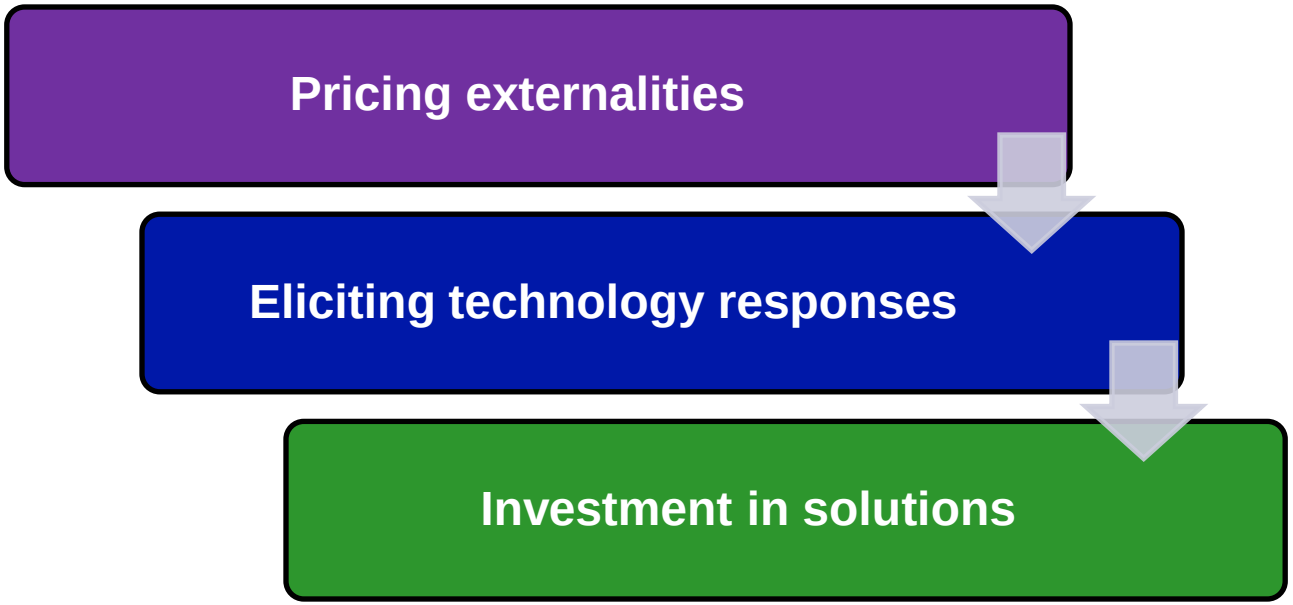
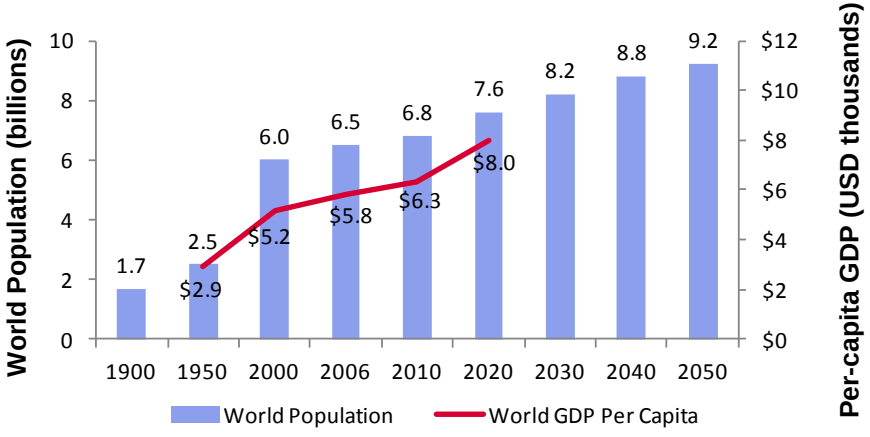
Environmental regulations, markets and investors



Understanding technology trends, not just best available technology, is potentially an important part of cost effective policy and regulation

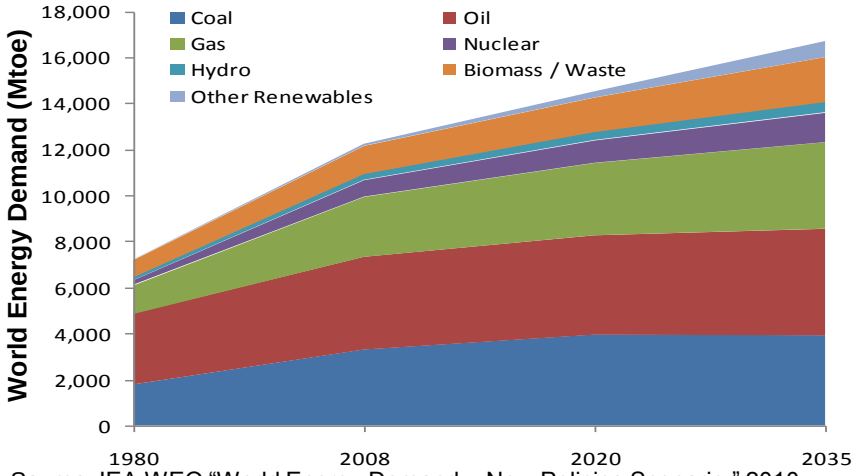
Climate change: an example of the need to price "externalities"

A growing world population and rising incomes…



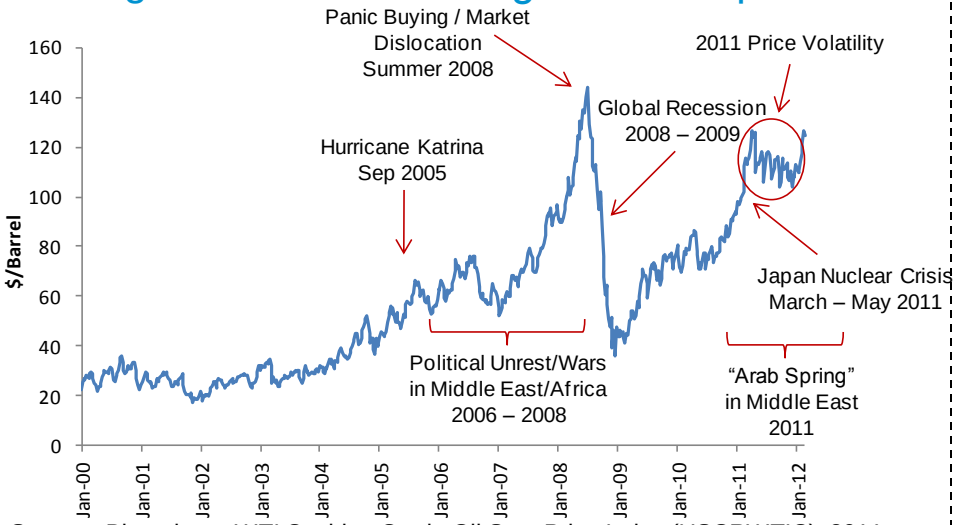
Source: Population Reference Bureau, 2008

increase global energy demand…



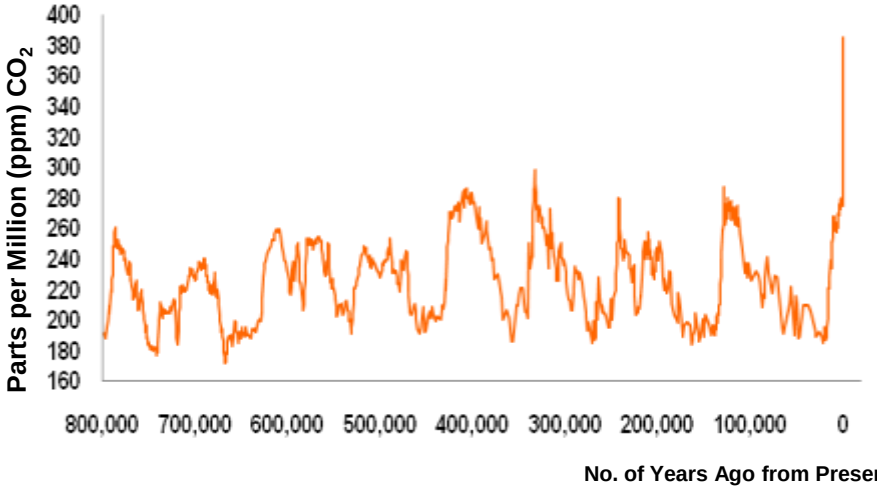
Source: IEA WEO "World Energy Demand – New Policies Scenario," 2010

leading to volatile and rising fossil fuel prices…



Source: Bloomberg, WTI Cushing Crude Oil Spot Price Index (USCRWTIC), 2011

and higher emissions of CO_2…



Source: Nature Journal, DBCCA analysis

Pricing “externalities” in energy markets: Health, safety, security and the environment

A comparative analysis of different energy fuel sources, based on current technology

Fuel	Health Concerns	Safety Concerns	Energy Security Concerns	Environmental Concerns
Oil / Petroleum	High	High	Very High	Very High
Coal	Very High	High	Low	Very High
Nuclear	Medium	High	Low	Medium
Natural Gas	Low	High	Medium / Low	Medium
Hydro	Very Low	Medium	Very Low	Low
Bioenergy	Very Low	Low	Very Low	Medium
Geothermal	Very Low	Low	Very Low	Low
Wind	Low	Very Low	Very Low	Very Low
Solar	Very Low	Very Low	Very Low	Low

Source: DBCCA Analysis 2011

The climate change investment universe is broad and deep in terms of sectors and technologies

Cleaner Energy

Power Generation
- Solar (PV, CSP, thermal)
- Wind (onshore, offshore)
- Other clean power (geothermal, hydro, landfill gas, marine, tidal, etc.)
- Fuel switch: coal to natural gas/ biomass; biomass to biomethane
- Clean coal and gas (CCS)
- Nuclear fission
- Increased efficiency
- Combined heat and power
- Mass energy storage
- Fuel cells
- Future breakthrough technologies (e.g. nuclear fusion)

Transport
- High efficiency / lower emissions vehicles
- Sustainable biofuels
- Flex fuel vehicles
- Hybrids
- Electric vehicles
- Battery technology
- Natural gas vehicles
- Hydrogen fuel cells

Energy & Material Efficiency

Building Efficiency
- Efficient & LED lighting
- Advanced materials
- Micro generation / CHP
- Retrofits, ESCO & Energy Services
- Advanced/efficient appliances & lighting
- Heating & cooling systems
- Building mgmt: home energy displays & smart meters
- District power/heat networks

Power Grid Efficiency
- Energy mgmt systems
- Infrastructure: advanced metering, UHV transmission, electric charging
- Storage: compressed air, batteries, flywheels
- Wide area monitoring
- Smart grid
- Distributed grid
- Grid security

Industrial Efficiency
- Expanded, efficient technology products
- Recycling of steel
- Valve fitting and improvements
- Speed controls
- Waste heat recovery
- Insulating distribution systems
- Membrane use
- Low carbon cement

Environmental Resources

Agriculture
- (Climate) smart machinery
- (Climate) smart irrigation
- Seeds & breeding technologies: GMO's & hybrids
- Clean/bio pesticides & fungicides
- Smart fertilizers
- GIS management systems

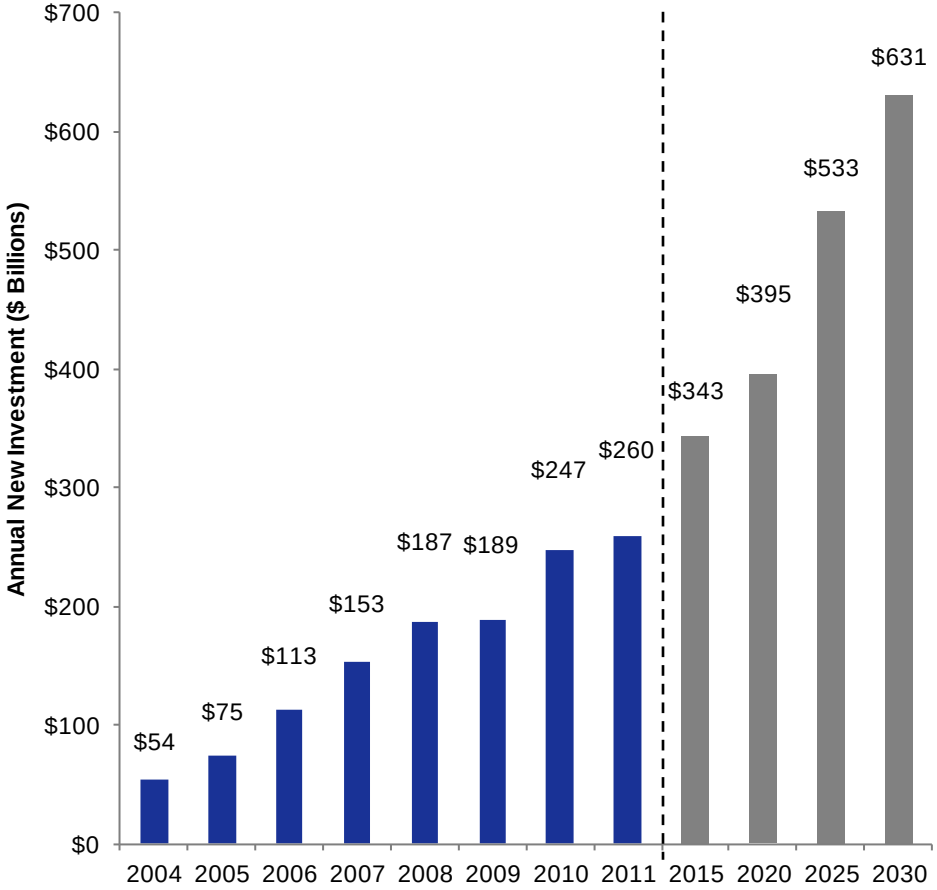
Water
- Filtration & membrane technology
- Purification & disinfection: pre-chlorination, coagulation, sedimentation
- Equipment: pipes, valves, etc.
- Safe chemicals
- Desalination
- Distribution & management: monitoring & metering
- Energy recovery devices
- Wastewater treatment

Waste Management
- Recycling & e-cycling
- Advanced/sustainable materials
- Anaerobic digestion
- Mechanical heat and biologic treatment
- Waste to energy
- Land remediation
- Material mgmt strategies
- Advanced waste sorting

Source: DBCCA Analysis 2012

Investment in climate change sectors presents a rich and diversified investment universe

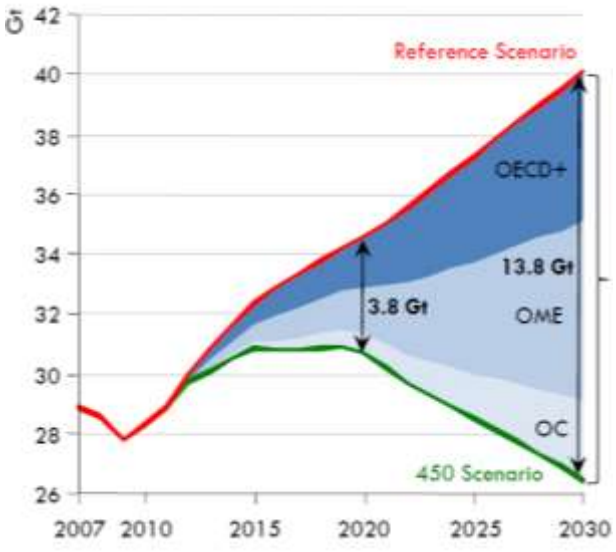
Significant amounts of capital are entering clean energy globally



Sources: 2004 – 2011 data, Bloomberg New Energy Finance, 2012;
2015 – 2030 forecast, DBCCA Analysis 2012

Opportunities abound in energy efficiency

Global Emissions in the IEA 2009 Reference and 450 Scenarios by Region



Abatement by Technology, 2030

Efficiency – 57%

Renewables & Biofuels – 23%

Nuclear – 10%

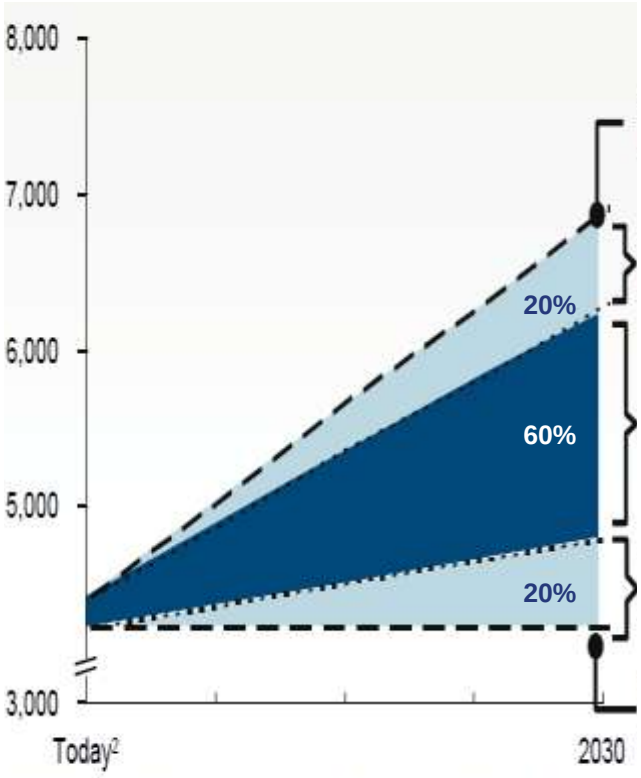
CCS – 10%

OECD+ = OECD plus other EU
OME = Other Major Economies OC = Other Countries

Source: OECD/IEA 450 Scenario, World Energy Outlook 2009

Universe extends beyond low carbon energy

Business as usual approaches will not satisfy growing demand for water…



Demand with no productivity improvements

Historical improvements in water productivity

Remaining gap

Increase in supply under business-as-usual

Existing Accessible reliable supply

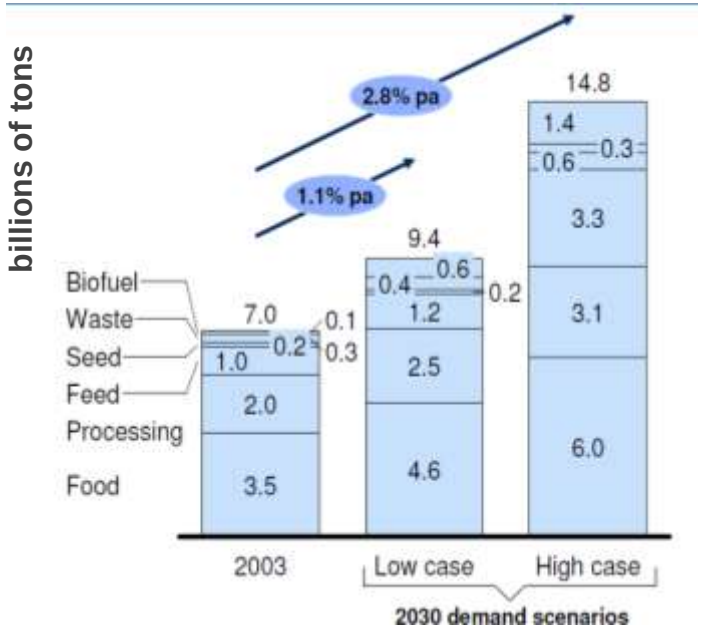
Source: 2030 Water Resources Group – Global Water Supply and Demand model, *Charting Our Water Future*, Exhibit II 2009; DBCCA Analysis, 2010

Agricultural production must double to feed the global population in 2030

Demand Scenario Assumptions

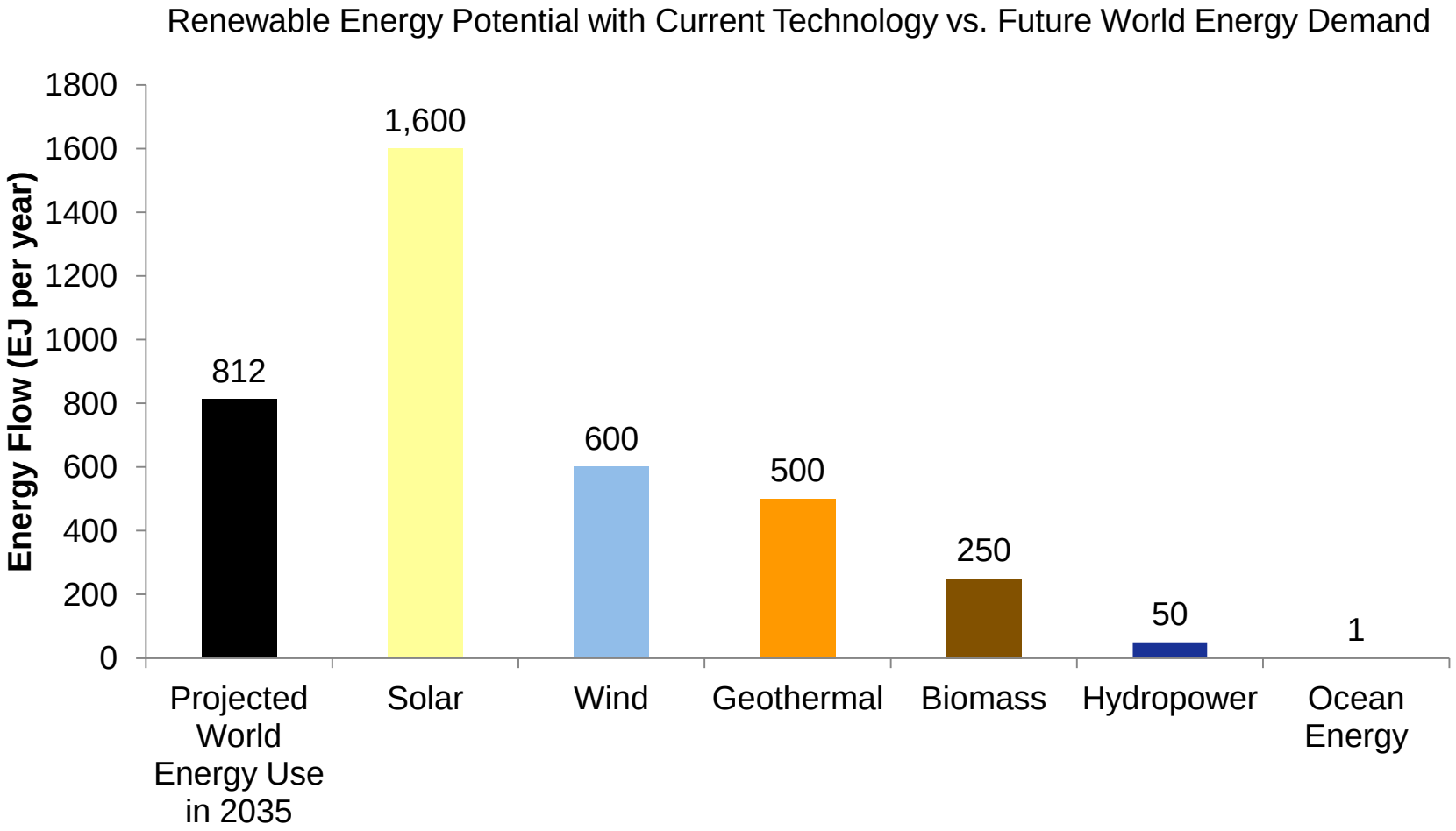
2030 low case: Only population growth drives increase in total demand

2030 high case: Per capita food consumption and caloric intake aligned to European level; high biofuel expansion



Source: McKinsey. 2009.

While fossil fuels are in finite supply, renewable sources are technically sufficient to meet world energy needs



Note: One exejoule equals 10^{18} joules. For reference, there are $3.6 * 10^6$ joules in one kilowatt-hour (kWh).
Sources: IEA, *International Energy Outlook 2011*, 2011; Worldwatch Institute. *State of the World 2009*, 2009; UNDP; Johansson et al., 2005.

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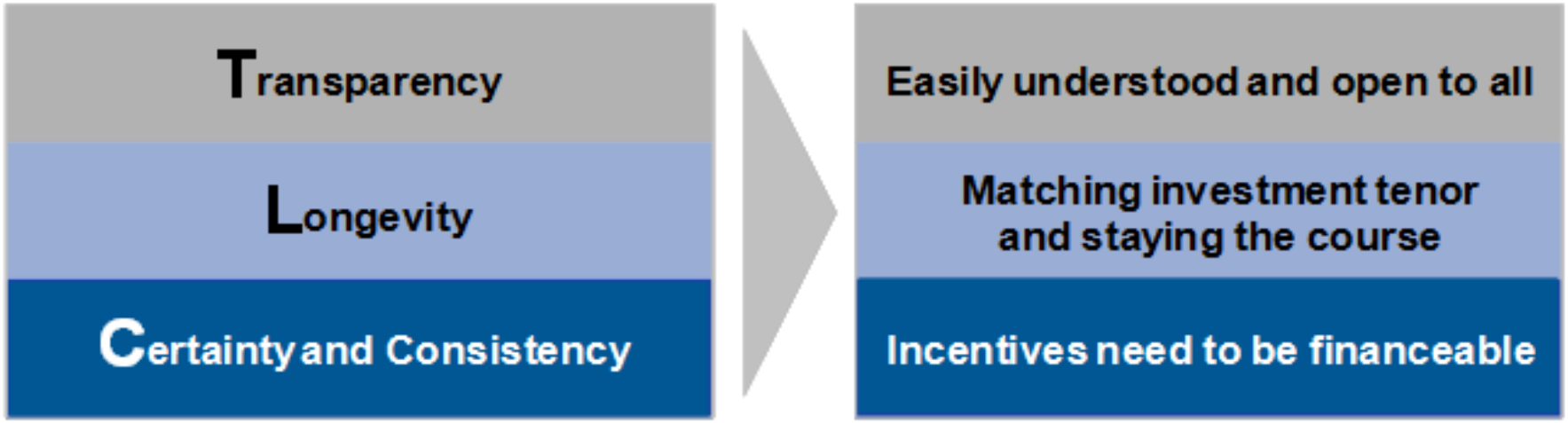
Role of Public Policy

Passion to Perform

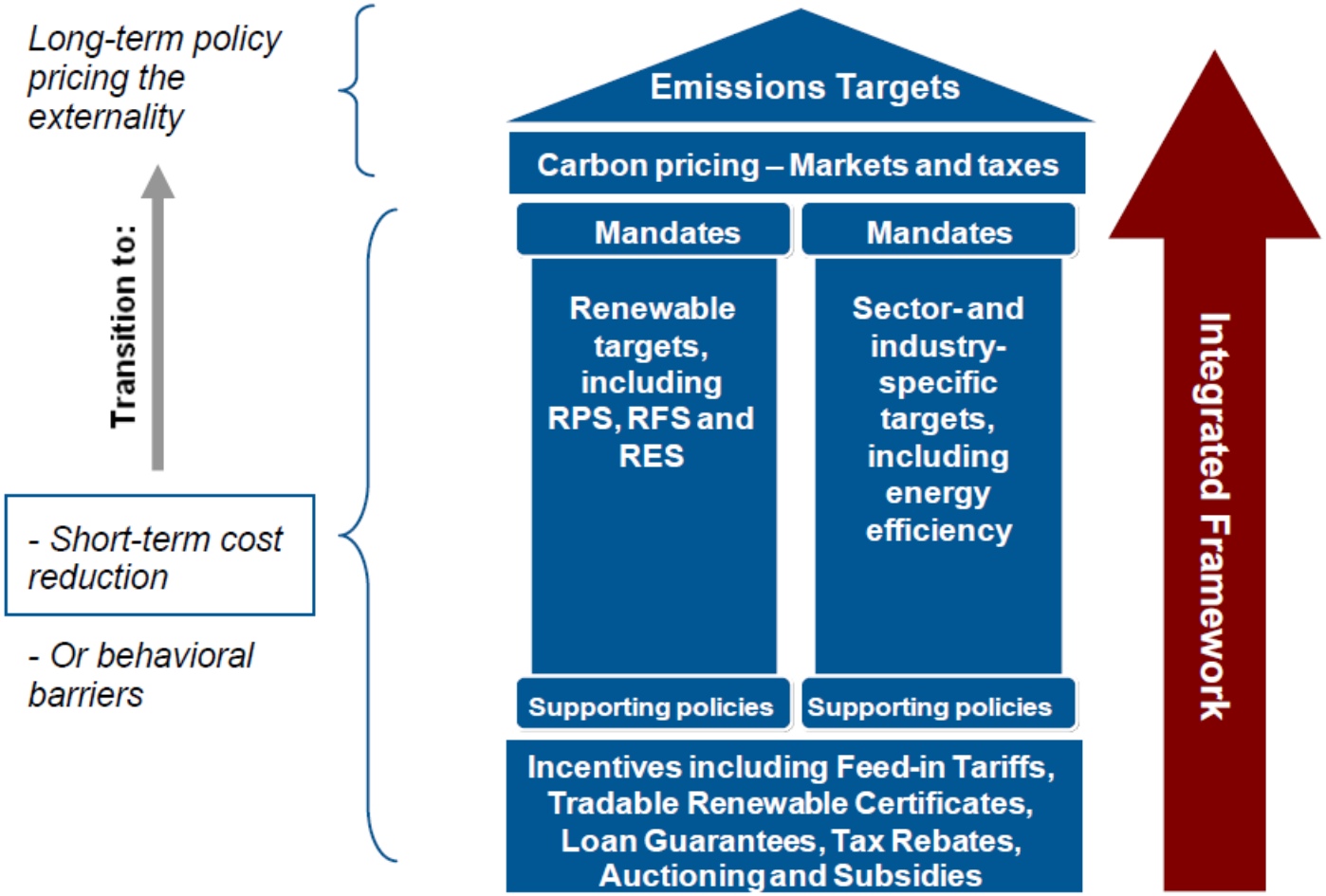
What do investors want from policy?

Investors essentially look for 3 key drivers in policy:



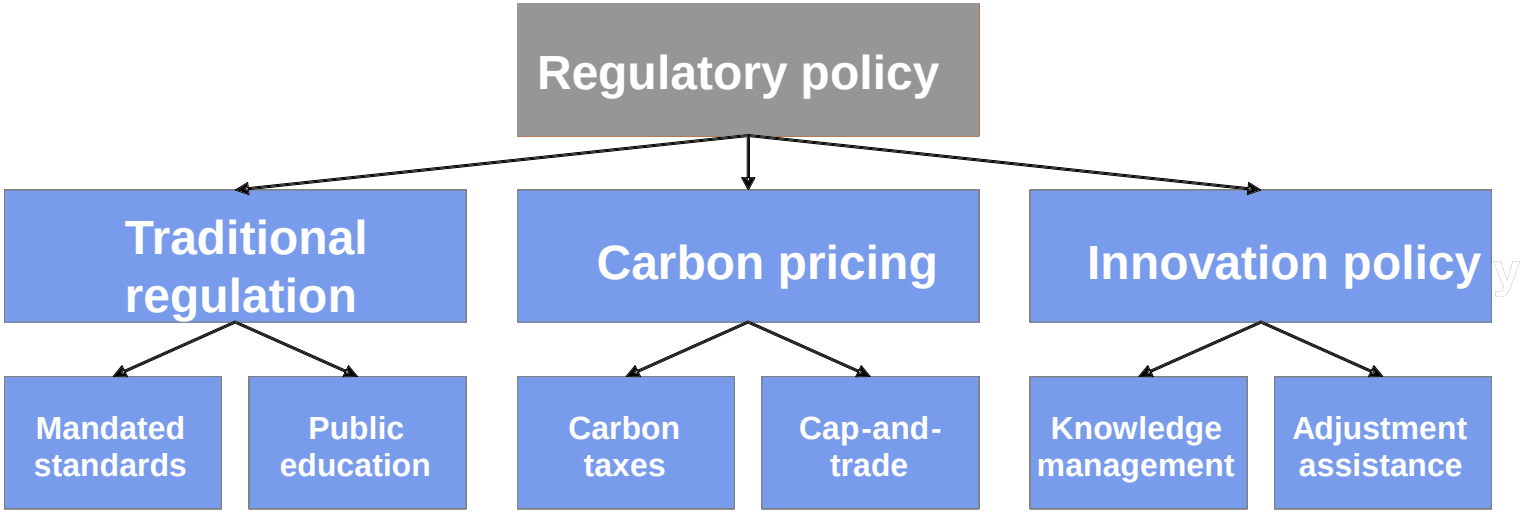
In assessing the potential success of policies, these factors should be taken into account

Government policy frameworks extend beyond emissions targets and carbon pricing, and require expertise



Note: RPS refers to Renewable Portfolio Standard; RFS refers to Renewable Fuel Standard; RES refers to Renewable Energy Standard
Source: DBCCA Analysis 2011

Three broad groups of policy available to climate change regulators on a geographic level



Risks

- National climate change policy still lacking in some major countries, such as the US
- Emissions reduction targets and mandates can also be subject to change

Risks

- Post-Kyoto Protocol framework still lacking, which has implications for the EU ETS and CERs (Carbon Emissions Reductions), as part of the CDM
- Carbon pricing lacking in major countries
- EU EUA prices have been volatile over the past two years

Risks

- Budget constraints lead to uncertain incentive structures in some countries
- Technologies that are more dependent upon incentives are more at risk
- Incentive structures vary by region, and some are stop-start and not long-term (such as the case in the US)

Best-in Class Energy Policies: Driving Transparency, Longevity and Certainty (TLC)

Country	Emissions Control			Financial Support				Long-term Grid Improvement Plan	Risks	Deployment		Likelihood of meeting mandates
	Binding/ Account-able Emission Target	Renew-able Electricity Standard	Long-term Energy Efficiency Plan	Feed-in Tariff	Long-term Govt-based 'Green Bank'	Tax Benefits	Long-term funding programs		Budget strength (deficit as % of GDP in 2011)	Capital Investment ($mn) 2009-2011	GDP 2011 (Official Exchange Rate $tn)	
Germany	✓c	✓	✓	✓	✓	✓	✓	✓	-1.7%	52,687	$3.63	Strong
China	✓ c regional	✓	✓	✓	✓	✓	✓	✓	-1.2%	191,222	$6.99	Strong
United Kingdom	✓c	✓	✓	✓	✓	✓	✓	✓	-8.8%	46,904	$2.48	Strong to Moderate
Australia	✓c	✓	✓	State-level	✓	✓	✓	State-level	-2.5%	10,977	$1.51	Strong to Moderate
Japan	✓	✓	✓	✓	X	✓	✓	✓	-8.5%	15,770	$5.86	Moderate
Brazil	✓	✓	✓	X	✓	✓	✓	✓	-3.1%	51,714	$2.52	Strong
Canada	✓	State-level	✓	State-level	X	✓	✓	State-level	-3.8%	25,363	$1.76	Moderate
India	⌛COP Acc	✓	✓	State-level	X	✓	✓	✓	-5.0%	41,229	$1.84	Moderate to Low
Mexico	⌛COP Acc	✓	✓	X	X	✓	✓	State-level	-2.4%	5,207	$1.19	Low
United States	⌛COP Acc	State-level	State-level	State-level	⌛	✓	State-level	State-level	-8.9%	219,498	$15.06	Moderate to Low
South Africa	⌛COP Acc	✓	✓	✓	X	X	✓	⌛	-5.2%	374	$0.42	Moderate to Low

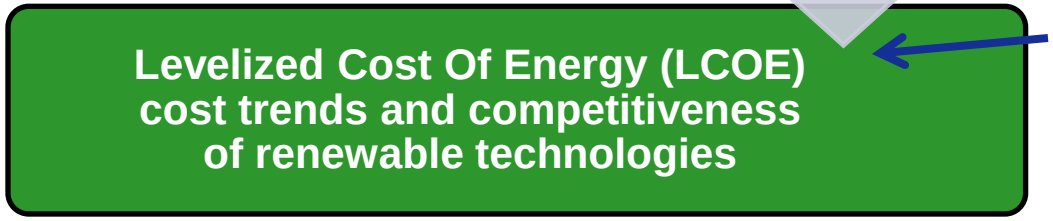
Notes: ⌛COP Acc = policy is a submission to the Copenhagen Accord and is not legally binding ; ⌛ = tentative / unconfirmed policy dependent on certain provisions (e.g. funding)

Source: DBCCA Analysis 2011; GDP and Budget Strength data: CIA World Factbook; Capital Investment by country: Bloomberg NEF 2012

Supportive public policy is helping to scale production volumes and accelerate technical progress…

Government support of public and private R&D can accelerate technological breakthroughs

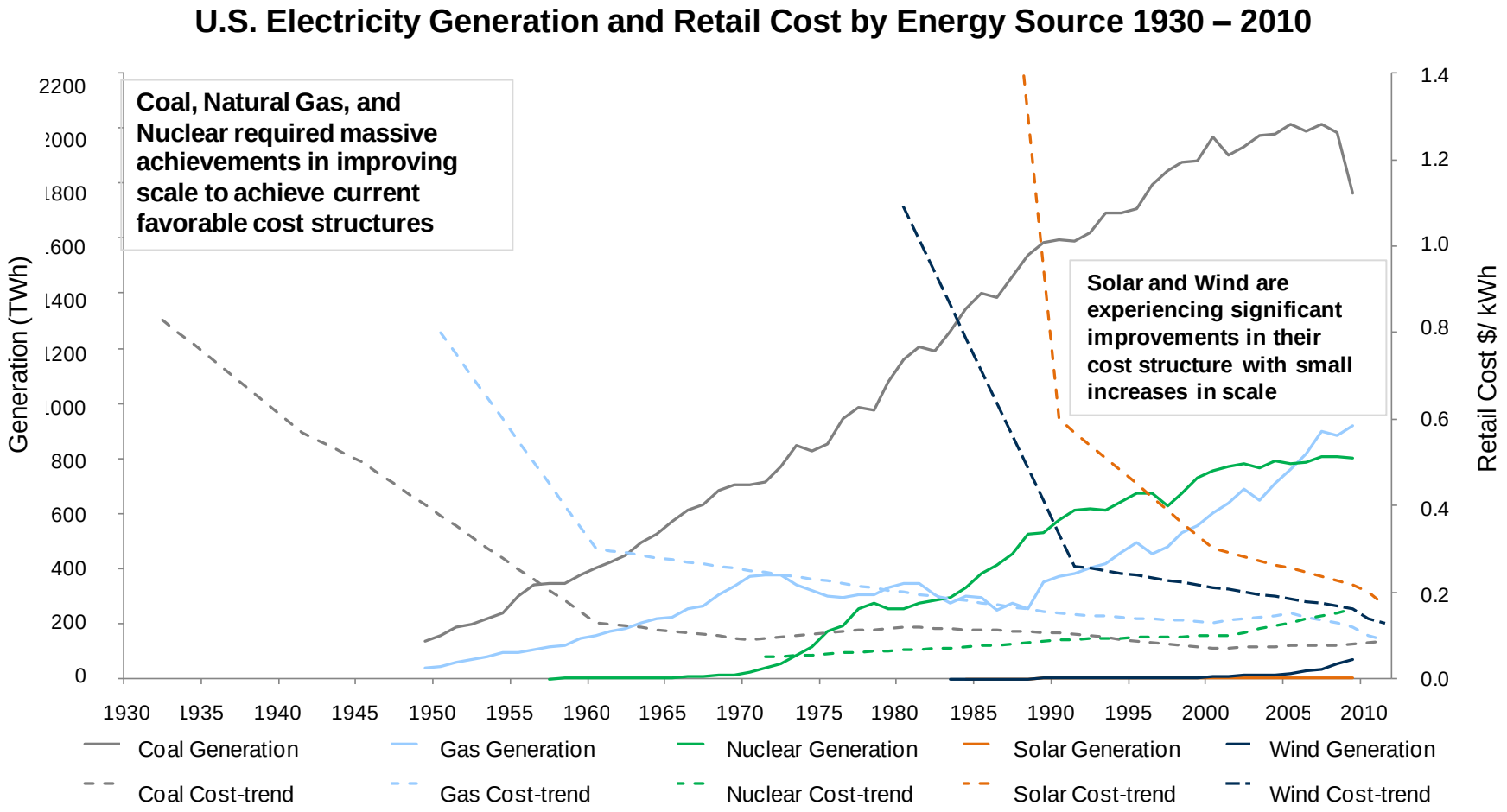
By stabilizing market expectations (and perceptions of risk), policy incentives can increase the *scale* of renewable energy manufacturing – and hence reduce the cost of renewable energy



Externalities need pricing

Sources: DBCCA analysis 2012

… and reduce costs so that renewables can compete with conventional energy sources (without subsidies)



Source: Hudson Clean Energy Partners Analysis, 2011

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The US Experience

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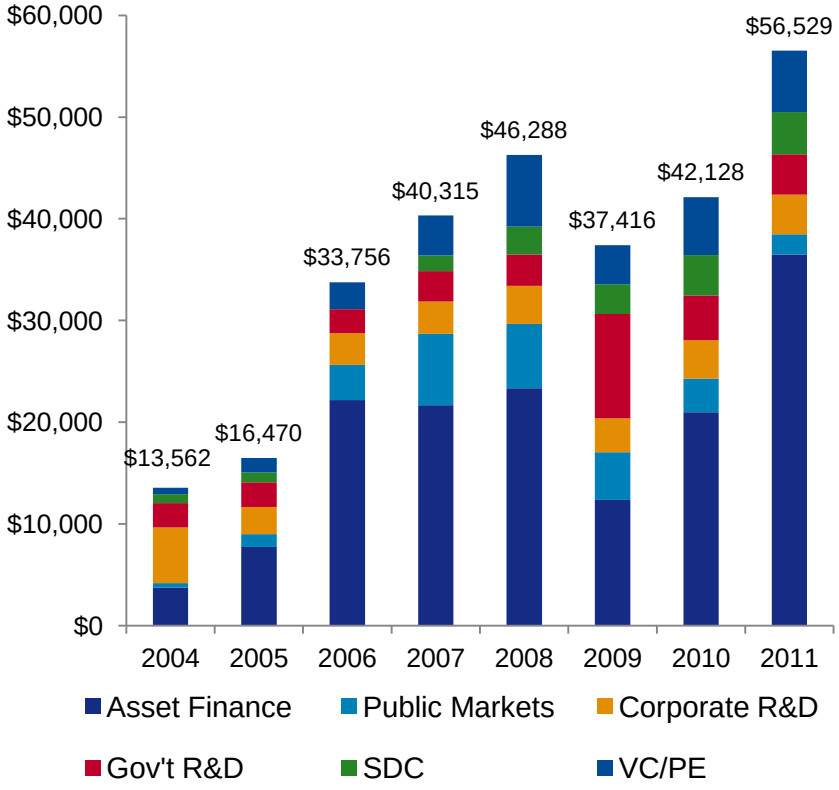
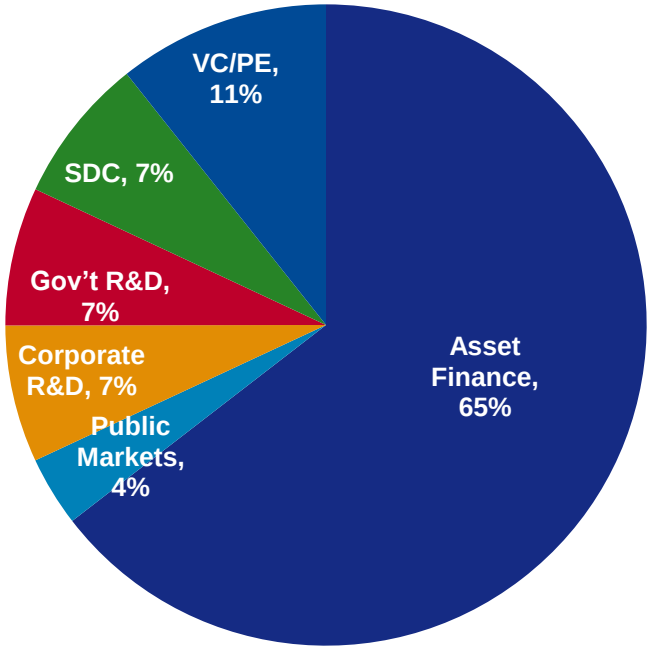
The US invests strongly in early-stage cleantech

In 2011 the share of VC/PE activity in total US clean energy investment was 11%

US Clean Energy Investment by Asset Class, 2004-2011 ($ Millions)



New Investment in US Clean Energy by Asset Class, 2011 (%)

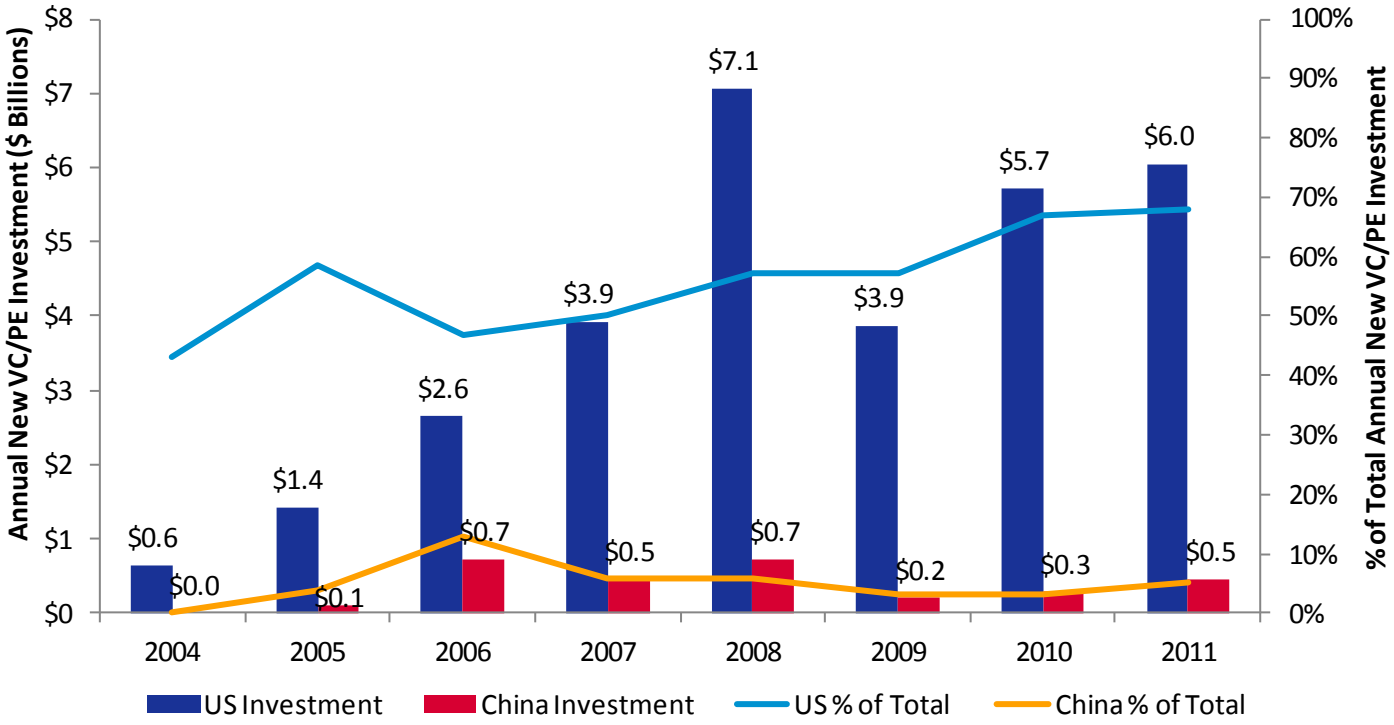


Notes: SDC is Small Distributed Capacity.
Source: Bloomberg New Energy Finance

… and the US leads the world in investing to commercialize clean energy technologies

In 2011, $6.0 billion of US transactions accounted for 68% of new global VC/PE investing in clean energy

This is the highest figure globally, and far outstrips China's private investment in this space, which in recent years has declined on both a relative and absolute basis



Source: Bloomberg New Energy Finance

… and aggressively promotes clean energy innovation

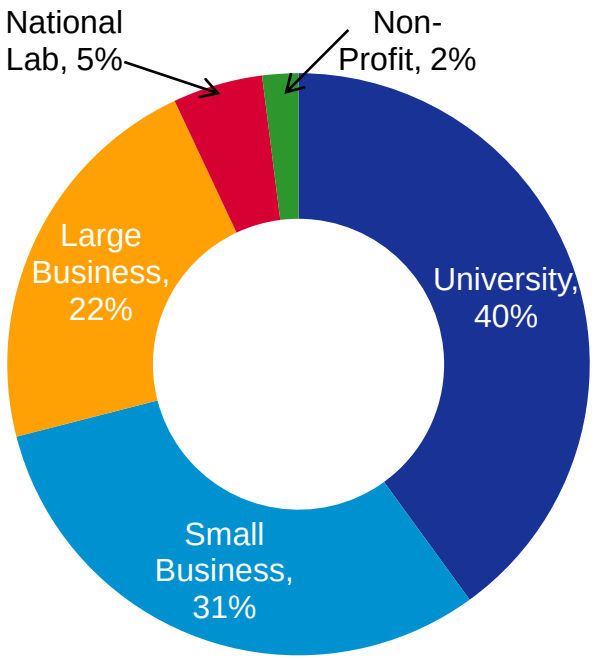
The US Department of Energy's Advanced Research Projects Agency – Energy (ARPA-E) funds high-risk technologies to reduce CO_2 emissions and improve energy efficiency

In 2009-10, ARPA-E awards of $400K-$9M to 121 projects (average award size $3M)

ARPA-E Program Areas

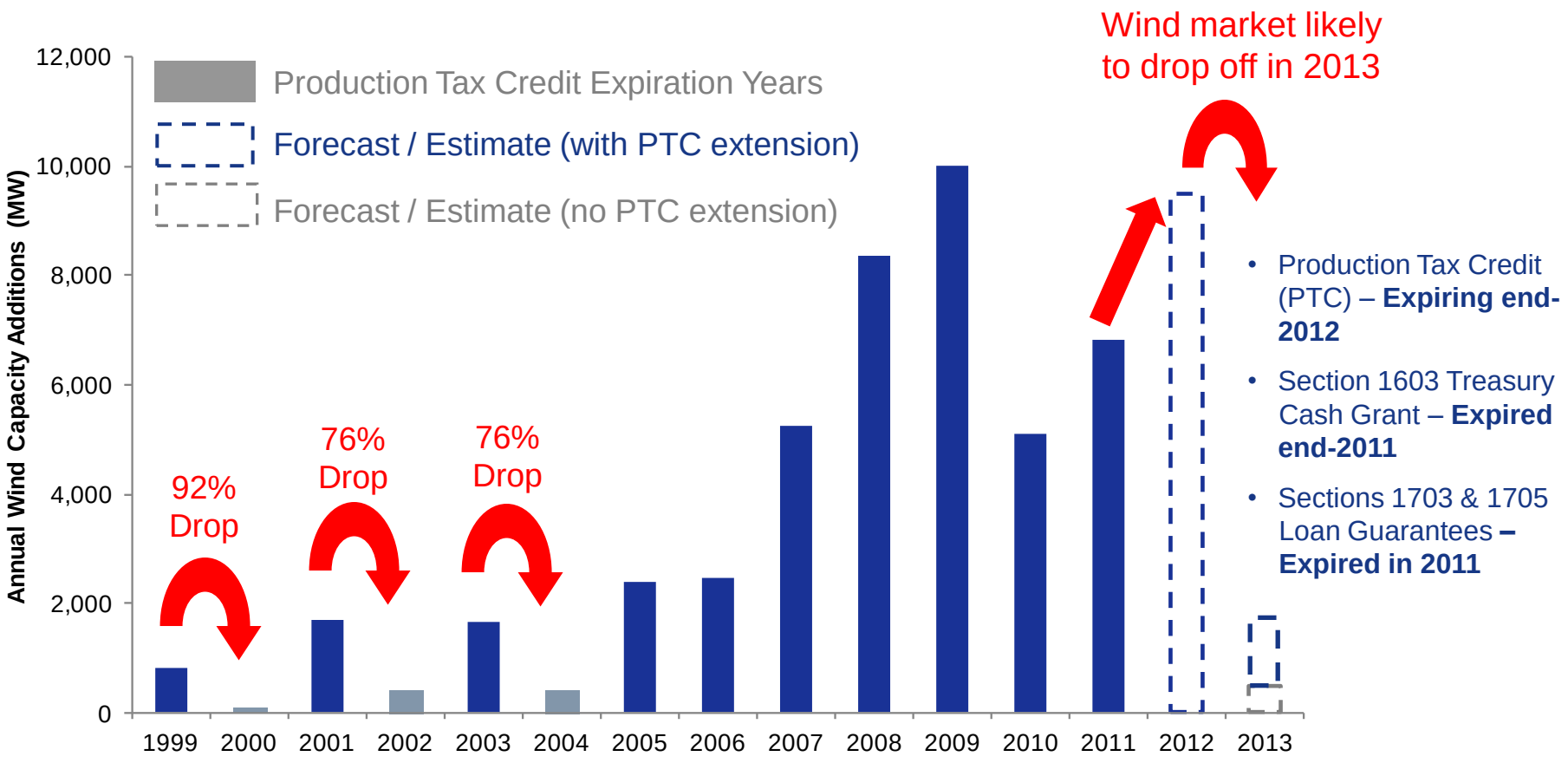
- battery technologies
- building cooling
- carbon capture
- electro-fuels (i.e. non-photosynthetic biofuels)
- green electricity network integration
- grid energy storage
- high energy thermal storage
- plants engineered to replace oil
- power electronics for electric grid applications
- power electronics for solar applications
- rare earth alternatives for critical technologies

ARPA-E Projects by Lead Organization Type



Source: ARPA-E, FY2010 Annual Report

A history of inconsistent US federal support for renewables



Sources: AWEA, 2012; Bloomberg New Energy Finance, 2012

Key federal policy drivers of US renewables deployment

Federal Policies

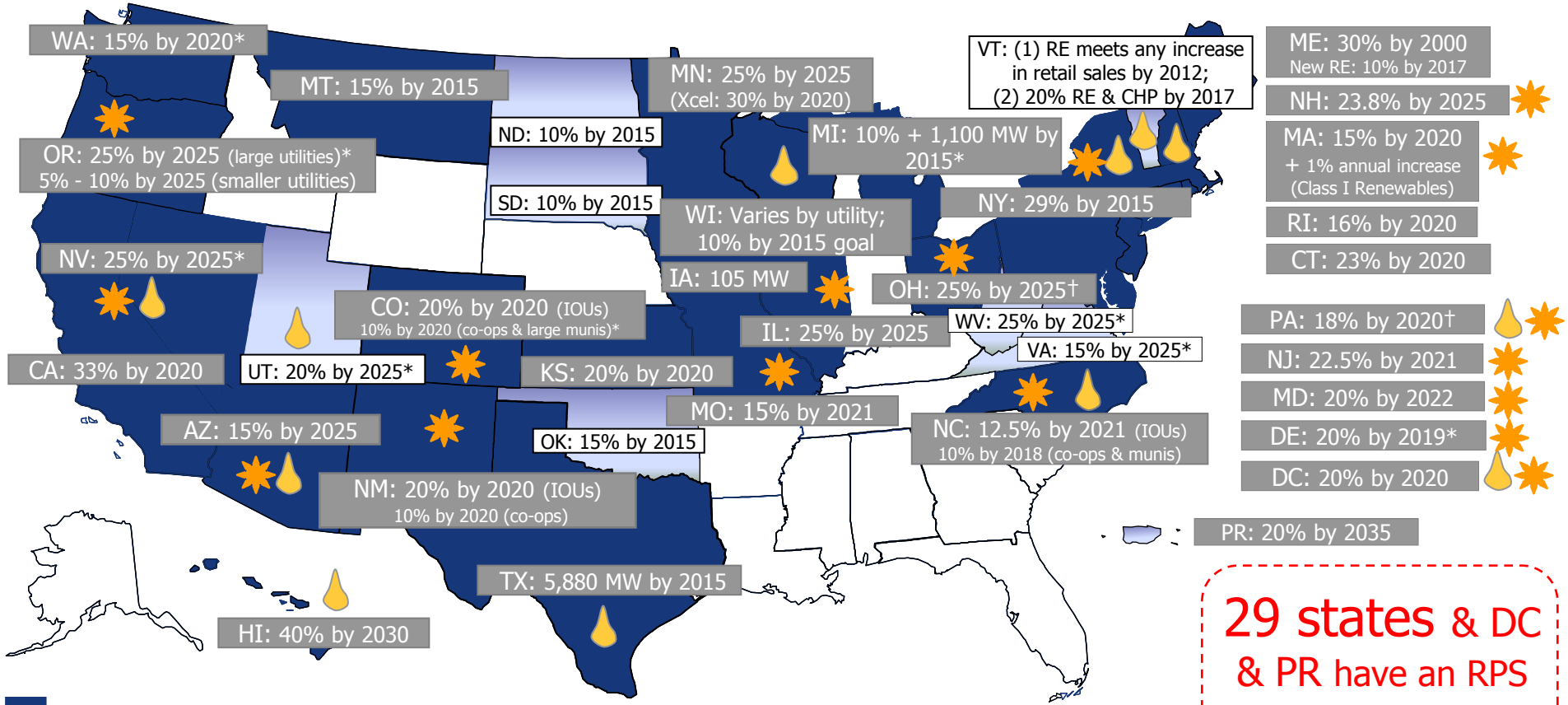
Business Energy Investment Tax Credit (ITC)	• 30% for solar, fuel cells, and small wind (<100 kW); 10% for geothermal, micro-turbines, and CHP (< 50 MW) • Scheduled to expire on Dec 31, 2016 • **Tax-equity market constrained**
Renewable Electricity Production Tax Credit (PTC)	• 2.2 ¢/kWh for wind, geothermal, and closed-loop biomass; 1.1 ¢/kWh for other eligible technologies • Scheduled to expire on Dec 31, 2012 – extension possible? • **Tax-equity market constrained**
1603 Program	• Expired Dec 31, 2011 • Provided 30% ITC in the form of a cash grant from the US Treasury

Additionally, 29 states (plus DC and PR) have Renewable Portfolio Standards (RPS)

➢ RPS mandates that utilities must procure a minimum % of generation from renewable sources

Sources: US Database of State Incentives for Renewables and Efficiency (DSIRE)

State policies helping to lead America in renewables



29 states & DC & PR have an RPS

7 states have goals

State renewable portfolio standard

State renewable portfolio goal

Solar water heating eligible

Minimum solar or customer-sited requirement

* Extra credit for solar or customer-sited renewables

† Includes separate tier of non-renewable alternative resources

Sources: US Database of State Incentives for Renewables and Efficiency (DSIRE); Goldman Sachs, "US State Policies Call for a Decade-Long Investment Cycle", Dec 6 2011

EPA standards drive closure of old, inefficient coal plants

Key Regulations

Utility Hazardous Air Pollution Standards (HAPS MACT)	• Targets emissions of heavy metals and acid gases from power plants • Affects 40% of existing coal-fired units (1,100 units) – many 30-50 years old • **Requires $10 bn/yr of capex** on scrubbers, sorbent injection, fabric filters • *In effect*: EPA issued rule in Dec 2011; plants have 3-4 years to comply[1]
Cross-State Air Pollution Rule (CSAPR)	• Requires 1000+ plants in 28 states to reduce emissions of SO_2 and NO_X • **Adds $2.4bn/yr of capex** on selective catalytic reduction and scrubbers • *Being litigated*: DC Court of Appeals recently stayed execution; April 2012 hearing had a mixed outcome
Greenhouse Gas Emissions	• Clean Air Act compels EPA to develop regulations for GHG emissions • Proposed new source performance standards (NSPS) for GHGs issued in March 2012 • Despite implementation uncertainty, **GHG regulatory risk can deter investment in new coal-fired generation**

$2bn/yr+ of additional retrofit capex from other forthcoming EPA rules:

- National Ambient Air Quality Standards (NAAQS) for particulate matter
- Cooling Water Intake Structure Rule (expected July 2012)
- Coal Combustion Waste Rule (expected 2012 or later)

Cumulative impact of EPA actions: shifts investment coal to gas

[1] *For reliability critical (i.e. Reliability Must Run, or RMR) units, EPA is providing up to an additional year to comply with HAPS MACT standards.*

Sources: "Fact Sheet: Mercury and Air Toxics Standards for Power Plants", Environmental Protection Agency (EPA), 2011; : "Fact Sheet: The Cross-State Air Pollution Rule: Reducing the Interstate Transport of Fine Particulate Matter and Ozone", EPA, 2011; Congressional Research Service, 2011; Washington Analysis, 2011.

Coal-to-gas fuel and asset switch decision tree matrix and commodity price sensitivity

Current US spot price of natural gas: $2.03/MMBtu[1]

Coal / Gas Scenarios	1	2	3	DBCCA Comment
Power Generation Type ($/mmBtu Fuel)	Existing Coal/Gas Plant LCOE	Depreciated Coal Plant EPA Retrofit Fully Loaded Cash Cost	New Build Coal/Gas Scrubbed EPA Compliant Plant Fully Loaded Cash Cost	
Coal @ $3.00	0.04-0.06	0.06-0.09	0.10-0.14	Coal fully loaded cash costs rise with greater EPA compliance
Gas @ $4.00	0.03-0.05	N/A	0.05-0.07	At $4/mmBtu, gas displaces coal across all scenarios
Fuel switch	Yes	Yes	Yes	Hedge a carbon price
Asset switch	Yes	Yes	Yes	Hedge a carbon price; build new gas assets to replace inefficient coal
Gas @ $6.00	0.05-0.07	N/A	0.06-0.10	At $6/mmBtu, only old unscrubbed coal beats gas on LCOE but not based on fully loaded cash cost
Fuel switch	No	Yes	Yes	
Asset switch	No	Yes	Yes	Hedge a carbon price; build new gas assets to replace inefficient coal
Gas @ $8.00	0.06-0.08	N/A	0.07-0.09	At $8/mmBtu, old coal beats gas on LCOE and new EPA compliant builds are breakeven with gas
Fuel switch	No	Yes	Selectively	Hedge a carbon price; dispatch efficient gas assets
Asset switch	No	Yes	Selectively	Hedge a carbon price; build new gas assets to replace inefficient coal

[1] Price is the average Henry Hub spot price for month of April
Sources: DBCCA analysis 2011; Oilnergy 2012

Performance standards, best available technology, and innovation

By imposing regulations and performance standards, EPA looks for best available current technologies to meet these requirements

Either this prices the regulated entity out of the market (e.g. coal to gas), or it produces a technological response that is cost effective

For example – in terms of GHGs, a critical technology would be CCS, but CCS is not yet commercially available

Should EPA focus both on best *current* technologies *and* best *future* technologies? Role of National Advisory Council for Environmental Policy and Technology (NACEPT)?

When developing regulations, EPA can work with other agencies – such as DOE's ARPA-E – to understand what is achievable and acceptable in current economy

EPA releases new rules and White House orders inter-agency coordination on gas fracking

At least 10 federal departments or agencies currently are mulling new regulations of the gas industry or have commissioned studies of its environmental impact

On April 13, President Obama issued an executive order to better coordinate federal oversight of gas fracking by establishing an “interagency working group”

Members include: EPA, Interior Department, DOE, National Economic Council, etc.

On April 18, the EPA released new final air emissions regulations for the oil and gas industry

These represent the first ever federal air regulations on hydraulically fractured and refractured natural gas wells

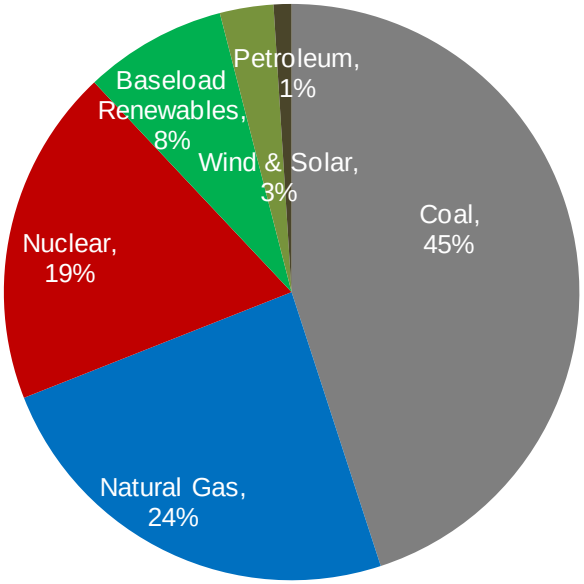
The EPA extended implementation to 2015, and so the rule is expected to have a limited near-term impact on gas drilling in the US

EPA also estimates that the rule will actually have an $11 million net benefit to the industry in 2015 due to increased capture of natural gas

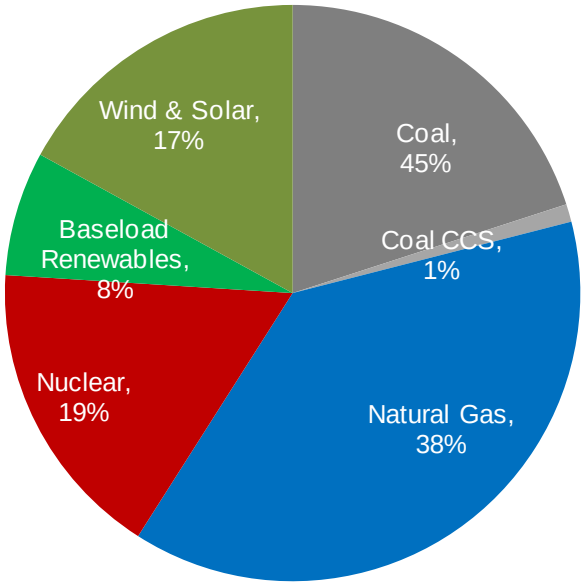
2010-2030: US electricity supply mix becomes greener and more gas-intensive

Assumes from 2010-2030 energy efficiency measures limit growth in electricity demand to a 0.7% compound annual growth rate (CAGR)

US Electricity Supply Mix 2010A (% Total TWh)



US Electricity Supply Mix 2030E (% total TWh)

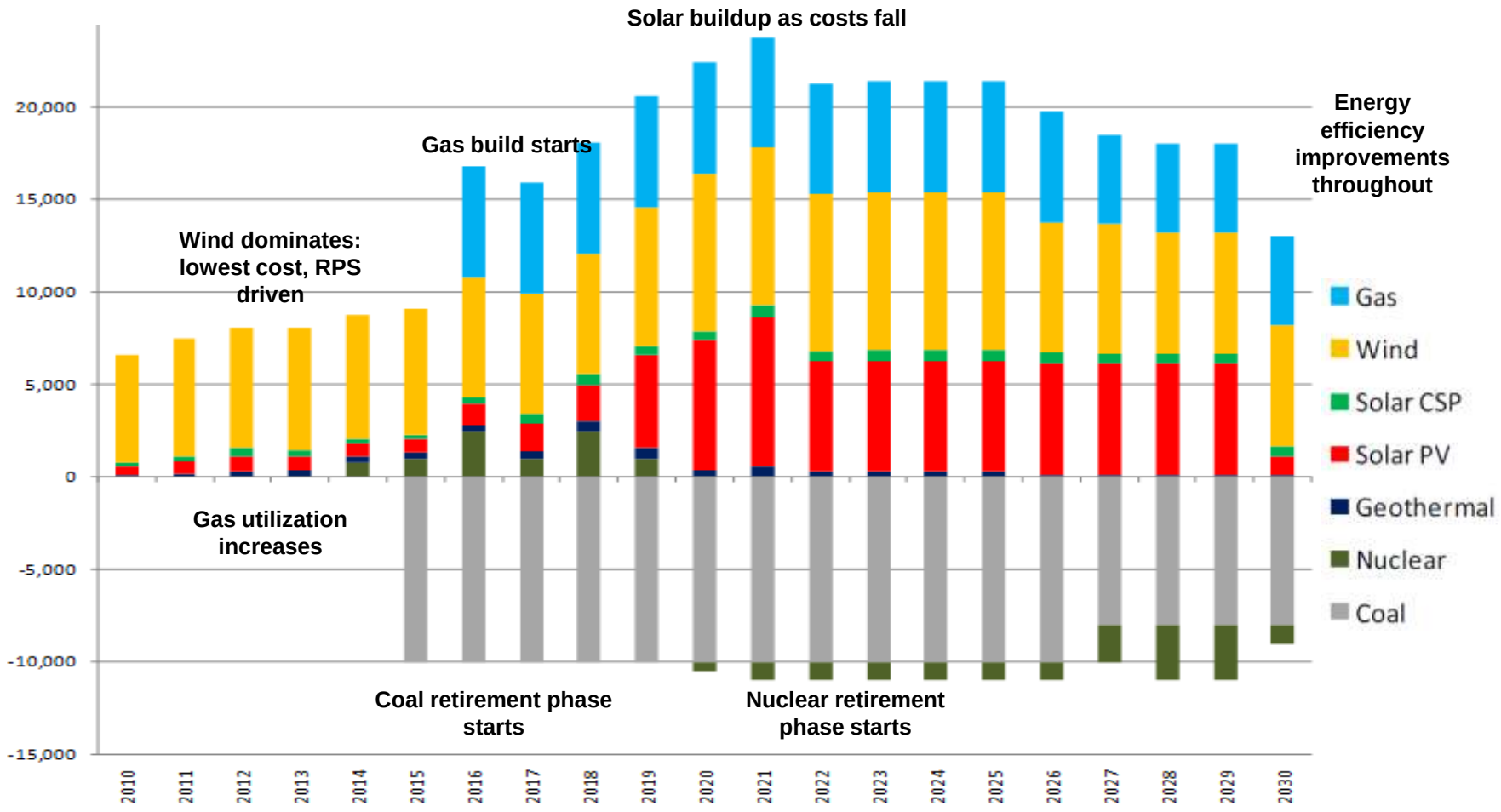


11% RE
24% Nat Gas

24% RE
38% Nat Gas

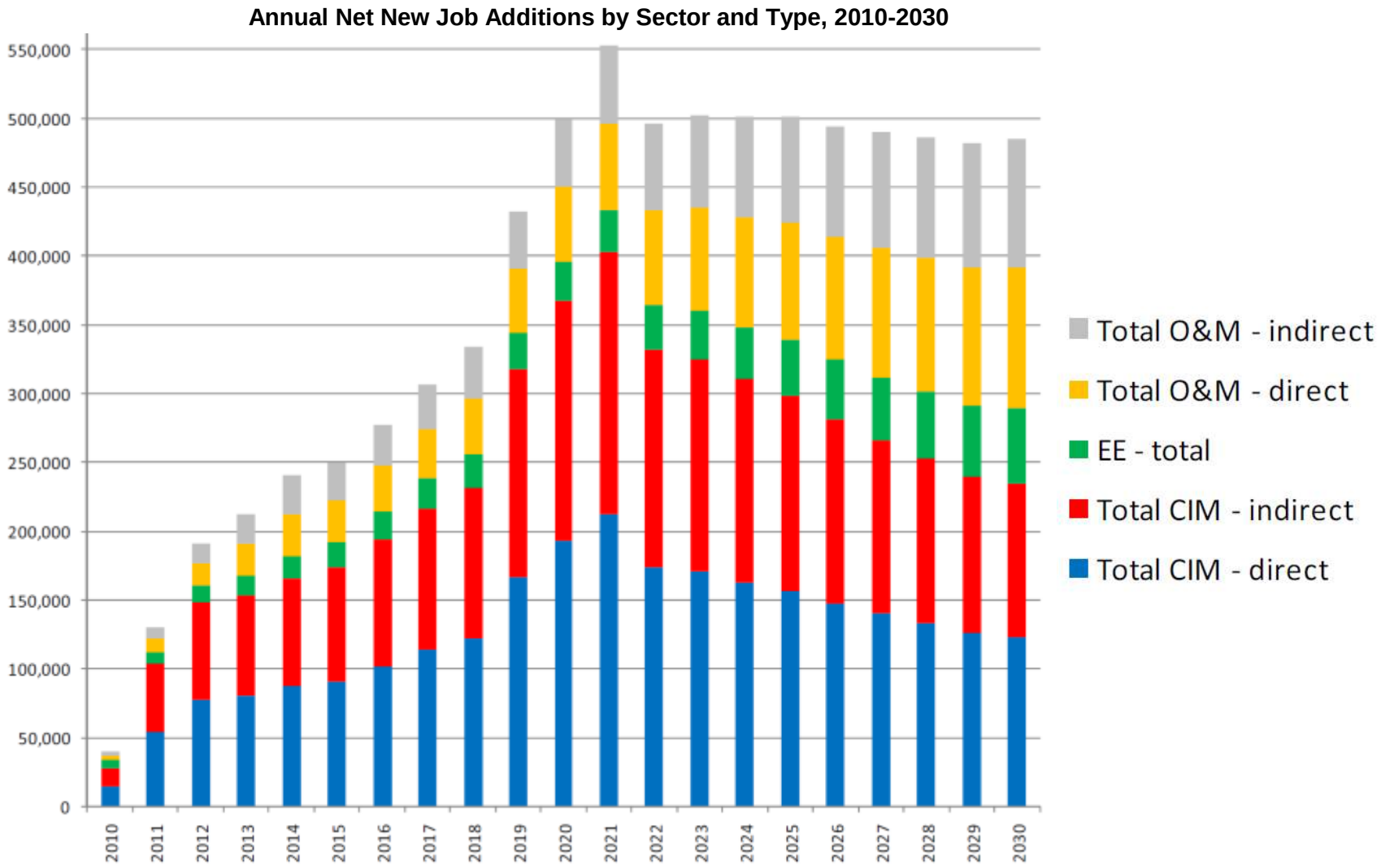
Sources: EIA; DBCCA analysis 2011

Repowering America: Key phases



Sources: WPK Model, DBCCA analysis 2011.

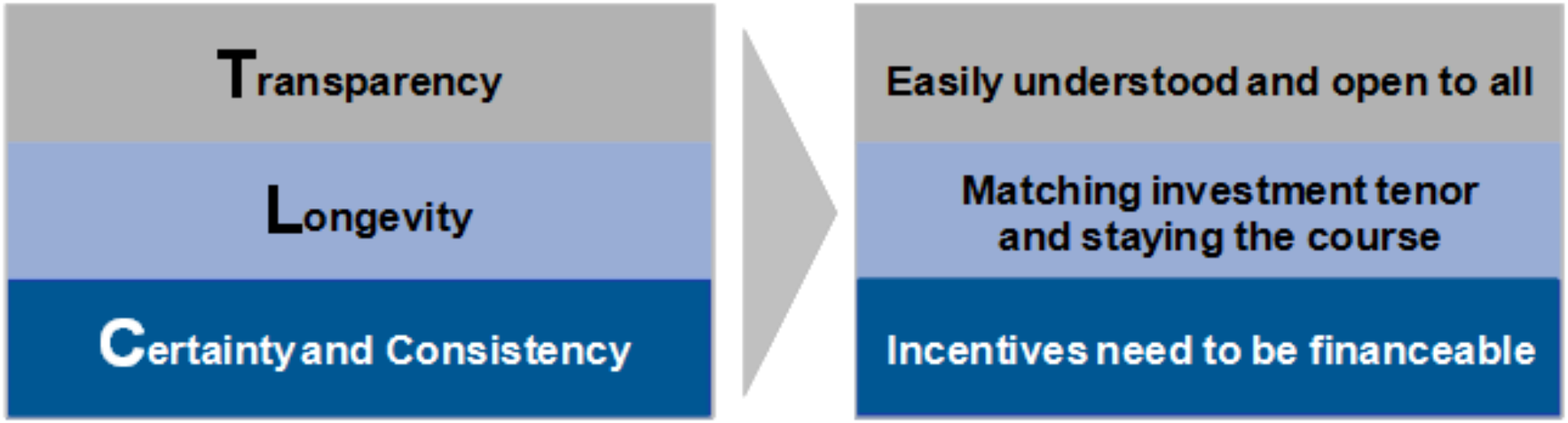
~500,000 net new jobs in 2030 as compared with 2010



Sources: WPK Model, DBCCA analysis 2011

And again…
What investors want from policy

Investors essentially look for 3 key drivers in policy:



In assessing the potential success of policies, these factors should be taken into account

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