



# **The Carbon Trust**

## **Accelerating the move to a low carbon economy**

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Head of International Development  
November 2009

# **Our mission is to accelerate the move to a low carbon economy**

## **We cut carbon emissions now**

- By providing business and the public sector with advice, finance and accreditation
- By stimulating demand for low carbon products and services

## **We cut future carbon emissions**

- By developing low carbon technologies through project funding and investment, expert advice and collaboration
- By identifying market failures and practical ways to overcome them

# The Carbon Trust plays a key role in supporting innovative technologies

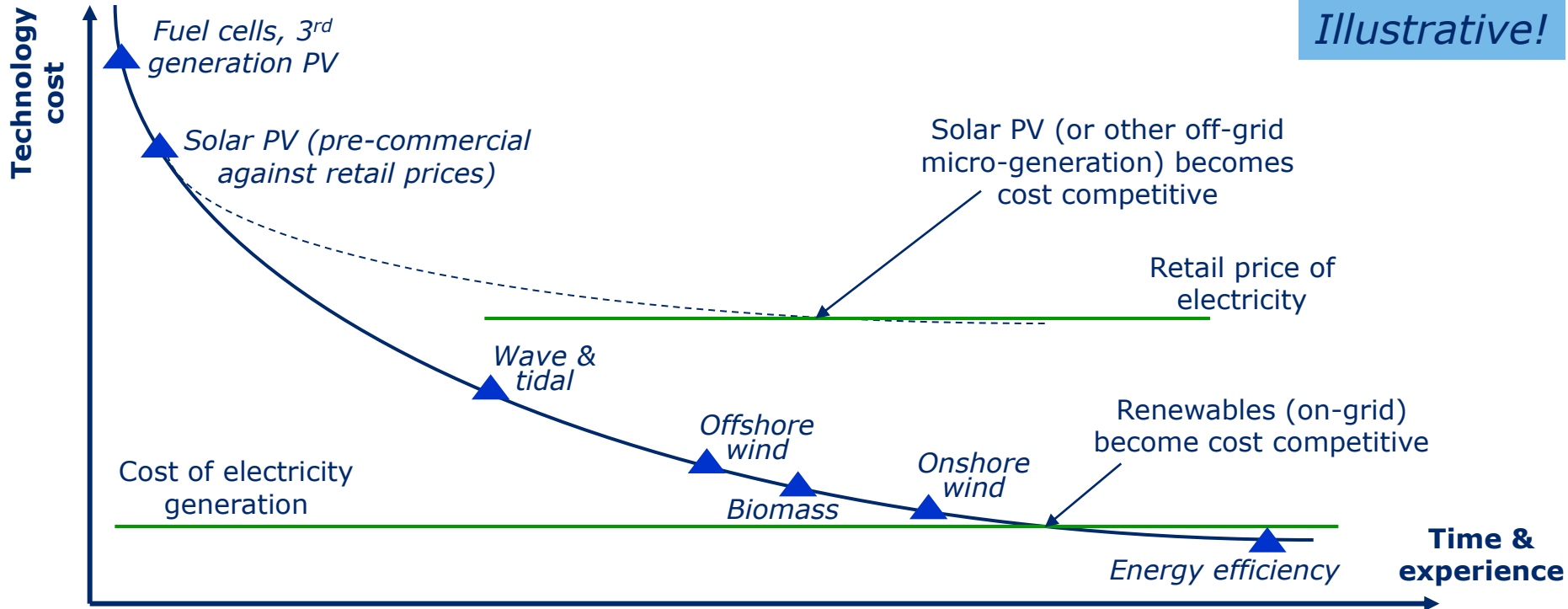


Since 2001 we have...

- **Screened over 1,800 research proposals and supported 166 projects**, with 65% of completed projects going on to generate patents, investment, funding or sales
- **Incubated 82 early stage companies**, who have gone on to raise £84m in private investment
- **Invested in 12 companies** as a venture capitalist
- **Committed over £100m** to accelerate progress, leveraging over £200m further in private investment
- **Collaborated with over 700 companies** on projects relating to technology development and demonstration
- **Published over 50 reports** relating to low carbon technology and innovation

# Innovation challenge is to reduce cost

*Illustrative!*



## R&D

Technical risk  
Small money  
Public £, no returns or  
VC £, 30-40% returns

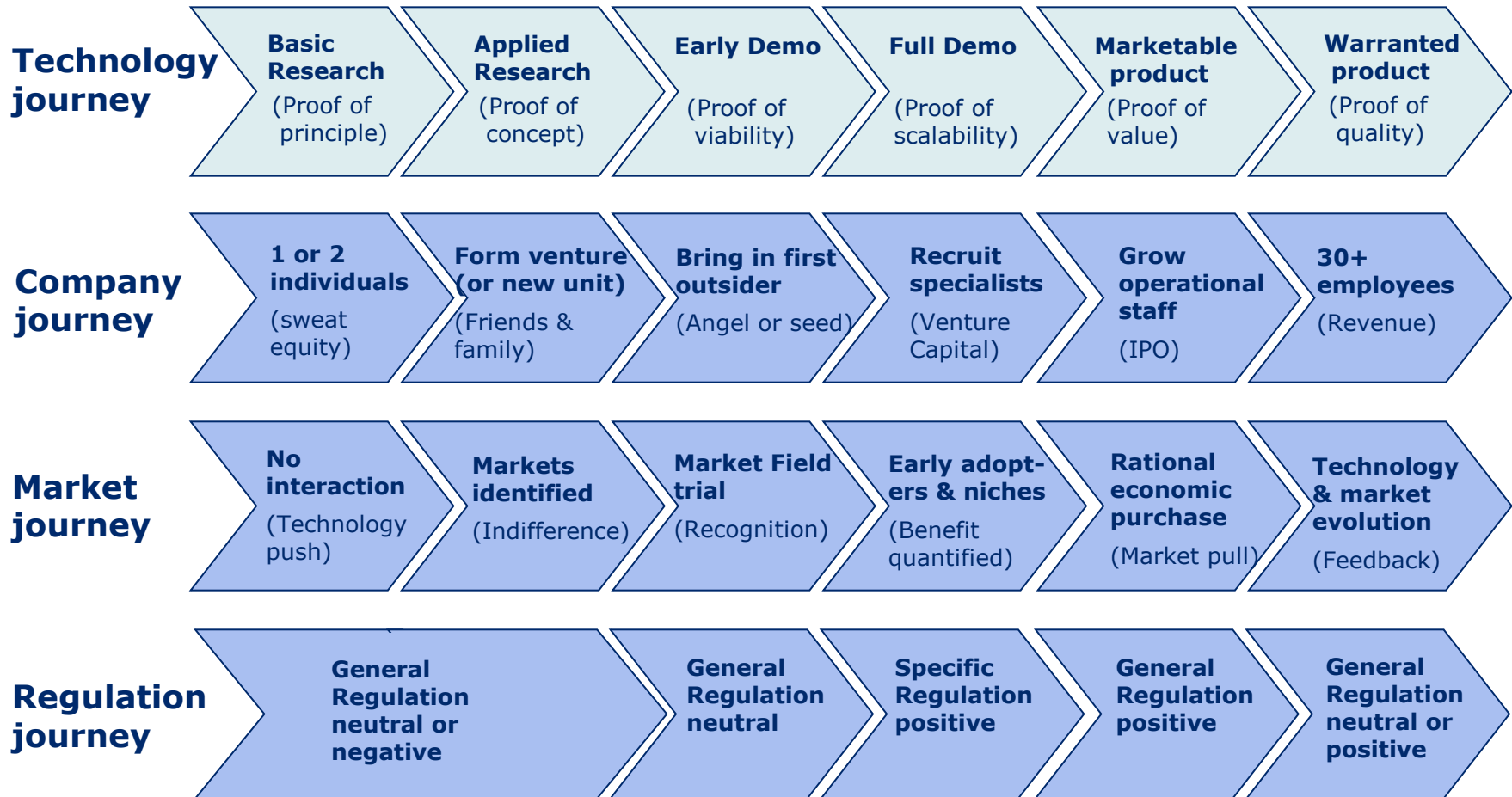
## Pre-commercial

Technical and political risk  
Big money  
Public support +  
VC £ +  
Finance, 15-20% returns

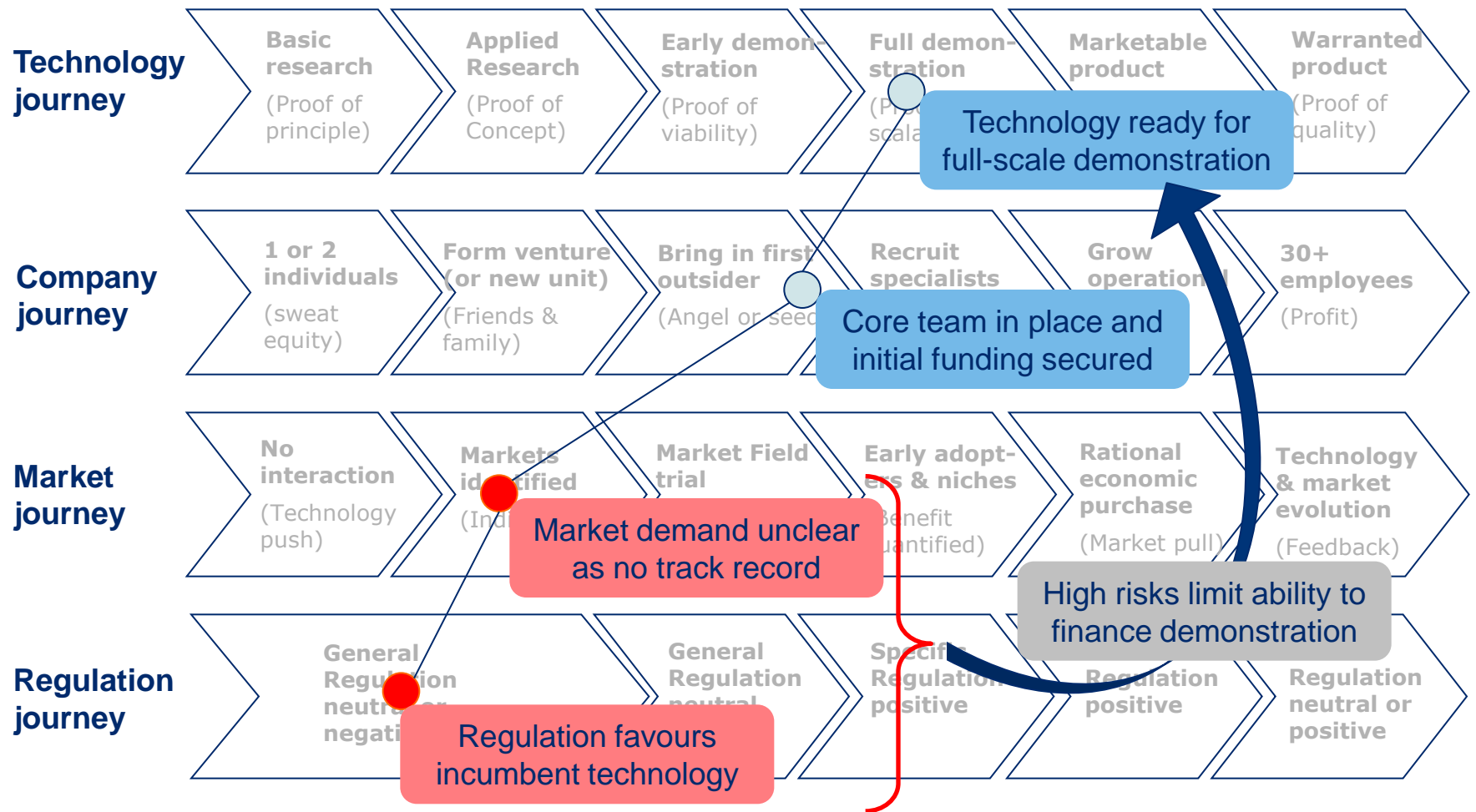
## Commercial

Market risk  
Huge money  
Corporate and utility  
returns

# Low carbon technology is *new*, deployed in *new* markets driven by *new* regulation

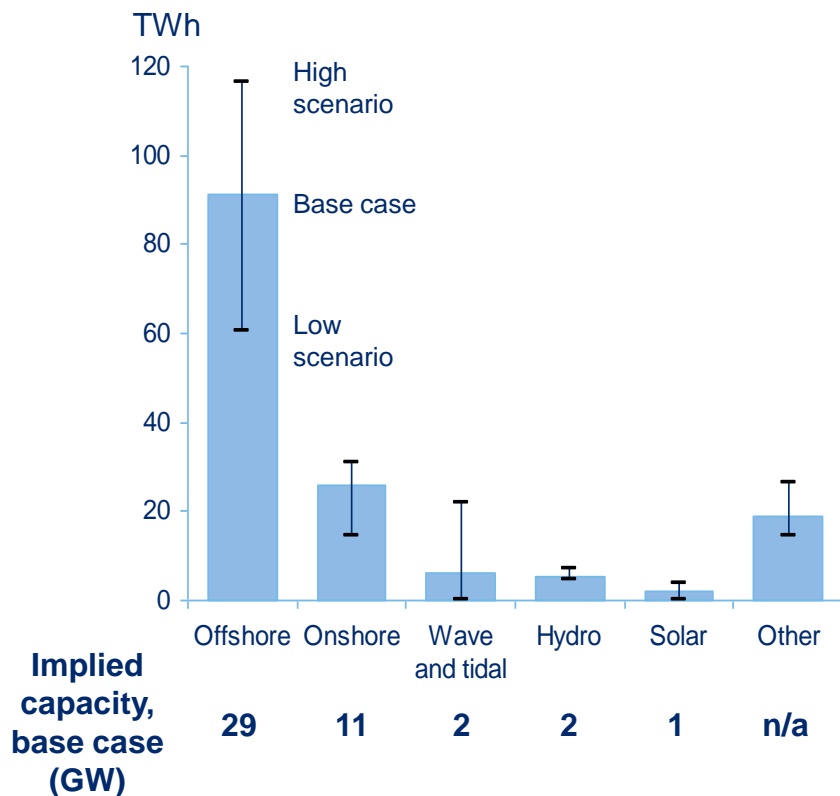


# In our experience, low carbon innovation needs progress on four parallel "journeys"



# Under a reasonable set of assumptions need 29GW of offshore wind

40% renewable electricity scenario by 2020<sup>1</sup>



Wind power is essential

**On- and offshore wind likely to make up >70% of renewable generation, even with a significant contribution from tidal**

- Limited scope for contributions from other technologies by 2020 due to resource constraints and shortage of scalable technology solutions

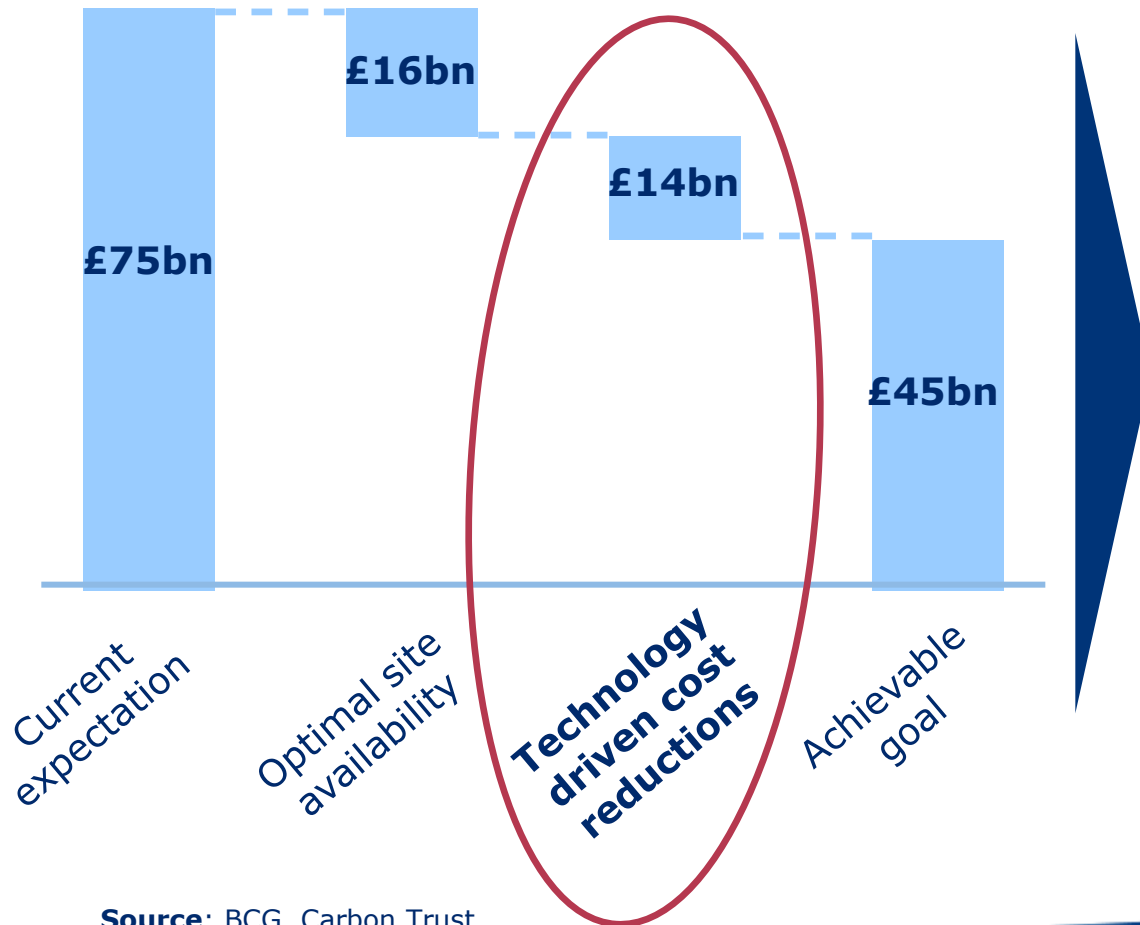
**Offshore wind the most 'flexible' technology in providing additional capacity; in extreme circumstances could range between 19GW and 36GW**

1. Landfill, cofiring, hydro, wave, solar and other projections from BERR, 'Renewables Obligation Consultation: Updated Modelling for Government Response', January 2008  
Source: BCG analysis

# Reduce UK cost of deploying offshore wind by £14 billion with £600 million of public RD&D



Cost of deploying 29GW of offshore wind power in the UK



## Increased RD&D funding

- Increased innovation and economies of scale will reduce the cost of offshore wind deployment by £14bn
- Requires £600 million in public funds and £1.2 billion in private funds
- Government's £405m low carbon investment fund stimulus is in the right direction – a good portion to applied by Q1 2011
- Need to fulfil the RD&D funding gap – including beyond 2011



# Offshore Wind Accelerator (OWA) to reduce cost by 10% with RD&D



**Program objective:** Catalyse a 10% reduction in the cost of offshore wind power through a targeted set of RD&D activities.

## Consortium structure

- Collaboration between Carbon Trust and major offshore wind farm developers



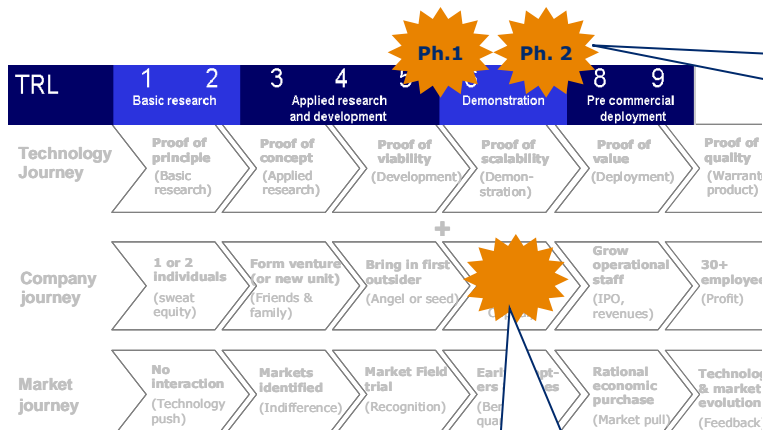
## Budget and timescale

- Provisional total budget of £60m to which Carbon Trust will contribute up to £20m
- Launched October 2008, 4-6 years
- 2013 provide commercial options for R3

## Four RD&D work-streams

- **Offshore foundations:** develop more cost effective designs for deeper water sites that feature lower capital and installation costs than current methods
- **Wake effects:** detailed investigation of wake effects in large arrays to improve accuracy of electricity yield predictions
- **Electrical systems:** systemic re-engineering of electrical systems to minimise losses and reduce costs of both intra-array and transmission to shore
- **O&M Access, logistics & transport:** Develop more cost-effective and safer turbine access systems to maximise operational availability

# There are a number of barriers to full-scale offshore wind deployments



**Technology:** Large-scale deployment of offshore wind requires cost reduction through development (Phase 1) and deployment (Phase 2) of underdeveloped technologies

**OFFSHORE WIND ACCELERATOR**

**Phase 1: Feasibility studies in four key areas**

- Foundation solutions
- Wake effect modelling
- Electrical systems concepts: HVDC vs AC
- Access, logistics and transport solutions

**Market:** Stimulate the development of the market and supply chain; partnership with, and active involvement from, five major offshore developers is key to delivering this

## Phase 2: Deployment

### Funding Partners

- Airtricity
- Dong Energy
- RWE Innogy
- Scottish Power
- StatoilHydro

# First cut identification of highest priorities – from 73 to 19 initiatives

Long lists

Reference	Description	Cost Analysis (Millions)	Cost Analysis (Millions)	Method 1 rank	Method 2 rank
DCI_P1_1	Develop stable government policy for revenue support	1	1	1	1
DCI_P1_2	Extend onshore grid infrastructure	2	2	2	2
DCI_P1_3	Build offshore grid hub	3	3	3	3
DCI_P1_4	Provision of additional resources to expedite the approvals process	4	4	4	4
DCI_P1_5	Offer a lower cost insurance product to the industry	5	5	5	5
DCI_P1_6	Progressive construction of a "Supergrid", the primary purpose of which would be to connect different European markets	6	6	6	6
DCI_P1_7	Review of grid policy for renewables	7	7	7	7
DCI_P1_8	Support and accelerate the evaluation for Round 3	8	8	8	8
DCI_P1_9	Additional resources to help expedite the approvals process	9	9	9	9
DCI_P1_10	Offer a lower cost insurance product to the industry	10	10	10	10
DCI_P1_11	Support development of Supergrid	11	11	11	11
DCI_P1_12	Revisit 3m depth requirement for undersea cables	12	12	12	12
DCI_P1_13	Develop stable government policy for revenue support	13	13	13	13
DCI_P1_14	Formation of a single streamlined agency for the consent process (as in Denmark)	14	14	14	14
DCI_P1_15	Public education role to develop public support for renewables	15	15	15	15
DCI_P1_16	Facilitate co-operation among developers regarding the reservation/use of vessels	16	16	16	16
DCI_P1_17	Development of standard contracts to better allocate risks and reduce negotiation time	17	17	17	17
DCI_P1_18	Facilitating and co-ordinating industry and government collaboration	18	18	18	18
DCI_P1_19	Provide good information "handbook" on offshore wind	19	19	19	19
DCI_P1_20	Encourage greater industry co-operation through application of resources to working groups	20	20	20	20
DCI_P1_21	Further studies on the application of learning from the O&G industry	21	21	21	21
DCI_P1_22	Provide greater feedback along the supply chain on quality/design/maintenance issues	22	22	22	22
DCI_P1_23	Supply chain optimisation studies	23	23	23	23
DCI_P1_24	Greater information sharing among developers (consenting)	24	24	24	24
DCI_P1_25	Co-operation among developers regarding the investment in grid infrastructure	25	25	25	25
DCI_P1_26	Co-operation among developers to help streamline design, procurement and operating processes	26	26	26	26
DCI_P1_27	Future industry planning information, insights into future designs, market sizes etc.)	27	27	27	27
DCI_P1_28	"Information broker" role to help educate developers about R&D / technology choices	28	28	28	28
DCI_P1_29	CT investment in a network of meet-measts to assist developer understanding of conditions	29	29	29	29
DCI_P1_30	Investment by developers in underwriting port capacity to allow UK port infrastructure development	30	30	30	30
DCI_P1_31	Investment in R&D / technology choices	31	31	31	31
DCI_P1_32	CT investment in a network of meet-measts to assist developer understanding of conditions	32	32	32	32
DCI_P1_33	Investment in R&D / technology choices	33	33	33	33
DCI_P1_34	CT investment in a network of meet-measts to assist developer understanding of conditions	34	34	34	34
DCI_P1_35	Investment in R&D / technology choices	35	35	35	35
DCI_P1_36	CT investment in a network of meet-measts to assist developer understanding of conditions	36	36	36	36
DCI_P1_37	Investment in R&D / technology choices	37	37	37	37
DCI_P1_38	CT investment in a network of meet-measts to assist developer understanding of conditions	38	38	38	38
DCI_P1_39	Investment in R&D / technology choices	39	39	39	39
DCI_P1_40	CT investment in a network of meet-measts to assist developer understanding of conditions	40	40	40	40
DCI_P1_41	Investment in R&D / technology choices	41	41	41	41
DCI_P1_42	CT investment in a network of meet-measts to assist developer understanding of conditions	42	42	42	42
DCI_P1_43	Investment in R&D / technology choices	43	43	43	43
DCI_P1_44	CT investment in a network of meet-measts to assist developer understanding of conditions	44	44	44	44
DCI_P1_45	Investment in R&D / technology choices	45	45	45	45
DCI_P1_46	CT investment in a network of meet-measts to assist developer understanding of conditions	46	46	46	46
DCI_P1_47	Investment in R&D / technology choices	47	47	47	47
DCI_P1_48	CT investment in a network of meet-measts to assist developer understanding of conditions	48	48	48	48
DCI_P1_49	Investment in R&D / technology choices	49	49	49	49
DCI_P1_50	CT investment in a network of meet-measts to assist developer understanding of conditions	50	50	50	50
DCI_P1_51	Investment in R&D / technology choices	51	51	51	51
DCI_P1_52	CT investment in a network of meet-measts to assist developer understanding of conditions	52	52	52	52
DCI_P1_53	Investment in R&D / technology choices	53	53	53	53
DCI_P1_54	CT investment in a network of meet-measts to assist developer understanding of conditions	54	54	54	54
DCI_P1_55	Investment in R&D / technology choices	55	55	55	55
DCI_P1_56	CT investment in a network of meet-measts to assist developer understanding of conditions	56	56	56	56
DCI_P1_57	Investment in R&D / technology choices	57	57	57	57
DCI_P1_58	CT investment in a network of meet-measts to assist developer understanding of conditions	58	58	58	58
DCI_P1_59	Investment in R&D / technology choices	59	59	59	59
DCI_P1_60	CT investment in a network of meet-measts to assist developer understanding of conditions	60	60	60	60
DCI_P1_61	Investment in R&D / technology choices	61	61	61	61
DCI_P1_62	CT investment in a network of meet-measts to assist developer understanding of conditions	62	62	62	62
DCI_P1_63	Investment in R&D / technology choices	63	63	63	63
DCI_P1_64	CT investment in a network of meet-measts to assist developer understanding of conditions	64	64	64	64
DCI_P1_65	Investment in R&D / technology choices	65	65	65	65
DCI_P1_66	CT investment in a network of meet-measts to assist developer understanding of conditions	66	66	66	66
DCI_P1_67	Investment in R&D / technology choices	67	67	67	67
DCI_P1_68	CT investment in a network of meet-measts to assist developer understanding of conditions	68	68	68	68
DCI_P1_69	Investment in R&D / technology choices	69	69	69	69
DCI_P1_70	CT investment in a network of meet-measts to assist developer understanding of conditions	70	70	70	70
DCI_P1_71	Investment in R&D / technology choices	71	71	71	71
DCI_P1_72	CT investment in a network of meet-measts to assist developer understanding of conditions	72	72	72	72
DCI_P1_73	Investment in R&D / technology choices	73	73	73	73

Commercial Initiatives	Number of mentions
Government controlled	8
1 Review of grid policy for renewables	5
2 Support and accelerate the evaluation of Round 3	1
3 Additional resources to help expedite the approvals process	1
4 Offer a lower cost insurance product to the industry	1
5 Support development of Supergrid	1
6 Revisit 3m depth requirement for undersea cables	3
7 Develop stable government policy for revenue support	3
8 Formation of a single streamlined agency for the consent process (as in Denmark)	2
9 Public education role to develop public support for renewables	1
Industry Stage of Development	
1 Facilitate co-operation among developers regarding the reservation/use of vessels	2
2 Development of standard contracts to better allocate risks and reduce negotiation time	2
3 Facilitating and co-ordinating industry and government collaboration	1
4 Provide good information "handbook" on offshore wind	7
5 Encourage greater industry co-operation through application of resources to working groups	1
6 Further studies on the application of learning from the O&G industry	1
7 Provide greater feedback along the supply chain on quality/design/maintenance issues	3
8 Supply chain optimisation studies	1
9 Greater information sharing among developers (consenting)	1
10 Co-operation among developers regarding the investment in grid infrastructure	2
11 Co-operation among developers to help streamline design, procurement and operating processes	2
12 Future industry planning information, insights into future designs, market sizes etc.)	3
13 "Information broker" role to help educate developers about R&D / technology choices	1
14 CT investment in a network of meet-measts to assist developer understanding of conditions	4
15 Investment by developers in underwriting port capacity to allow UK port infrastructure development	1
16 Investment in R&D / technology choices	2
17 CT investment in a network of meet-measts to assist developer understanding of conditions	1
18 Investment in R&D / technology choices	1
19 CT investment in a network of meet-measts to assist developer understanding of conditions	1

● 73 initiatives

## FEASIBILITY

(Additionality, UK Economic Benefit, CT 'Doability')

Low

High

Feasibility / importance evaluation

● Application of evaluation criteria in this context

High  
IMPORTANCE  
(Scale, Acceleration)

Low

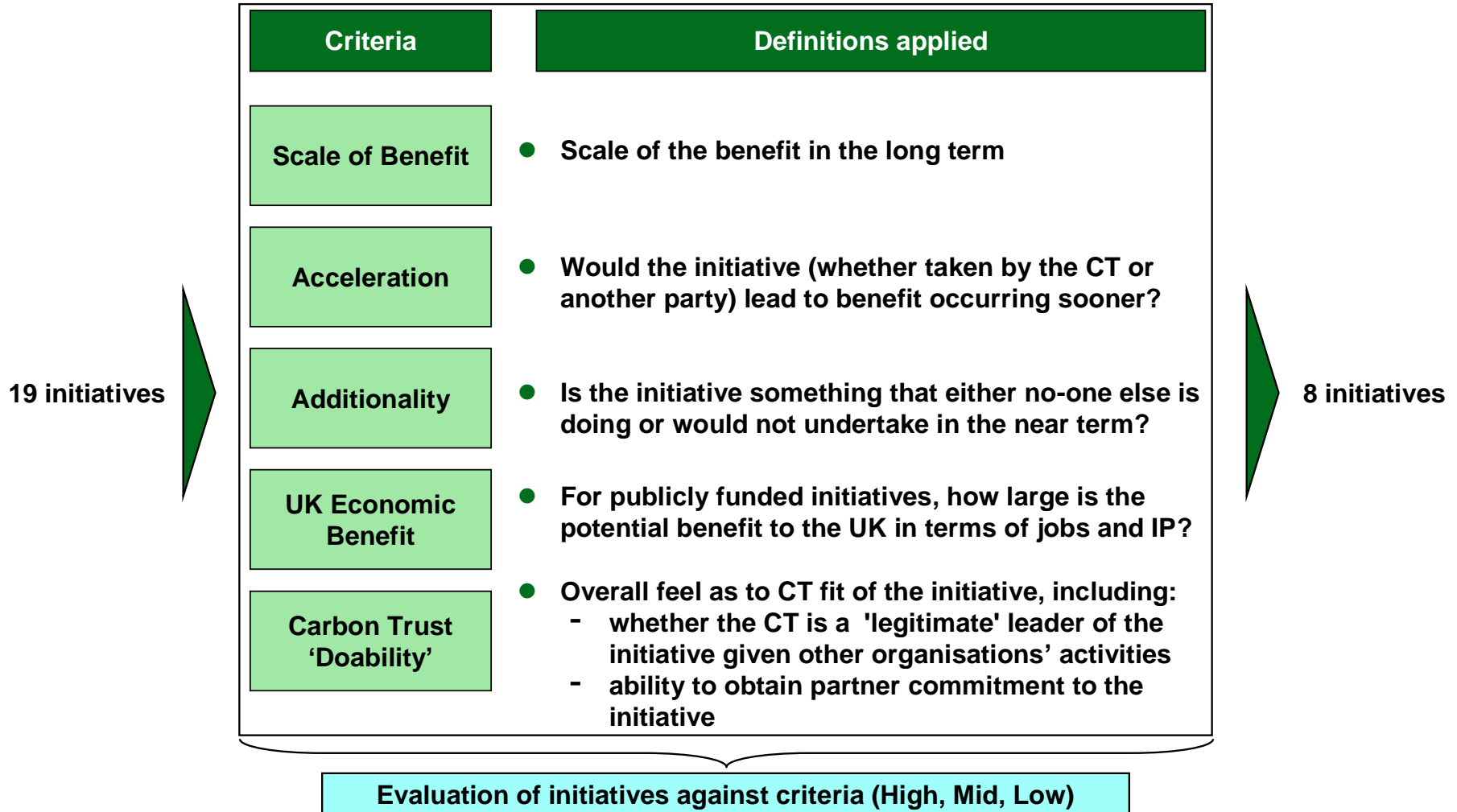
<ul style="list-style-type: none"> <li>Develop stable government policy for revenue support</li> <li>Extend onshore grid infrastructure</li> <li>Build offshore grid hub</li> </ul>	<ul style="list-style-type: none"> <li>Review of grid policy for renewables</li> <li>Support and accelerate the evaluation for Round 3</li> <li>Formation of a single streamlined agency for the consent process</li> </ul>
<ul style="list-style-type: none"> <li>Provision of additional resources to expedite the approvals process</li> <li>Offer a lower cost insurance product to the industry</li> <li>Progressive construction of a "Supergrid", the primary purpose of which would be to connect different European markets</li> </ul>	<ul style="list-style-type: none"> <li>Change the DTI requirement that subsea cables be buried to a depth of 3 metres</li> <li>Increased public education role to develop support for renewable energy in general, and for offshore wind energy in particular</li> </ul>



● Higher feasibility / importance ideas taken forward

● Refinement to 19 initiatives

# Second cut identification of highest priorities – from 19 to 8 initiatives



# Phase 1 Delivery structure



Key:

- OWA Partners
- Carbon Trust
- Third party contractors



- Strategic direction
- Budgetary control

- P1 Programme management
- P2 Development

- Project management
- Project reporting
- Data gathering

- Technical support
- Data provision

- Technical delivery
- Data analysis



# Phase 2 Demonstrations



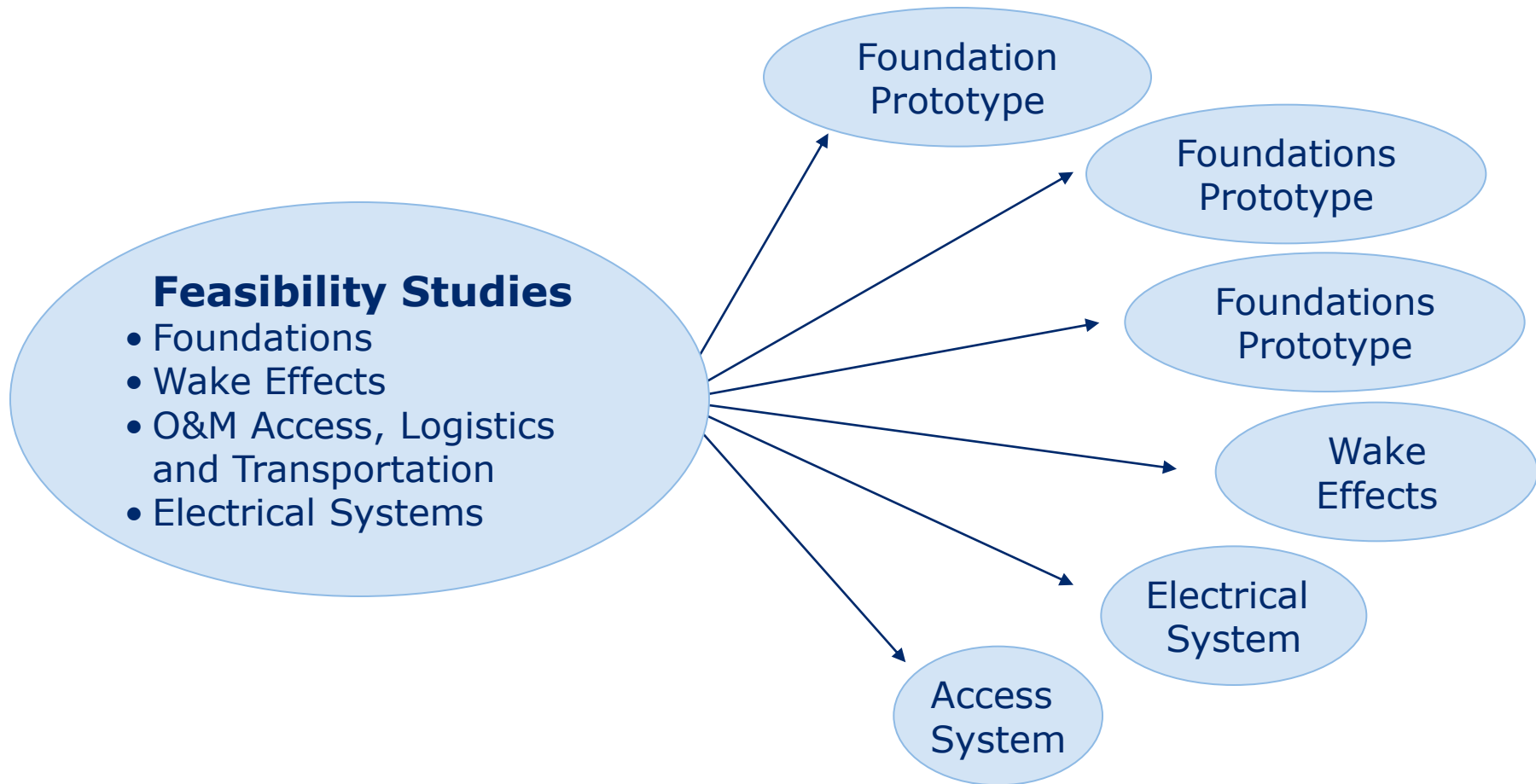
2009

2010/2011

2012/2013

Phase 1

Phase 2

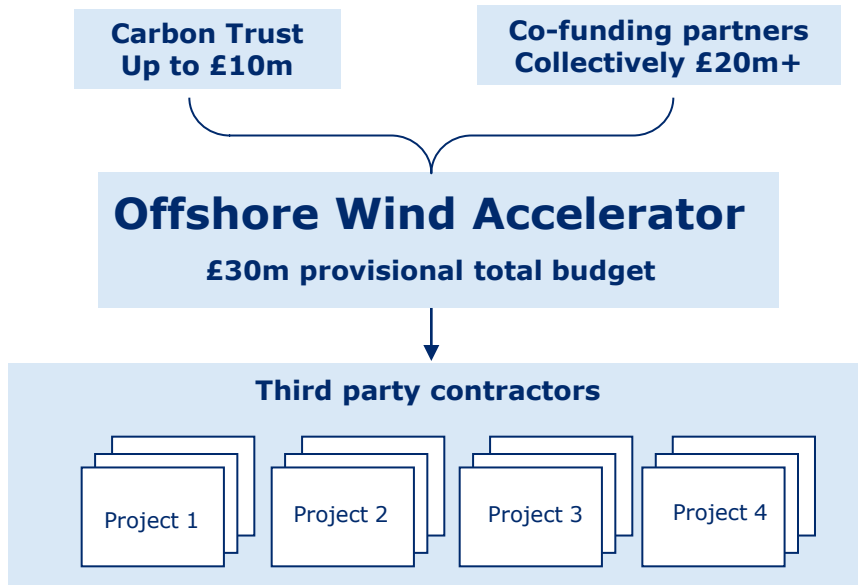


# OWA collaborative structure allows IP sharing and benefits all industry



## Collaborative structure

- With project developers due to focus on cost reduction in short-med term
- Activities are prioritised according to industry needs; co-funders provide route to market for results
- Key benefits to co-funders are shared costs/risks and access to additional technical resources
- Benefits to Carbon Trust are leverage, direct industry engagement and accelerated carbon reductions
- IP sharing across work programme – where benefits all of industry. (Not sharing knowledge on IP sensitive areas)



# Opening future markets: technology acceleration

- Technology accelerators focused on addressing barriers to technology development
- Technologies may be pre-commercial or require significant adaptation to a new environment
- Emphasis on cost reduction – faster than normal
- Collaborate with industry partners – to achieve co-funding and IP / knowledge sharing that benefit all of industry
- Current accelerators include:
  - Offshore wind
  - Marine Energy



## **Technology commercialisation: directed research acceleration**

- Directed Research Accelerators target innovation gaps
- Aim to overcome technical barriers to development of specific low carbon technologies
- Established in commercial Special Purpose Vehicles to capture IP
- Invest up to £10m over 3-5 years
- Current research accelerators include:
  - Advanced Photovoltaics
  - Algae biofuels
  - Pyrolysis oil



**Questions?**

**[www.carbontrust.co.uk](http://www.carbontrust.co.uk)**



# Opening future markets: technology acceleration

## Marine Energy

### Opportunity

- Supply up to 20% of UK's electricity needs from marine energy

### Challenge

- Reducing cost of wave and tidal stream devices

### Solution

- £3.5m programme to accelerate cost reduction focusing on:
  - New device concepts
  - Component technologies
  - Installation, operation & maintenance
- £22.5m grant programme to support the deployment of the leading wave and tidal stream devices



# Marine Energy Accelerator will reduce investment to achieve cost-competitiveness

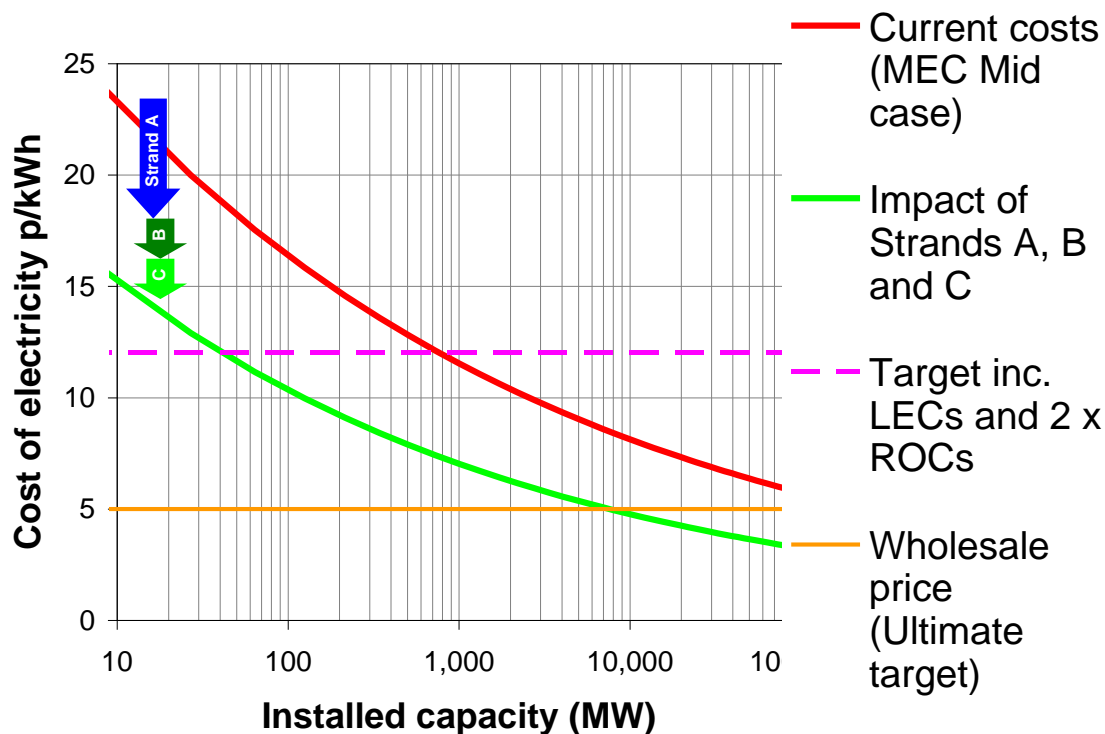
Strand A:  
New device concepts



Strand B:  
Component technologies



Strand C:  
Operations & maintenance



## Technology commercialisation: directed research acceleration

### Advanced Bioenergy: Pyrolysis oil for transport

#### Opportunity

- Develop pyrolysis oil to replace fossil fuels in existing transport infrastructure delivering greater than 80% carbon savings

#### Challenge

- Upgraded high quality pyrolysis oil for use in conventional refineries

#### Solution

- Research accelerator to speed development
- Up to £20 million investment
- Focus on waste biomass



# Technology commercialisation: directed research acceleration



## Advanced Bioenergy: Algae biofuels

### Opportunity

- Potential for CO<sub>2</sub> savings >80% relative to fossil fuels
- 6-10 fold increase in biomass yield per hectare compared with conventional biomass feedstocks – without need for fresh water

### Challenge

- Develop low-cost, high productivity production systems at scale

### Solution

- Phase 1: 3-year £3-6 million R&D project
- Phase 2: 5-year £10-20 million large-scale demonstration project





# Technology commercialisation: directed research acceleration

## Organic Solar Photovoltaics

### Opportunity

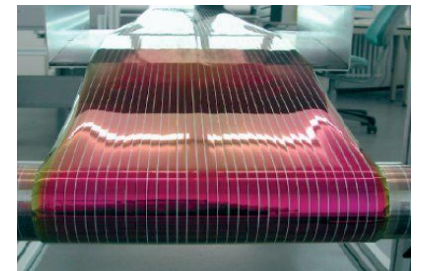
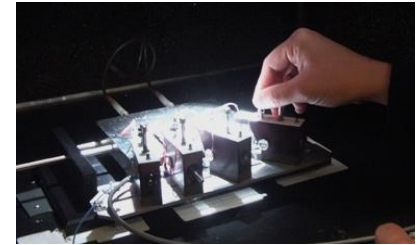
- Deploy 1GW of organic solar PV by 2017, which could deliver CO<sup>2</sup> savings of over 1 million tonnes per year.

### Challenge

- Halve the cost of organic solar PV technology

### Solution

- £5 million Advanced PV accelerator
- Partnering with Cambridge University and The Technology Partnership
- Catalyst to move projects through “valley of death” from research through to attractive investment for strategic buyers



### Partners



UNIVERSITY OF  
CAMBRIDGE



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