Modelling investment in RD&D – Will Mission Innovation make a difference?

Fionn Rogan et al

IEA-ETSAP Workshop on Energy Modelling and Applications

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ERI
ENVIRONMENTAL RESEARCH INSTITUTE
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EPMG
ENERGY POLICY & MODELLING GROUP

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Centre for Marine and Renewable Energy

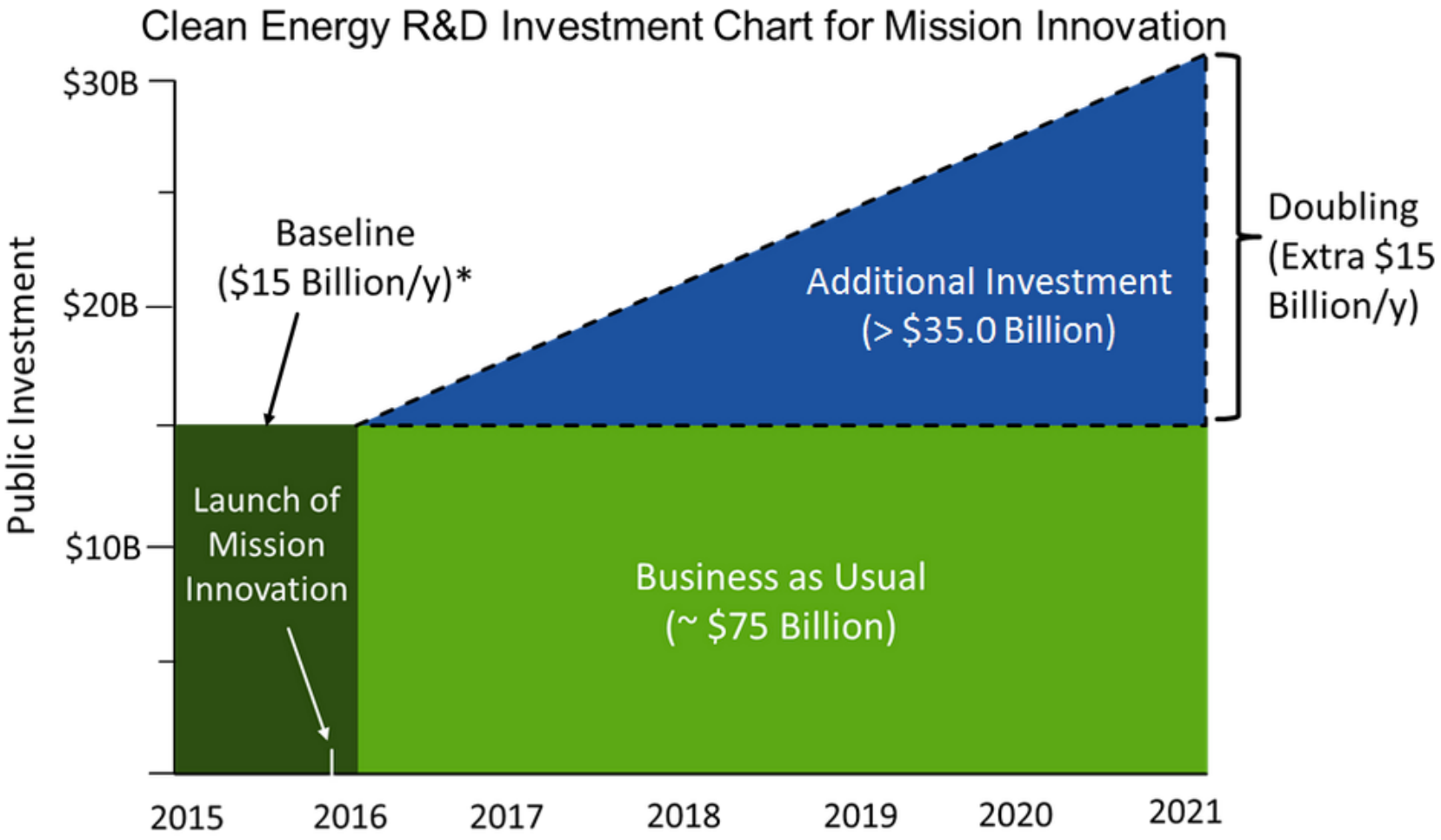
A TRADITION OF INDEPENDENT THINKING

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Presentation Overview

- Mission Innovation
  - Overview
  - Challenges
- Modelling Technology Learning
  - Overview
  - Challenges
- UCC-EPMG Modelling & Analysis
  - TIMES Multiple Scenario Analysis
  - Innovation System Analysis

Mission Innovation

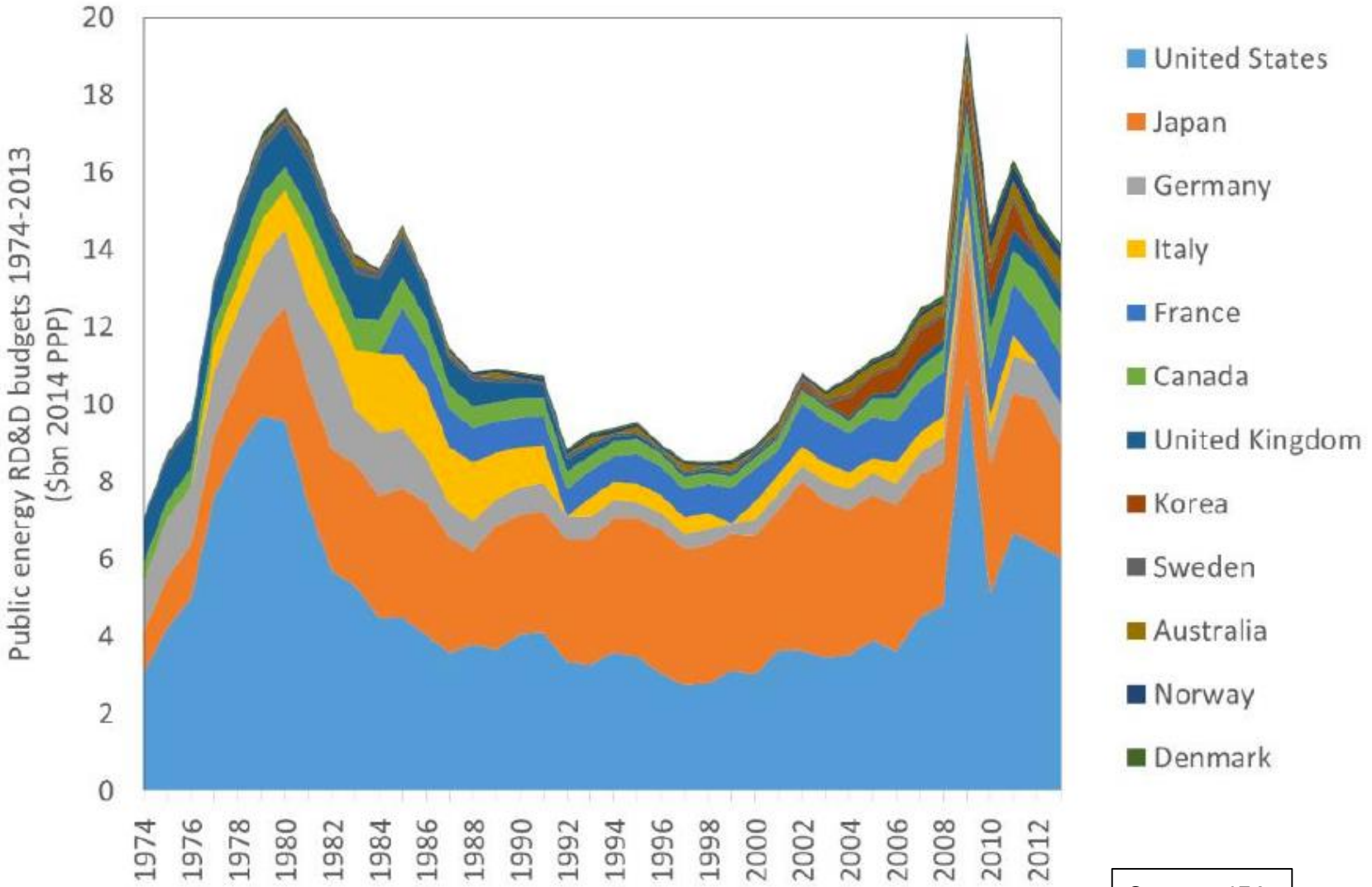


Source: Mission Innovation

Mission Innovation Challenges

1. Funding
2. Prioritisation
3. Uncertainty

1. Mission Innovation - Funding



Source: IEA

1. Mission Innovation - Funding

Centralised approach

- Government led, top down
- Collaboration prioritised over competition
- Government laboratories take the lead, e.g.
  - Fraunhofer in Germany
  - RISO in Denmark

Decentralised approach

- Market led, bottom-up model
- Competition prioritised over collaboration
- Start-ups and Original Equipment Manufacturers (OEMs) take the lead

Source: Hannon, 2016

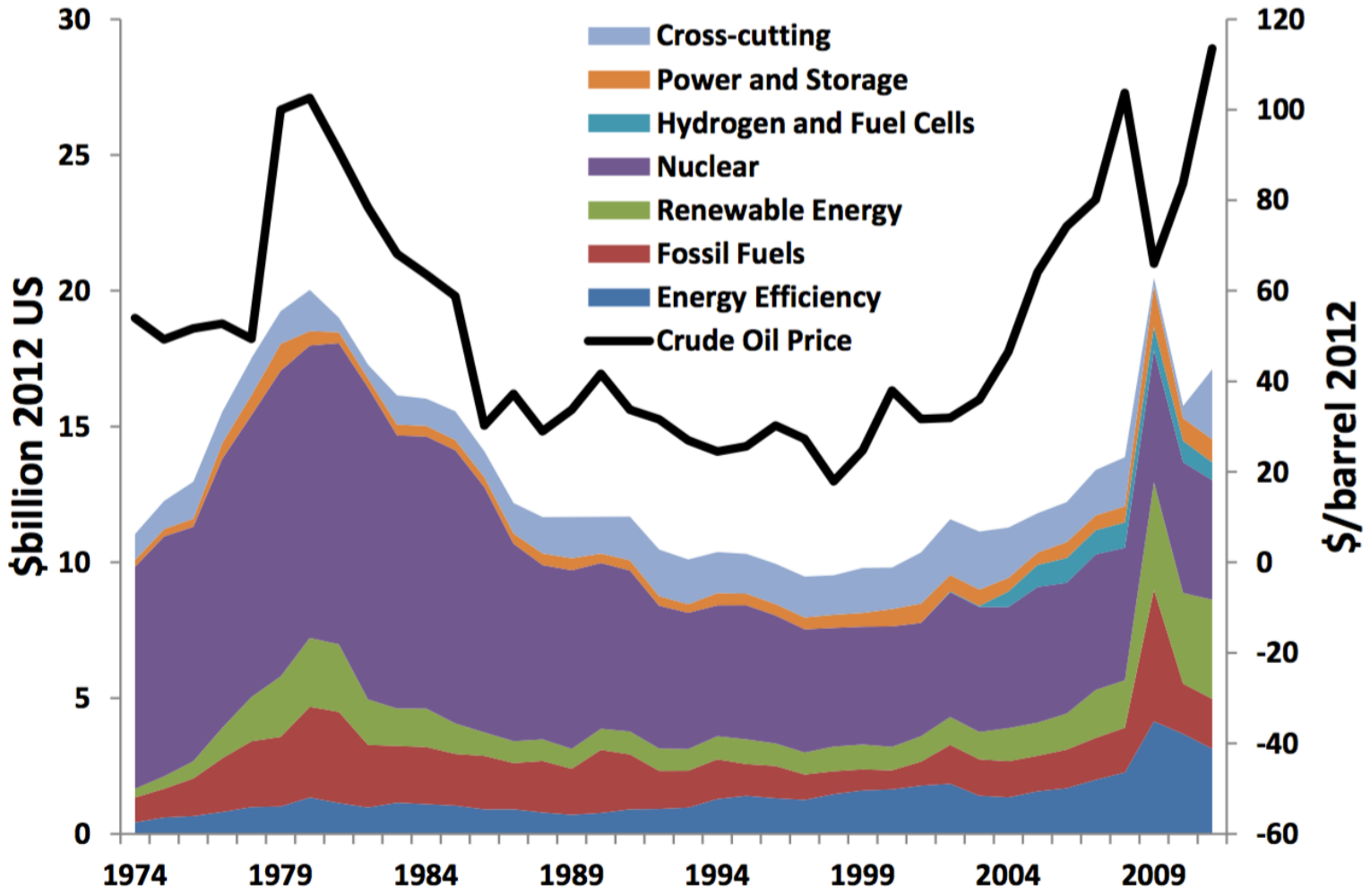
2. Mission Innovation - Prioritisation

Mission Innovation Clean Energy R&D Focus Areas

	AUSTRALIA	BRAZIL	CANADA	CHILE	CHINA	DENMARK	EUROPEAN UNION	FINLAND	FRANCE	GERMANY	INDIA	INDONESIA	ITALY	JAPAN	KINGDOM OF SAUDI ARABIA	MEXICO	NETHERLANDS	NORWAY	REPUBLIC OF KOREA	SWEDEN	UNITED ARAB EMIRATES	UNITED KINGDOM	UNITED STATES
INDUSTRY & BUILDINGS	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
VEHICLES & OTHER TRANSPORTATION	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●		●	●	●	●		●	●
BIO-BASED FUELS & ENERGY	●	●	●			●	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●	●
SOLAR, WIND & OTHER RENEWABLES	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
NUCLEAR ENERGY	●	●	●		●											●			●		●	●	●	●
HYDROGEN & FUEL CELLS	●	●	●		●	●	●	●	●	●	●			●	●	●	●	●	●			●	●	●
CLEANER FOSSIL ENERGY		●	●		●	●		●		●	●	●			●		●		●					●
CO_2 CAPTURE, UTILIZATION & STORAGE	●	●	●		●	●	●		●	●	●	●		●	●	●	●	●	●		●	●	●	●
ELECTRICTY GRID	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●
ENERGY STORAGE	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
BASIC ENERGY RESEARCH	●		●			●	●		●	●	●	●	●	●	●		●	●		●	●		●	●

Source: Mission Innovation

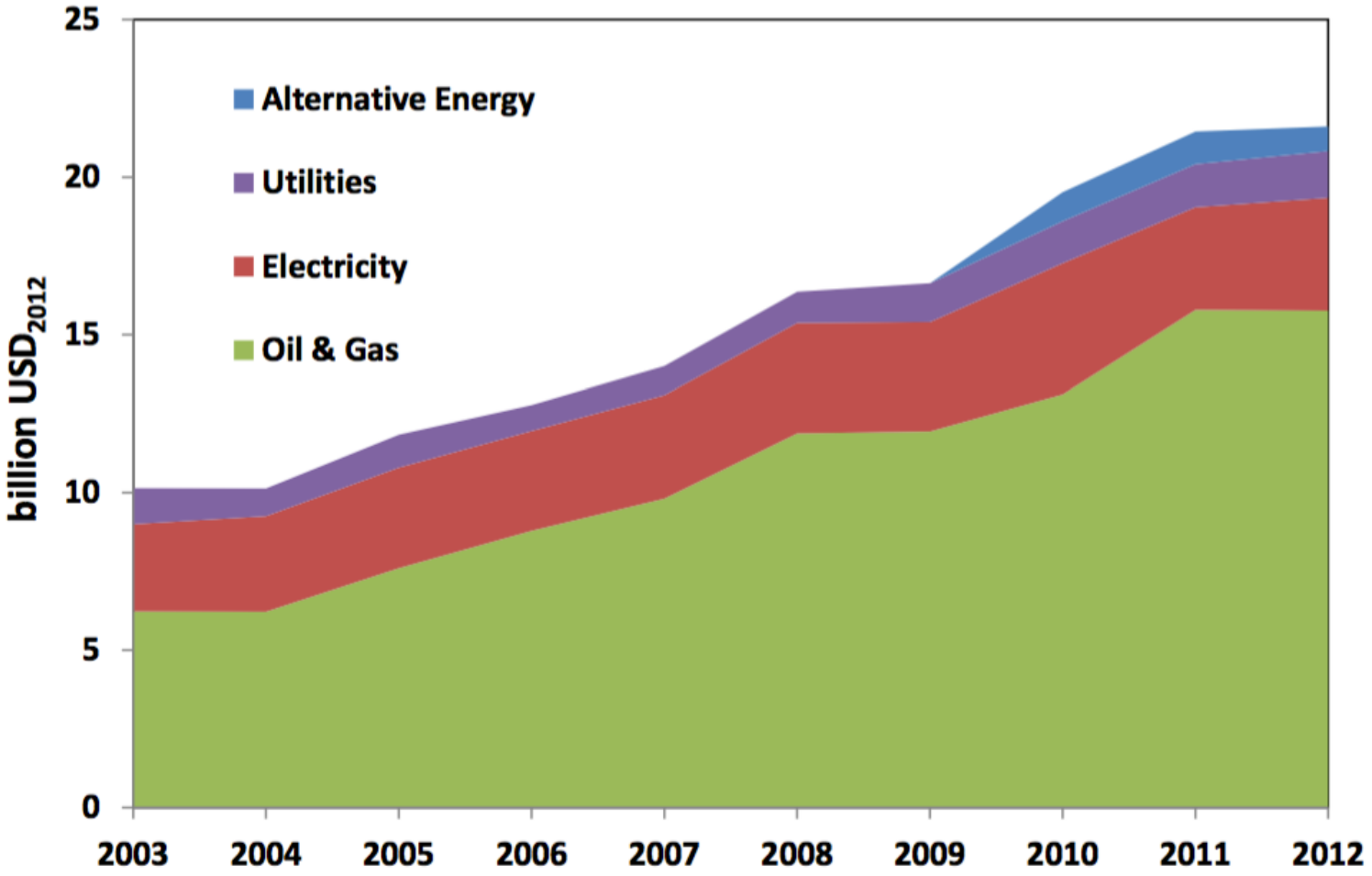
2. Historic Prioritisation - Public Sector



Note: for IEA countries only

Source: Rhodes et al, 2014

2. Historic Prioritisation – Private sector



Note: EC survey of top 1200 global companies

Source: Rhodes et al, 2014

3. Mission Innovation - Uncertainty

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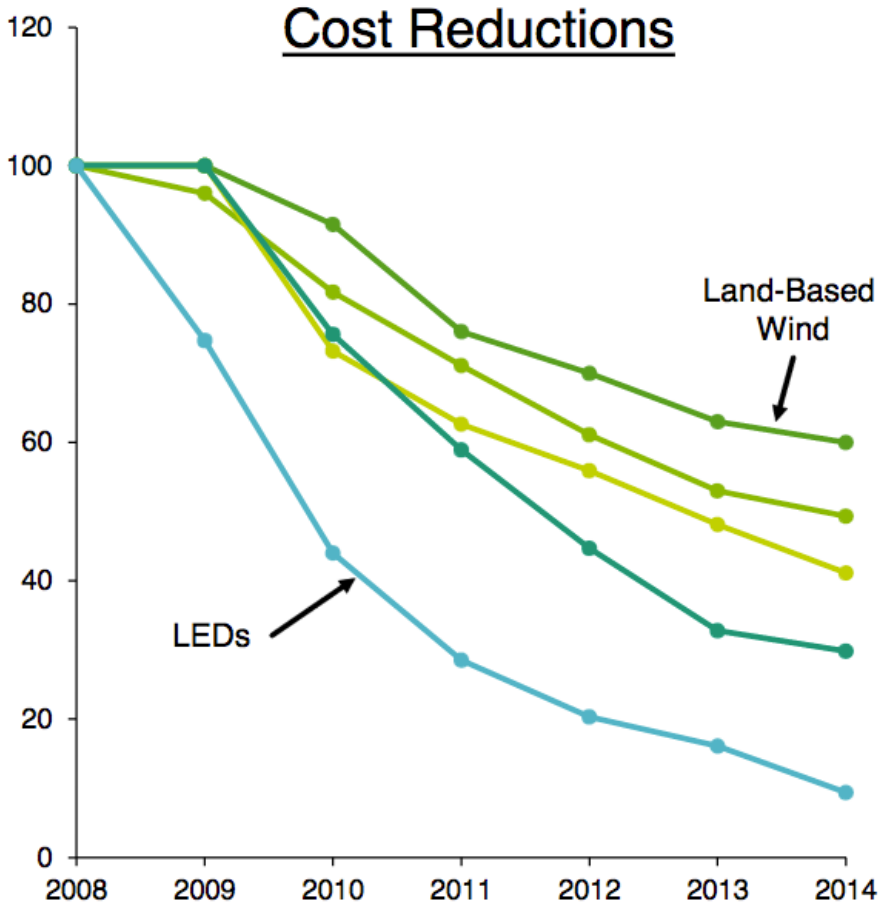
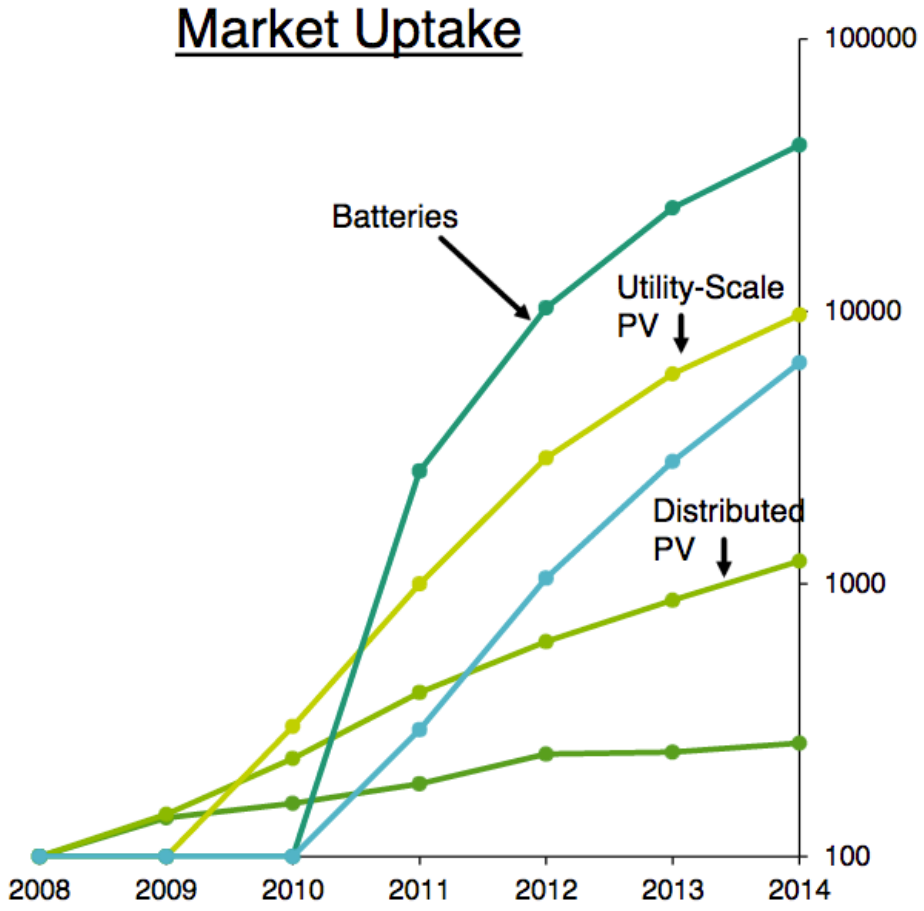




Source: Mission Innovation

Modelling Technology Learning

TECHNIQUES FOR MODELLING TECHNOLOGY LEARNING IN ENERGY SYSTEM MODELS

Elia, A. Rogan, F. Ó Gallachoir B

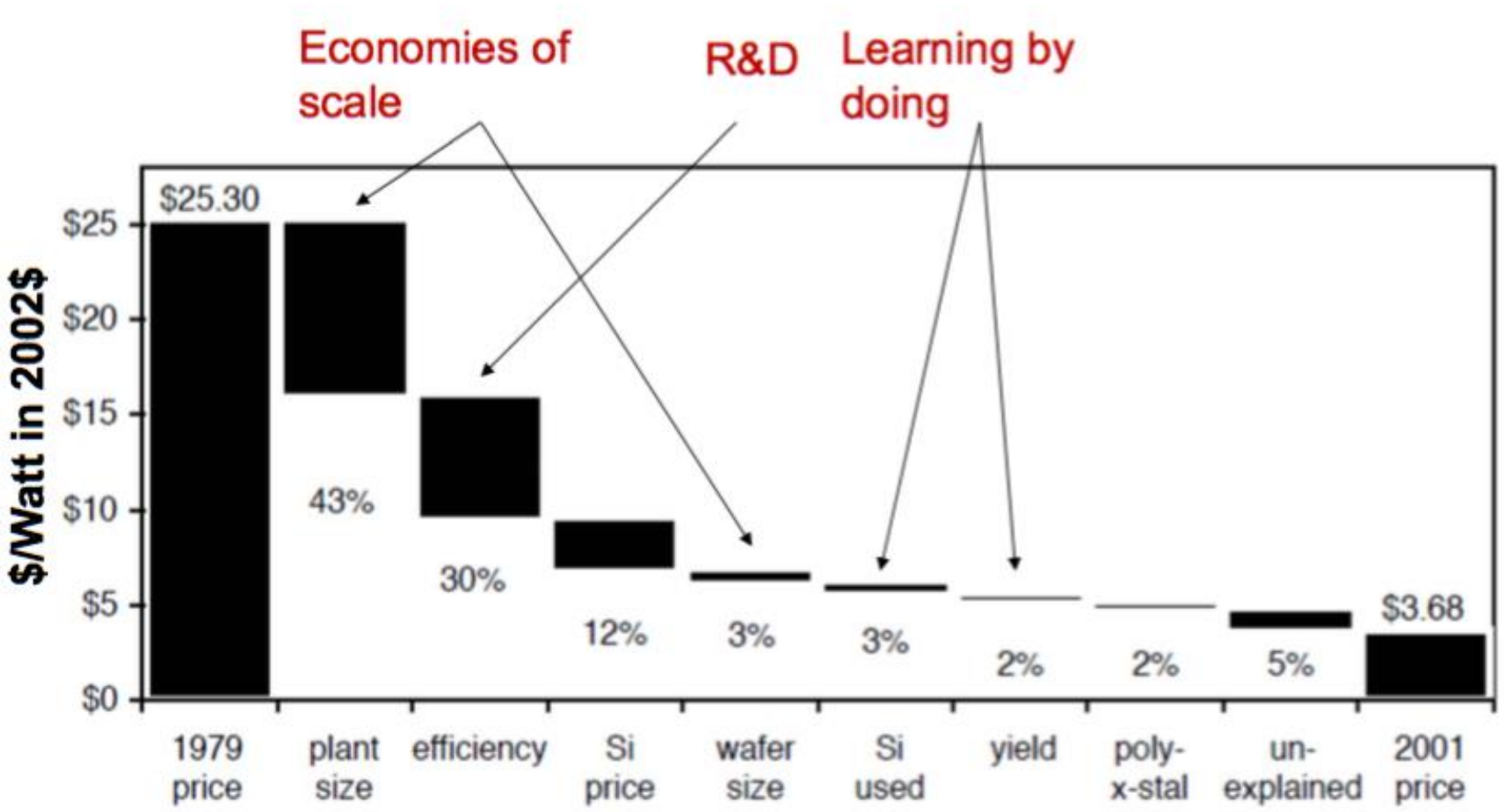
ABSTRACT

Investigating technological change has become a key research area in the last year to provide a better understanding of technology innovation and adoption in the context of an energy system. A common method used to investigate the innovation is the learning curve approach (LC), it can provide an exhaustive representation of the phenomena of technological learning.

Modelling Technology Learning

Name	Description
Learning by Researching	Technology improvements from Research Development & Demonstration (RD&D) particularly scientific advances
Learning by Interacting	Technology improvements from network interaction between all actors in technology development & diffusion stages
Learning by Doing	Technology improvements achieved during the production process
Scale Effect	Technology improvements from economies of scale such as plant size, mass production
Learning by Using	Technology improvements from customer-firm feedback during market deployment
Other Approaches	Learning curves plus other methods (e.g. engineering, bottom-up technical approaches, expert judgement)

Modelling Technology Challenges

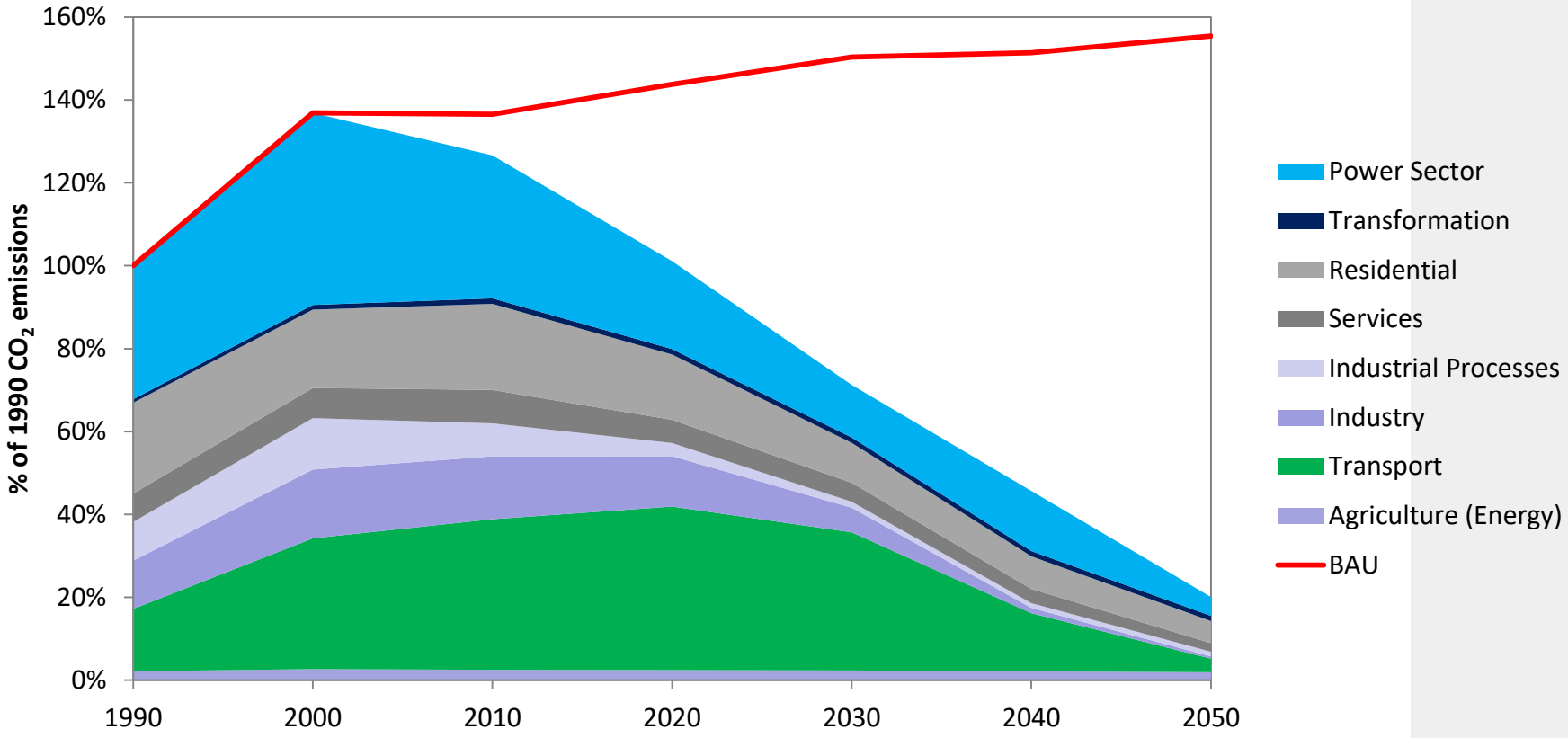


Source: Diaz et al, 2015 based on Nemet, 2007

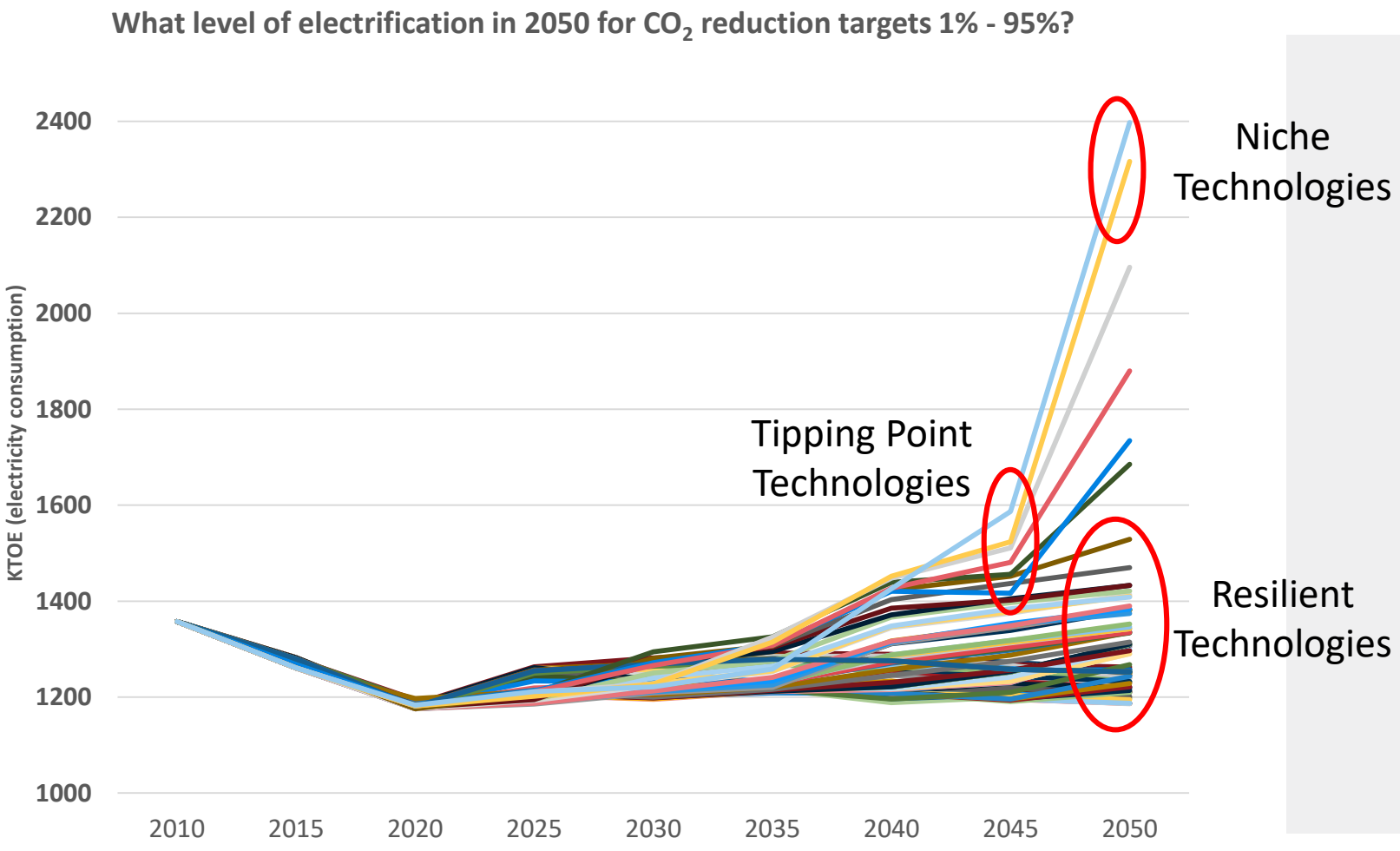
UCC-EPMG Modelling & Analysis

1. Irish TIMES Energy System Model
2. Multiple Scenario Analysis
3. Resilient Technologies
4. Niche Technologies
5. Innovation System Analysis

1. Irish TIMES Energy System Model



2. Multiple Scenario Analysis



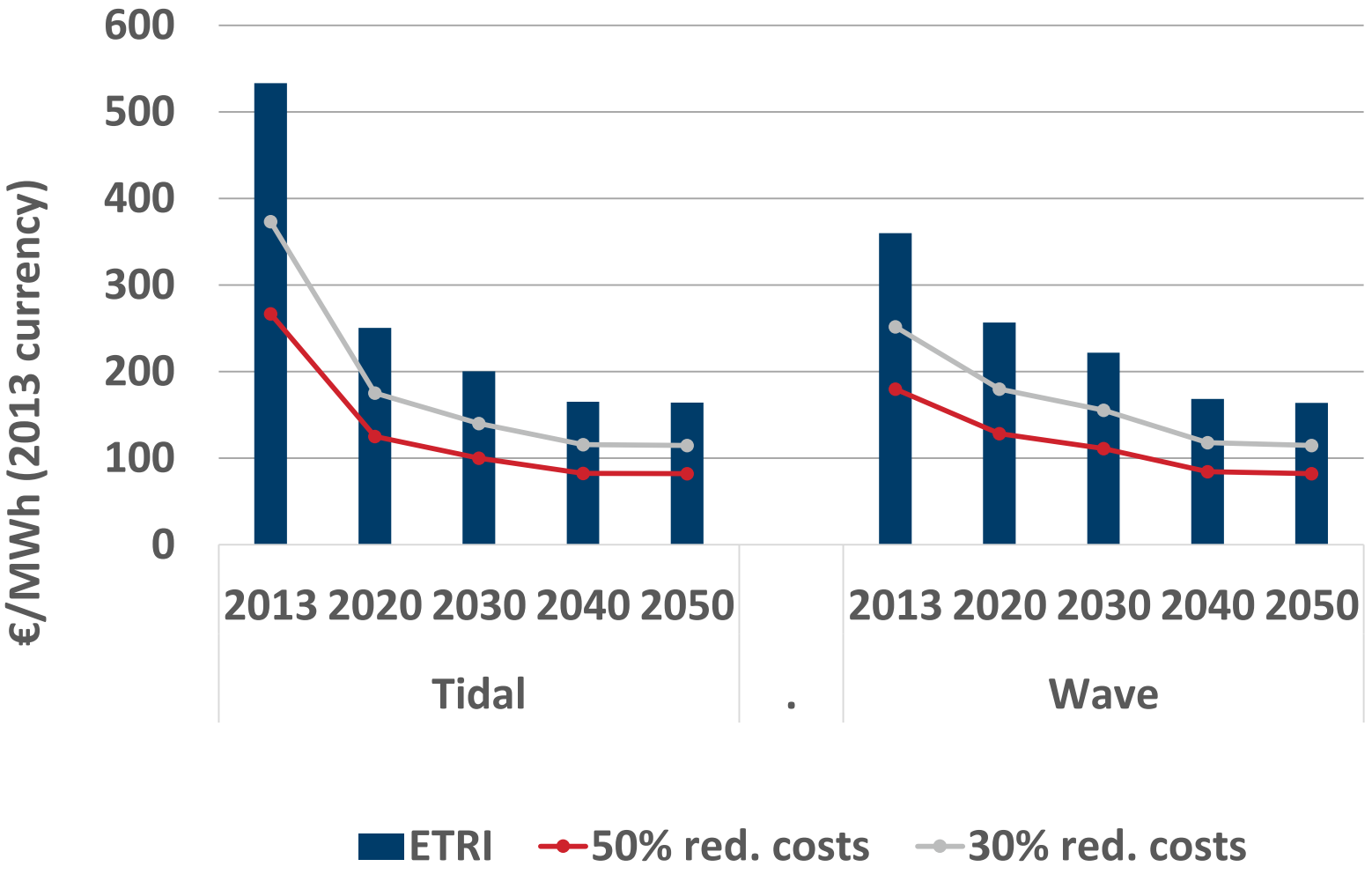
2. Multiple Scenario Analysis

- Multiple scenarios based on different
  - Technology cost profiles
  - Technology availability factors
  - Emission reduction targets

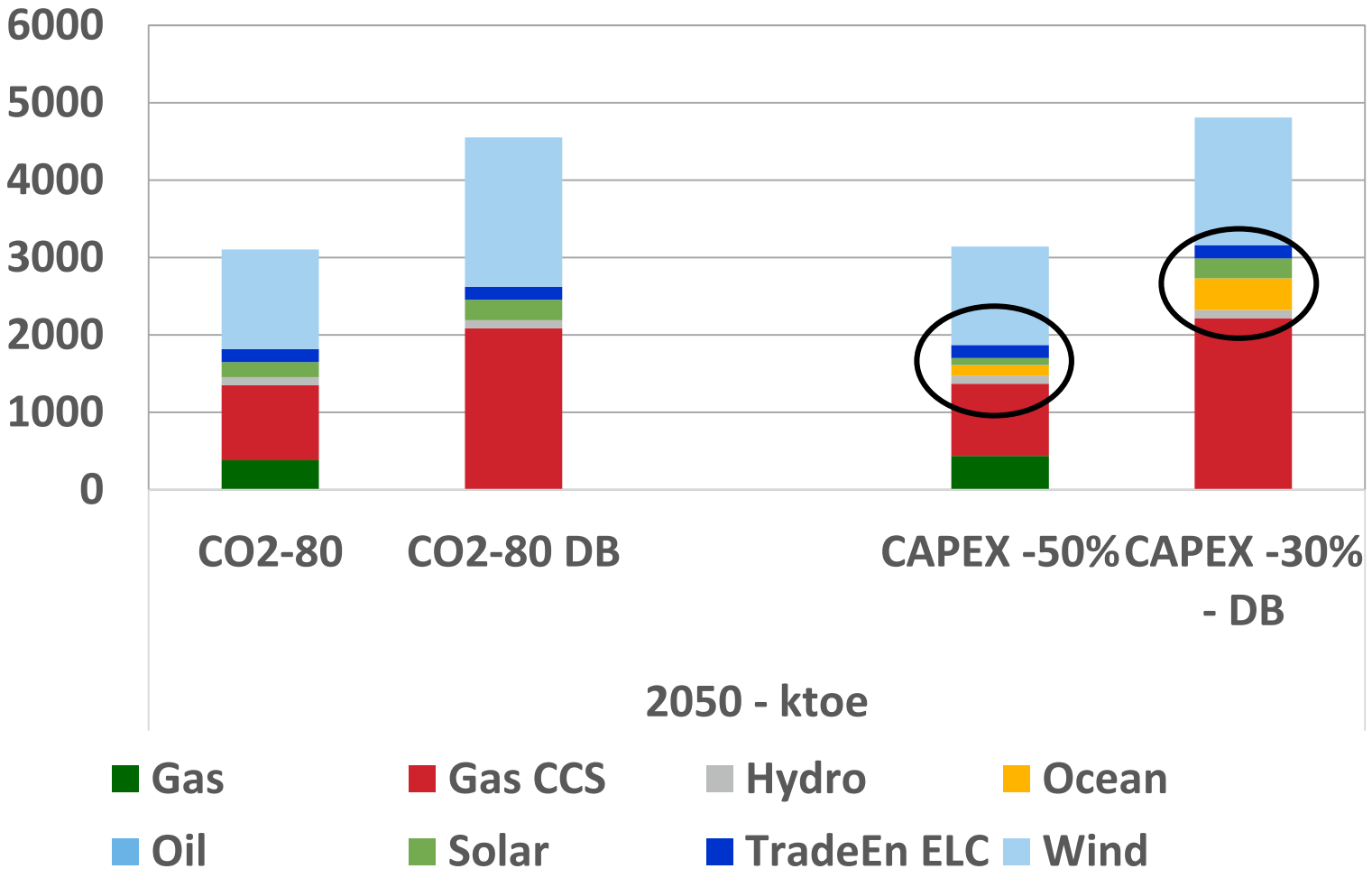
- What technologies are installed in many scenarios?
  - Resilient technologies
  - E.g. Onshore wind energy

- What technologies are installed in few scenarios?
  - Niche technologies
  - E.g. Wave and tidal energy

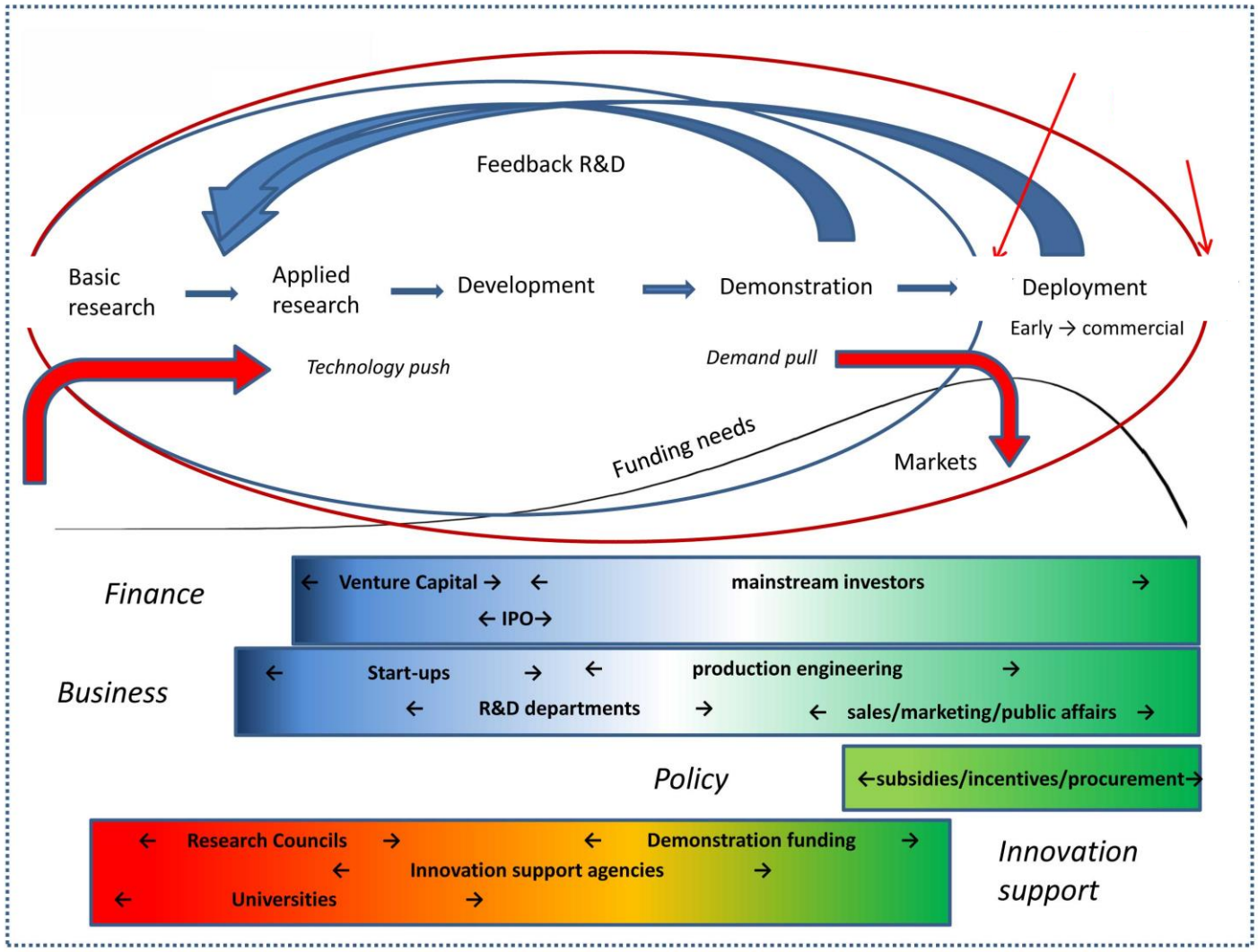
4. Niche Technologies



4. Niche Technologies



5. Innovation System



Source: Imperial University

5. Innovation System - Functions Analysis

Functions	Examples of indicators
Influence on direction of search	Numbers of key policies, targets, etc
Knowledge development	R&D, TRL development, learning curves, etc
Knowledge diffusion	Networks of learning, public/private collaboration, training, etc
Market formation	Market support mechanisms, new entrants, etc
Entrepreneurial activity	Start-ups, mergers, etc
Resource Mobilization	Finance capital, human capital, etc
Legitimation	Alignment of interests for all stakeholders

Mission Innovation

- Multiple Scenario Analysis
  - E.g. TIAM energy system model
  - Range of prioritisation scenarios based on historical investment
  - Range of technology learning assumptions/formulae for different technologies
- Resilient technologies/scenarios
- Tipping point technologies/scenarios
- Niche technologies/scenarios
- Innovation System Analysis
  - Are the model assumptions too heroic?

Thank you

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