Accelerating the Deployment of Offshore Renewable Energy Technologies

IEA Implementing Agreement on Renewable Energy Technology Deployment

RETD

IEA - RENEWABLE ENERGY TECHNOLOGY DEPLOYMENT

The mission of RETD is to accelerate the large-scale deployment of renewable energies

RETD stands for "Renewable Energy Technology Deployment".

RETD is a policy-focused, technology cross-cutting platform that brings together the experience and best practices of some of the world's leading countries in renewable energy with the expertise of renowned consulting firms and academia.

- Created in 2005, RETD is an Implementing Agreement that functions under the legal framework of the International Energy Agency.
- Currently 10 countries are members of the RETD: Canada, Denmark, France, Germany, Ireland, Italy, Japan, the Netherlands, Norway and the United Kingdom.
- RETD commissions annually 5-7 studies. The reports and handbooks are publicly and freely available on the RETD's website at www.iea-retd.org.
- In addition, RETD organizes at least two workshops per year and presents at national and international events.

Agenda

- Objective, Scope and Context
- Costs
- Barriers
- Model Policy Framework
- Project Development Guidelines
- Conclusions and Recommendations

The study aims to foster offshore renewable energy technologies deployment.

- In 2010, RETD appointed Mott MacDonald (http://www.mottmac.com/) to support its role of assisting policy makers and project developers to better understand the specifics of offshore renewable energy and to give them practical guidelines on how to foster its deployment.
- The report focuses on the ten RETD member countries (Canada, Denmark, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, UK) as well as eight other countries which have shown activity in the marine renewable industry (Belgium, China, Finland, Portugal, Spain, Sweden, Taiwan and USA).
- Offshore wind, wave and tidal technologies are covered in this study.

Offshore renewables can contribute significantly to world energy generation, under the right conditions.

- **World energy consumption in 2009 reached 17,000 TWh/year.**
  - Growing demand is expected to continue to create a significant burden on global resources, while...
  - ...having a negative impact on the environment, and
  - ...exacerbating energy security and reliability issues.

- **World theoretical resource for offshore renewables is 260,000 – 330,000 TWh/year,**
  - … although practical potential will be lower (the global figure is not yet estimated).
  - Offshore renewables can significantly contribute to the energy mix in the medium to longer-term, should the right political and economic conditions exist.
  - This will help minimize further depletion of global resources and negative environmental impacts,
  - ...while increasing energy security and reliability and creating economic opportunities.

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Offshore wind is already commercial, wave and tidal technologies are reaching full scale demonstrators

Prinses Amalia Wind Park (formerly Q7)

Source: Mott MacDonald

- **Commercial offshore wind projects have been operational since the 1990s.**
  - 45 offshore wind farms are operational (Jan 2011)
  - Cumulative installed capacity is 2964 MW at the end of 2010
  - High growth industry but still maturing
  - Future advances: further offshore, deeper waters, larger machines with new technologies
- **Wave and tidal devices are still being developed, with no clear front runner.**
  - 10 pilots projects are operational to date
  - At different stages of development
  - Large scale prototypes currently being tested
  - First arrays (up to 10 MW) planned for 2012

Risks can be mitigated to help project development

- Offshore renewables have higher risks than onshore technologies
- Complete removal of these risks is not feasible
- Mitigation measures can reduce risks to acceptable levels for development

Oyster 1 Wave Energy Device

Source: Aquamarine Power

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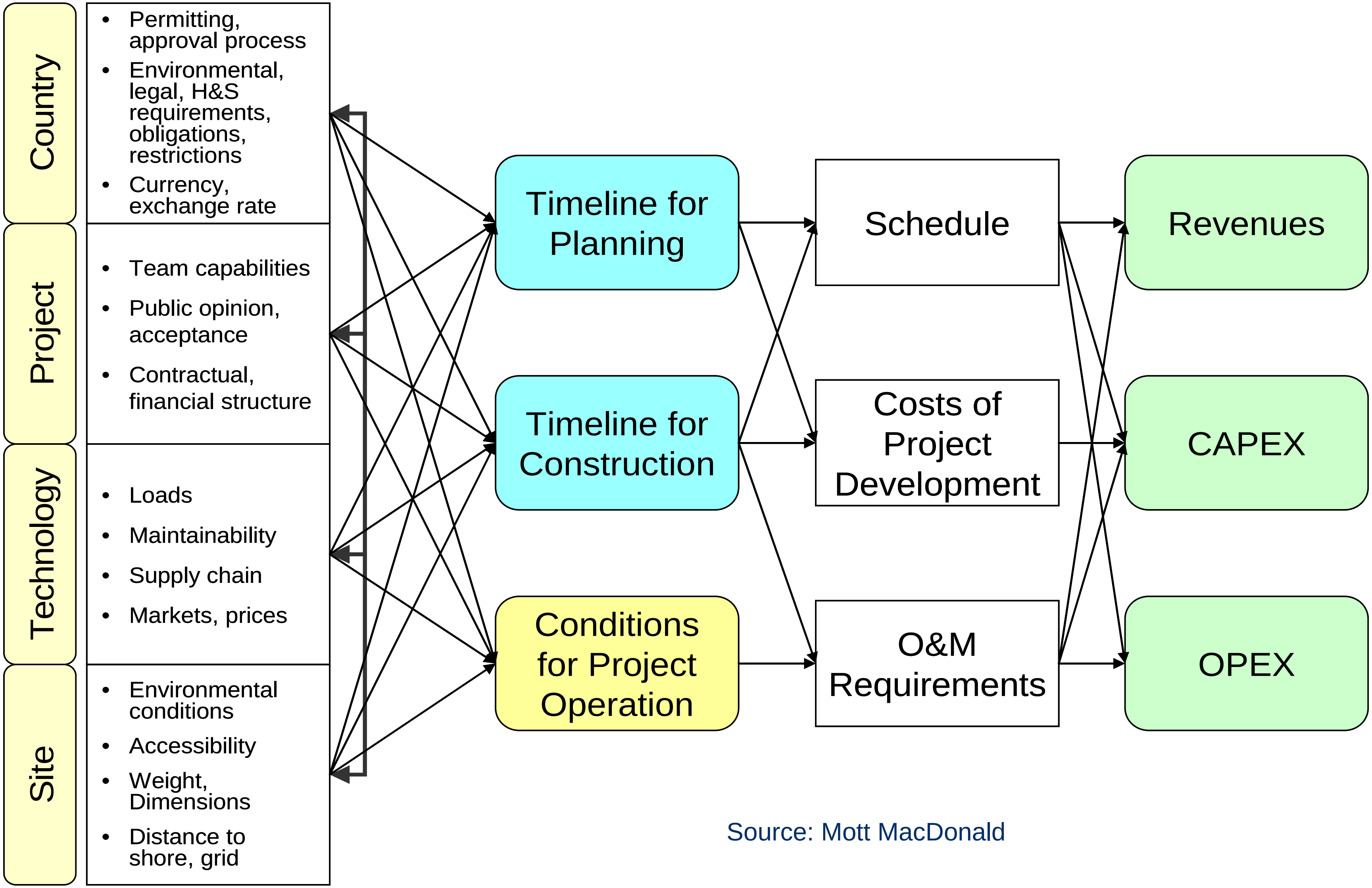
Offshore renewable technologies currently have a high cost of energy (COE).

- **Offshore wind COE** for installed project
  - Current COE: 120-250 €/MWh.
  - Future COE likely to decrease as supply chain develops and learning rates take effect.

- **Wave and tidal COE** for installed project
  - Current COE: high, uncertain and technology dependent.
  - Future COE (first arrays and small farms):
    - Wave: 140-530 €/MWh
    - Tidal: 110-220 €/MWh

- **Current wholesale power prices**:
  - EU: 45-65 €/MWh
  - USA / Canada: 40-60 $/MWh

Costs: key variables to project cost structure



Source: Mott MacDonald

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Offshore renewable energy technologies face a large number of barriers and challenges.

- Access to **financing**
- Lack of **long term or stable policy** commitment and market opportunity
- **Complex planning and permitting**
- Lack of adequate funding for **Technology RD&D**
- Others, including
  - **Health & Safety** issues
  - **Environmental** challenges
  - Competing **sea usage**
  - **Supply chain** issues
  - **Skills** shortages

Thanet offshore wind farm

Source: Mott MacDonald

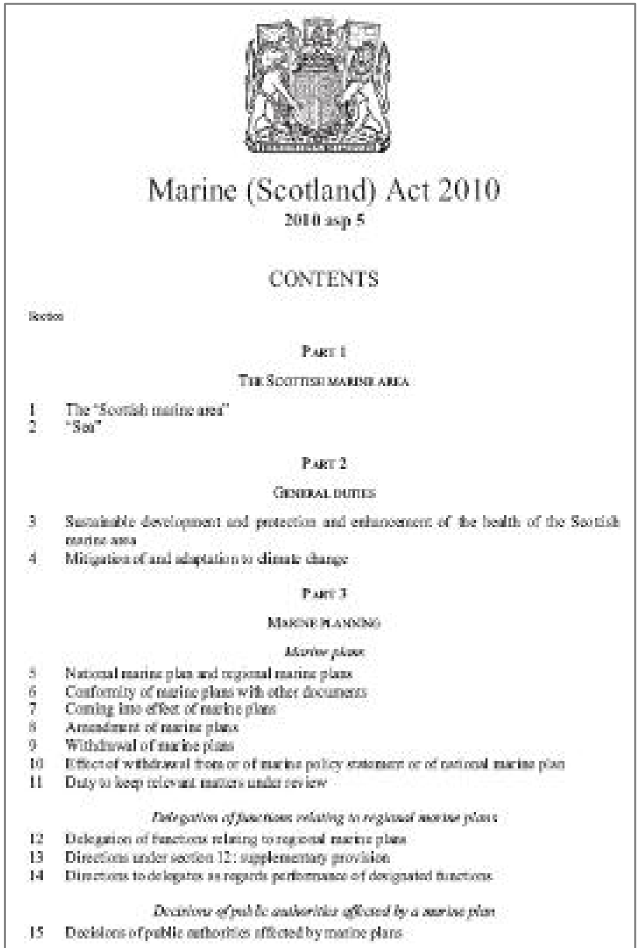
Financing of marine projects is the biggest barrier for their deployment.

- A combination of financial support mechanisms is required:
  - RD&D public and private funding,
  - Capital subsidies (market push) and revenue support (market pull)
- The scope, size and duration of support mechanisms are important to bring successful technologies and projects across the “Valley of Death”
- Financing options:
  - Balance sheet financing
    - Debt raised by corporations is cheaper
    - Involve fewer parties
    - Control and risk remain with owner
    - Capital intensive
  - Project finance (successfully implemented for offshore wind)
    - Greater leverage of owners’ funds
    - More expensive and greater complexity
    - Some control offered to lenders

Lack of long term, stable policy and inadequate level of financial support is a key barrier

- Developer and investor confidence is negatively affected by changing environment created by short term, unstable policies
- Levels of financial support (feed in tariffs or tradable certificates) often insufficient resulting in investors and developers seeking less risky alternatives
- Governments can also support by investing in infrastructure (harbours, grid upgrades)
- Success for offshore wind has happened in countries were these barriers were lifted (Belgium, Denmark, Germany and the UK) resulting in significant deployment

Complex planning and permitting processes can detract interest.



Marine (Scotland) Act 2010
2010 asp 5

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12 Delegation of functions relating to regional marine plans
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15 Decisions of public authorities affected by marine plans

- **Prescriptive planning conditions** limit project and technology options, potentially causing an increase in project costs and timescales.
- **Regulatory barriers** delay upgrades in infrastructure (onshore and offshore grid) leading to increased deployment timescales.
- **Streamlined applications**, one-stop shops and pre-permitted areas have proved successful where deployment has been achieved.
- **Allocation of seabed rights** to the right developers, with clearly defined milestones, is important to minimise the wasted areas occupied by projects that are not progressing.

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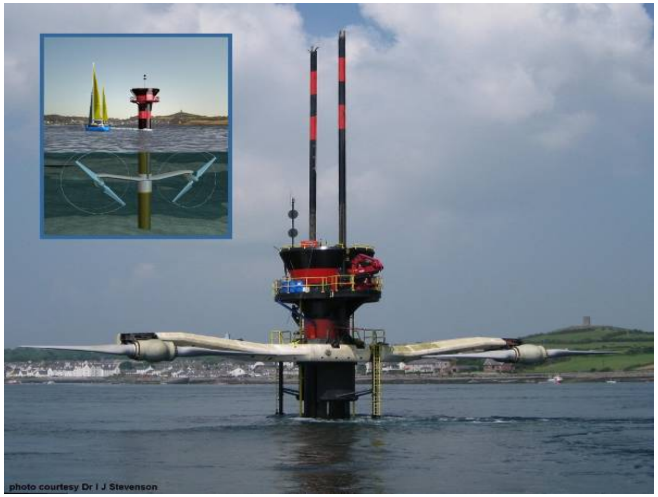
Key technical challenges are shared by all offshore renewables.

- Technical challenges:
  - Technology (more advanced models for offshore wind, reaching commercial stage units for wave and tidal)
  - Design optimisation
  - Reliability
  - Installation
  - Operation and maintenance
  - Grid connection (onshore and offshore grid) and integration
  - Decommissioning
- Technical barriers are surmountable but impact on cost of energy
- RD&D activities are required to remove, reduce or mitigate technical barriers and lower costs

Seagen 1.2 MW horizontal axis tidal turbine



Source: Marine Current Turbines

H&S, environment, competitive sea uses, supply chain and skills shortages can all be important barriers

- **H&S** risks related to construction and operation in the difficult marine environment
- **Environmental concerns** can cause delays, oppositions and increased costs
- **Competitive sea usages** can lead to reduced development opportunities or opposition
- **Supply chain restrictions** can lead to higher costs or delays
- **Skill shortages** can lead to delayed projects and increased risks

Substation installation by floating crane at EnBW Baltic 1 offshore wind farm

Source: Mott MacDonald

Focus on continuing removal of barriers…

- **Permitting:**
  - One-stop agencies instead of large number of government agencies
  - Clear permitting requirements from the start
  - Definition or identification of suitable offshore development zones
- **Access to capital:**
  - Funding of pilot project together with private firms
  - Support mechanisms for early investment (tax breaks, grants for device development, underwriting of projects)
  - Government financing body to support commercial lending
- **Support for early development:**
  - Measuring campaigns, seabed surveys and other measurements
  - Clear development milestones so sites are not reserved for projects that will not materialise

Focus on continuing removal of barriers…(Cont'd)

- **Grid connection:**
  - Clear arrangements for the provision of suitable grid connection (onshore and offshore)
  - Adequate commercial recourse if not available on time
- **Supply chain creation and development:**
  - Funding for device, foundation, mooring and other services development
  - Provide suitable manufacturing bases and harbours
  - Create centres of excellence
  - Support conferences, seminars and other networking

Bremerhaven port current facilities and planned extension for offshore wind

Source: offshore-windport.de

Focus on continuing removal of barriers…(Cont'd)

- **Skills development:**
  - Identification of skills shortages
  - Active promotion of career opportunities, training facilities and courses

- **Health, Safety and Environment:**
  - Outline clear environmental requirements in line with Equator Principles
  - Mitigation of environmental barriers could be addressed by early, open engagement with the relevant stakeholders, appropriate marine spatial planning and adoption of EIA recommendations
  - Adopt internationally accepted H&S guidelines, promote strong industry culture, staff training, best practices and technical innovations

Flexible support mechanisms that are proportional to risk undertaken and overall desired capacity are needed.

- Phased tariffs with pilot projects implemented in calmer waters to enable lessons to be learned – later projects receiving less support once learning has occurred
- Flexible tariffs based on resource, water depth, distance from shore
- Tendered capacity model whereby tariffs are bid to develop projects at particular sites

Installation of Beatrice offshore wind farm

Source: Mott MacDonald

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Model Policy Framework

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Investment opportunities

Innovation and competition

Strategic Policy Framework

-long-term, consistent regulatory policy

- compulsory GHG reduction targets

- energy security, diversification policy

- technology deployment policy

Open electricity markets

Planning and permitting

Access to grid

Environmental and social impacts

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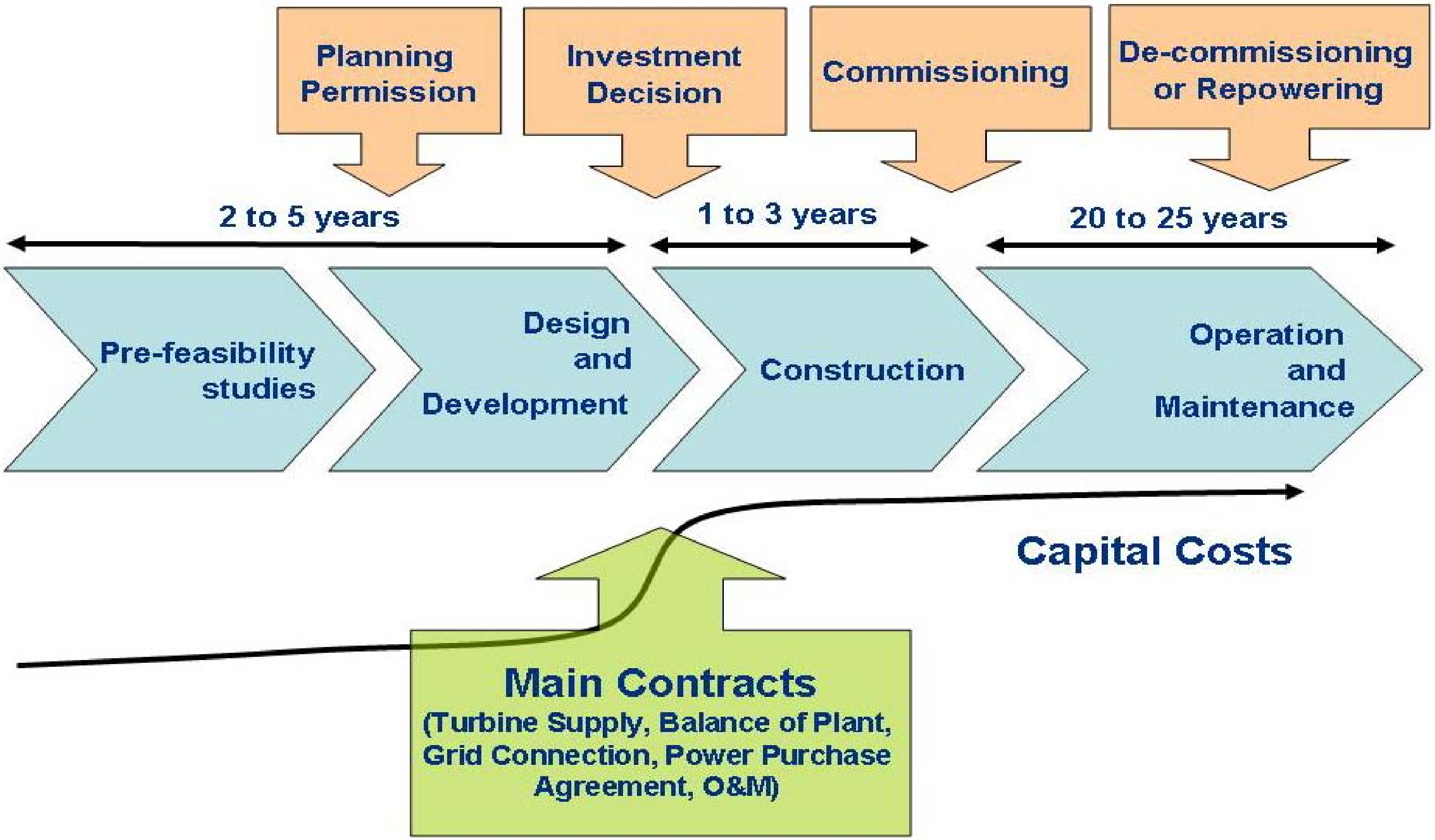
Follow best practices at all stages of project development



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Conclusions

- Offshore renewable technologies can play an important role in meeting policy objectives of cleaner and more secure sources of energy combined with economic opportunity.
- Offshore wind is the front runner with a number of commercial projects already in operation; wave and tidal technologies are reaching full scale demonstrators stage.
- The offshore industry is far from being mature and offshore renewable technologies remain costly and require financial support mechanisms.
- Barriers remain, but mitigation measures exist.
- Each country or region faces unique circumstances that shape their decision to support or not the development of offshore RET and projects.

Conclusions (Cont'd)

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- A model policy framework is suggested that can be used by countries or regions already involved in or considering the development of an offshore RE programme.
- An effective policy framework requires strong and visible support from governments and government agencies to emphasize the commitment to the industry.
- The governments' support can be phased out gradually as technologies mature and risks are reduced.
- Project developers should follow best practices for each stage of projects' lifecycles to minimise risks and reduce cost overruns.

For additional information on RETD

Online: www.iea-retd.org
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Full Report and Appendices are available to download at: www.iea-retd.org

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