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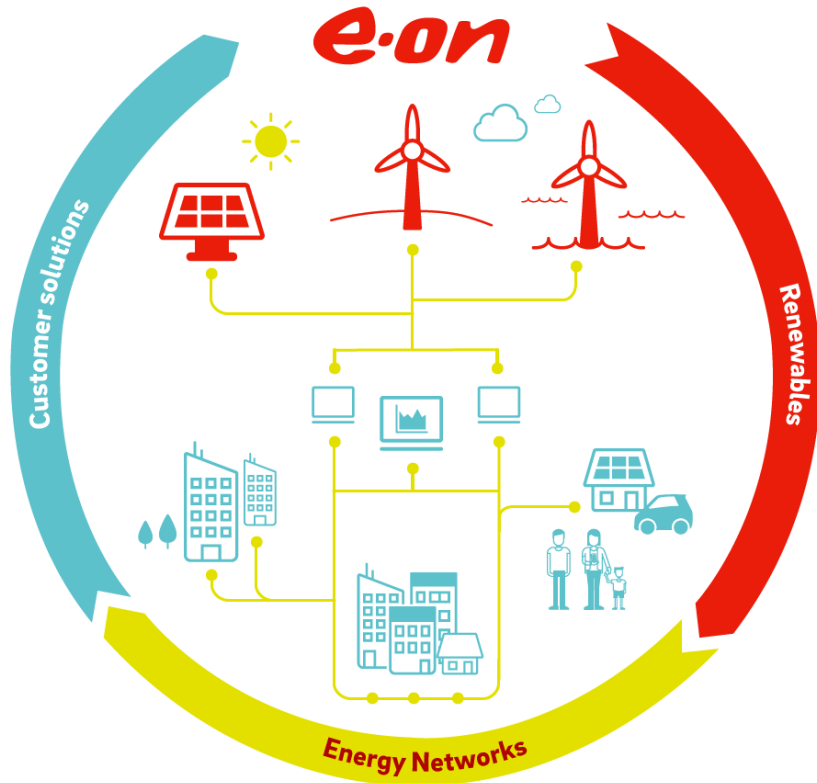
Setting the Pace in
Renewable Energy

An Energy Utility Perspective and Approach to Airborne Wind

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Henrik Wall

Freiburg
06.10.2017

Renewable energy is one of the three key pillars in E.ONs strategy



Global trends like sustainability and climate protection, digitalization and technological innovation are altering the energy landscape. At the same time our customers' energy needs are changing.

A new energy world – decentralized, green, and interconnected – is emerging. Our core businesses reflect the key energy trends:

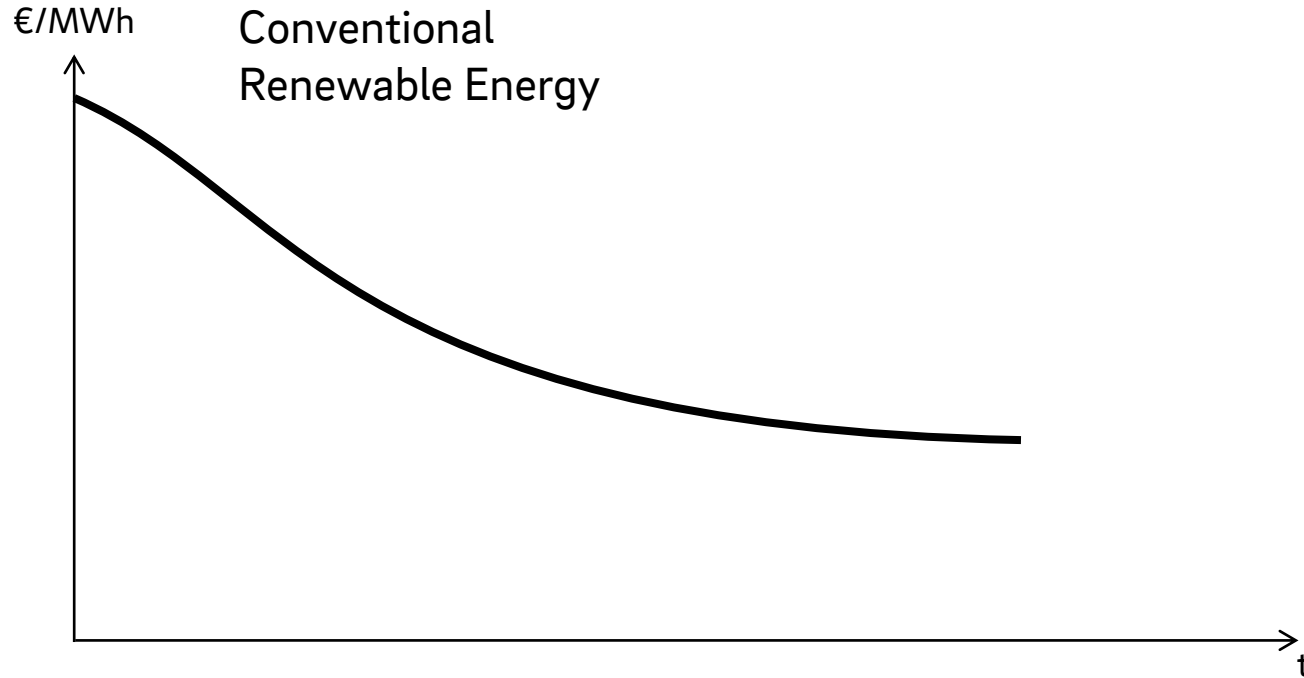
The global growth of **renewables**

The transformation of yesterday's power lines into tomorrow's smart **energy networks**

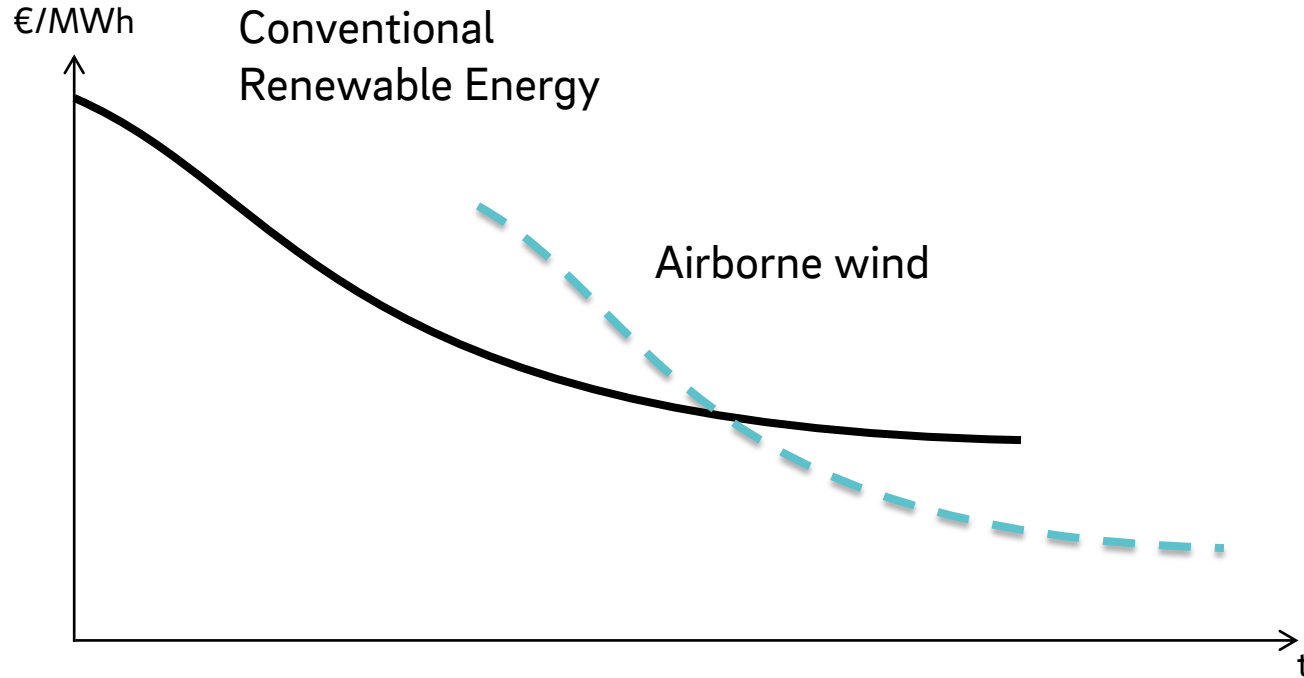
The increasing demand for innovative **customer solutions**

Partner for the New Energy World

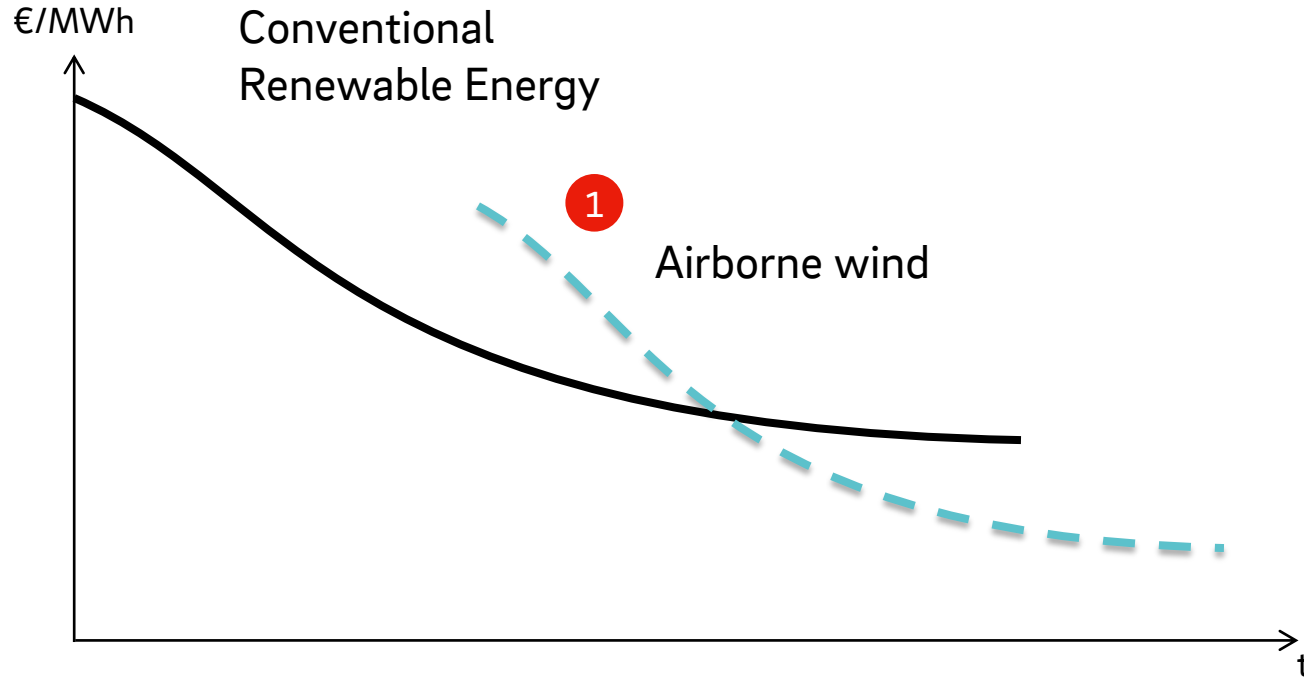
Great cost reduction has been achieved for conventional renewable energy...



Great cost reduction has been achieved for conventional renewable energy, AWE has the potential to make the next jump in the curve

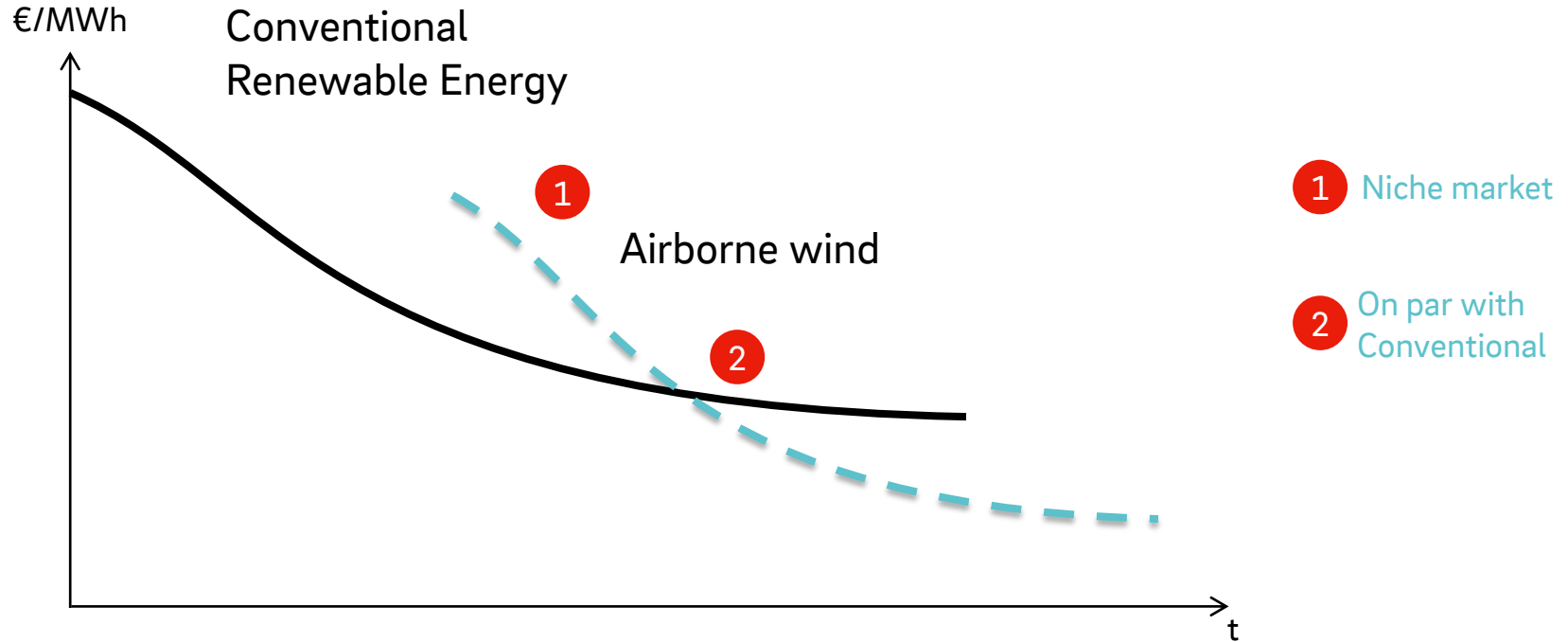


Great cost reduction has been achieved for conventional renewable energy, AWE has the potential to make the next jump in the curve

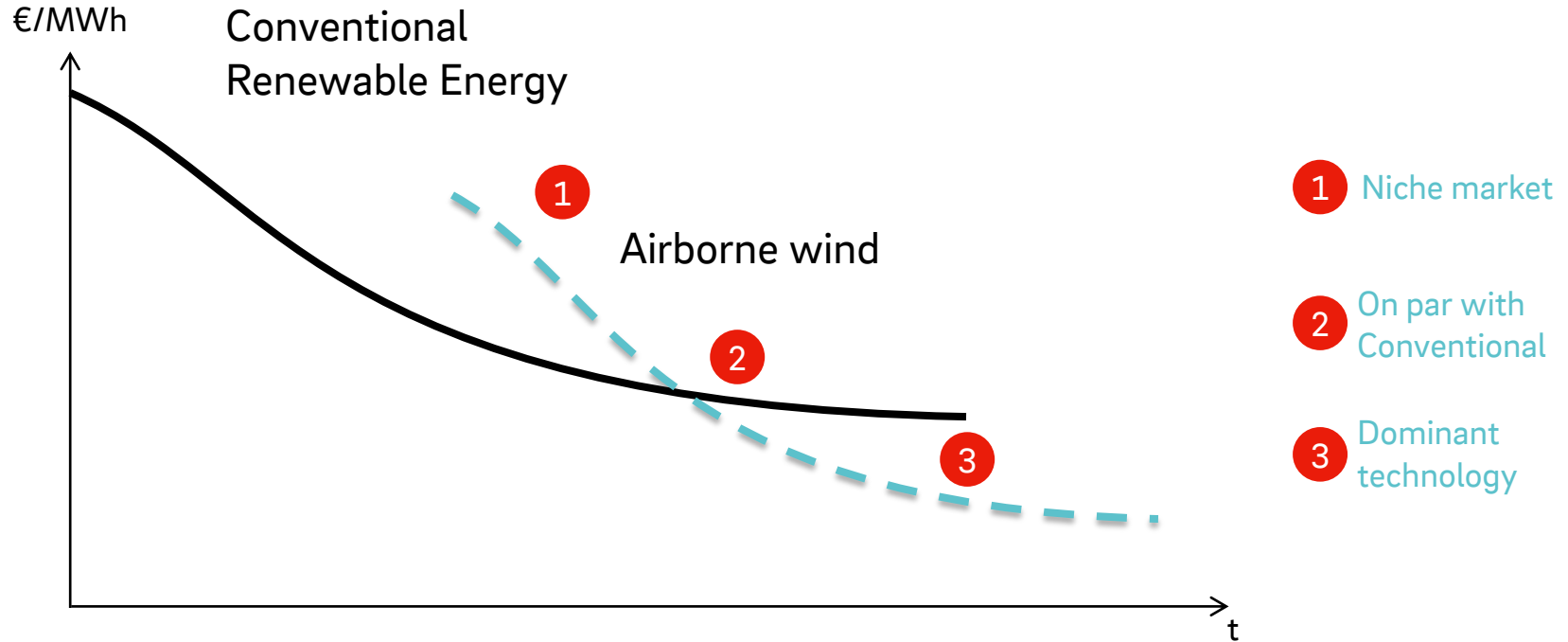


1 Niche market

Great cost reduction has been achieved for conventional renewable energy, AWE has the potential to make the next jump in the curve



Great cost reduction has been achieved for conventional renewable energy, AWE has the potential to make the next jump in the curve



“The only place
SUCCESS
comes before
WORK
is in the dictionary”

- Vince Lombardi

E.ON in the AWE industry



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E.ON supports game-changing technology for wind energy

12/13/16

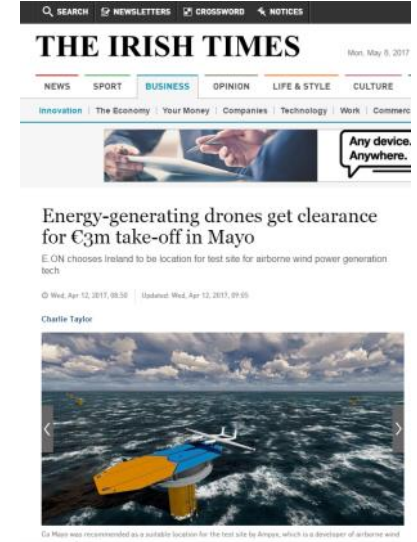
Stake in British company Kite Power Solutions



E.ON fosters the development of a game-changing technology to produce power from wind. The company invested in Kite Power Solutions (KPS). This British start up company secured a new investment of approx. 6 million euro. E.ON invested along with Schlumberger and Shell Technology Ventures.

- E.ON, together with Shell and Schlumberger invested approx. 6M€ in Kite Power Systems
- E.ON committed to invest in development, and if successful, construction and operation of a demonstration site in County Mayo in Ireland
- Entering into a collaboration agreement with Ampyx Power as a first user of the site
- Working together with promising technology developers, research institutes, authorities and legislators
- Attended AWEC 2013, 2015, 2017

<https://www.eon.com/en/about-us/media/press-release/2016/eon-supports-game-changing-technology-for-wind-energy.html>



<https://www.irishtimes.com/business/innovation/energy-generating-drones-get-clearance-for-3m-take-off-in-mayo-1.3045271>

Test Sites scope

Onshore

Purpose;

- Testing and verification of full system behavior
- Power prediction
- Array/wake effects
- Assessment of O&M requirements
- Technology development

Requirements;

- Permits, O&M facilities, Grid connection
- Large, flat area without obstacles
- Restricted airspace ~1 km dome over and around the site



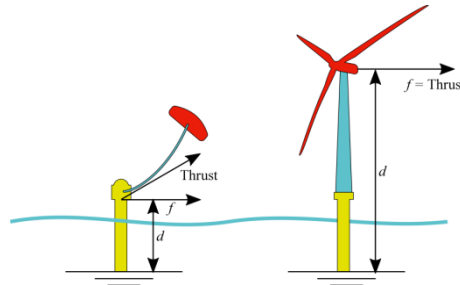
Offshore, conventional foundations

Purpose;

- Testing and verification of full system behavior in offshore environment
- Assessment of regulatory requirements
- Assessment of offshore specific O&M

Requirements

- Permits, O&M facilities, Grid connection
- Fixed sea bed foundations
- Close to shore
- Restricted airspace ~1 km dome over and around the site



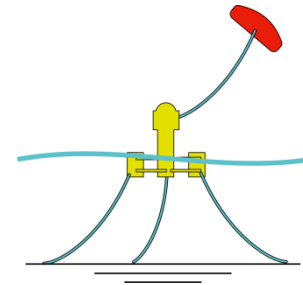
Offshore, floating foundations

Purpose;

- Testing and verification of full system behavior in offshore environment
- Testing and verification of floating foundation concept + airborne wind
- Floating foundation specific O&M (such as towing full system to shore, ..)

Requirements;

- Permits, O&M facilities, Grid connection
- >25m water depth
- Close to shore
- Restricted airspace ~1 km dome over and around the site



There are three stages of the AWE assessment which is designed for different purposes

Early contact

- Governance & company
- History & way forward
 - Technical concept
- Targeted commercialization
- Opportunities to working together

-Days

Test site collaboration

- HSE
- Electrical system
- General system design
- Main components
- If applicable; Offshore specifics

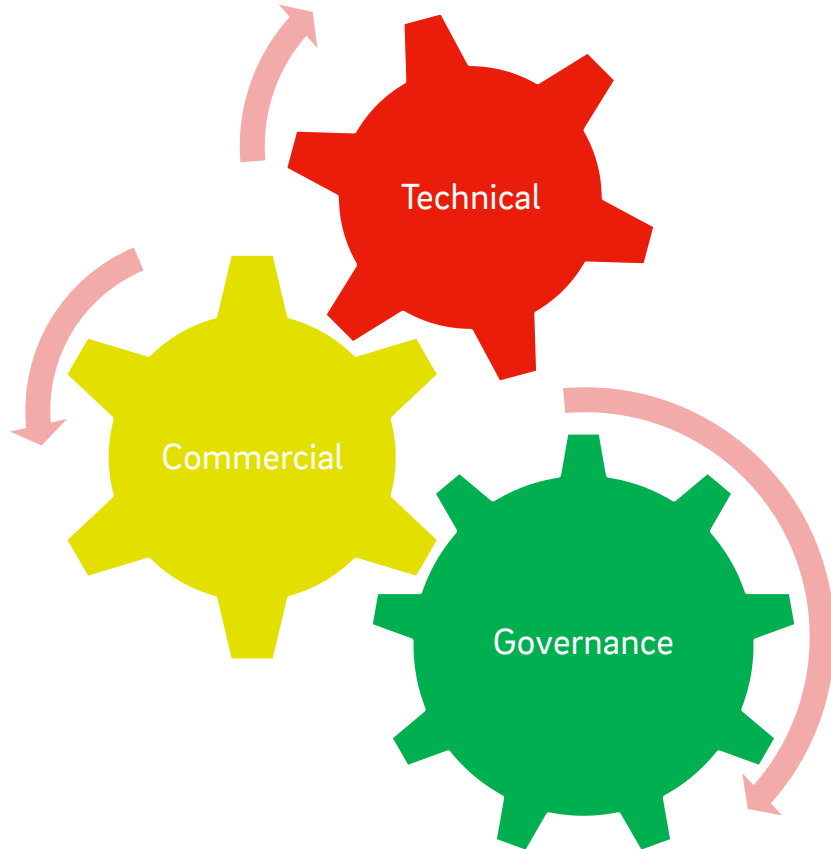
-Weeks

Commercialization

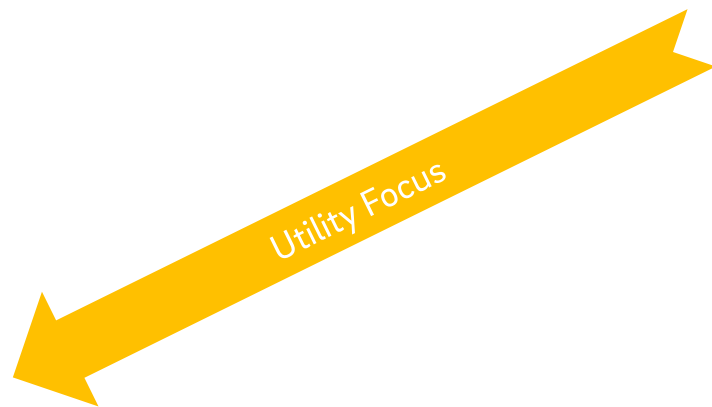
- HSE
- Main components
- Failure rates
- O&M concept
- Supply chain
- Offshore specifics

-Months

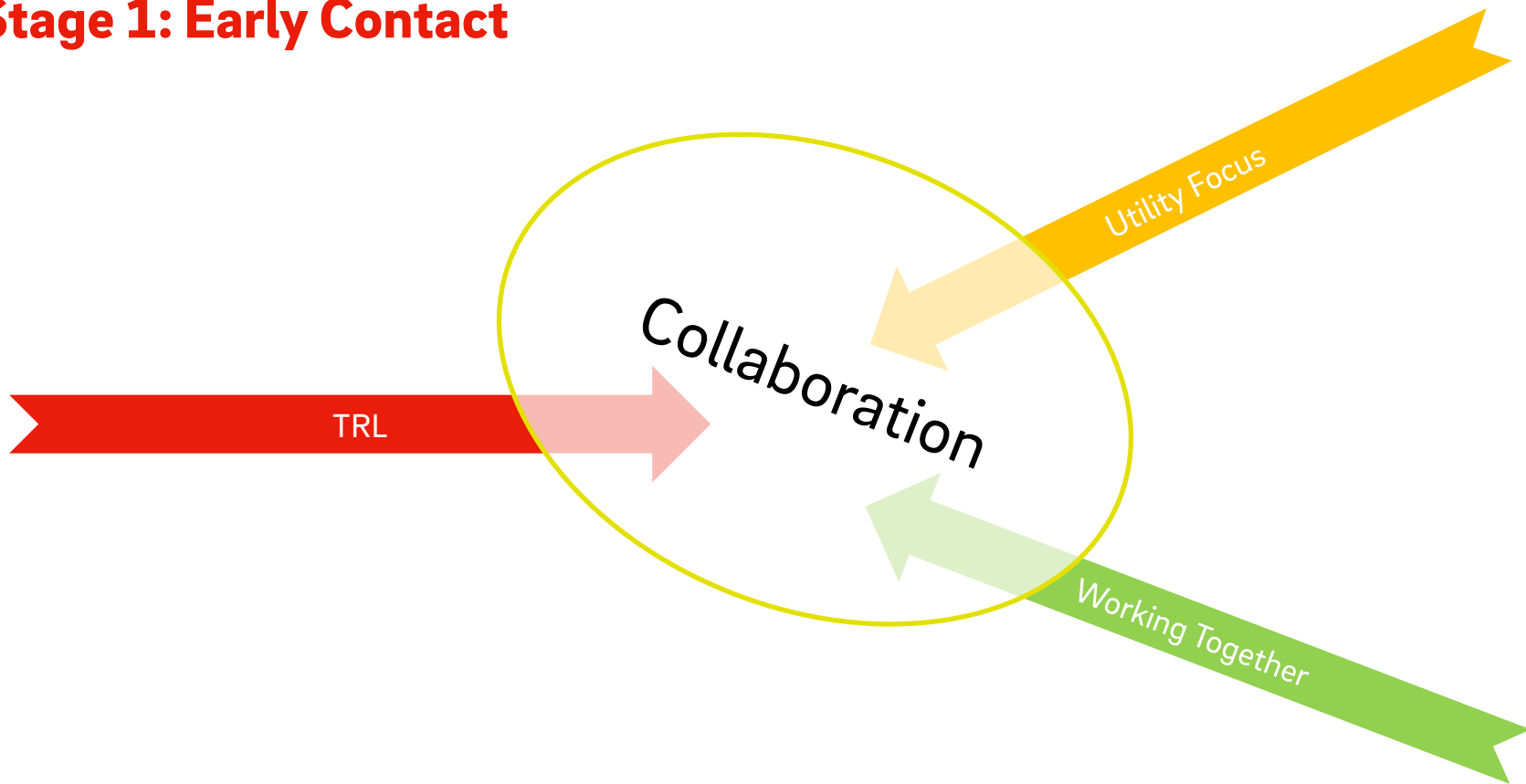
In our assessment we consider three different topics



Stage 1: Early Contact



Stage 1: Early Contact

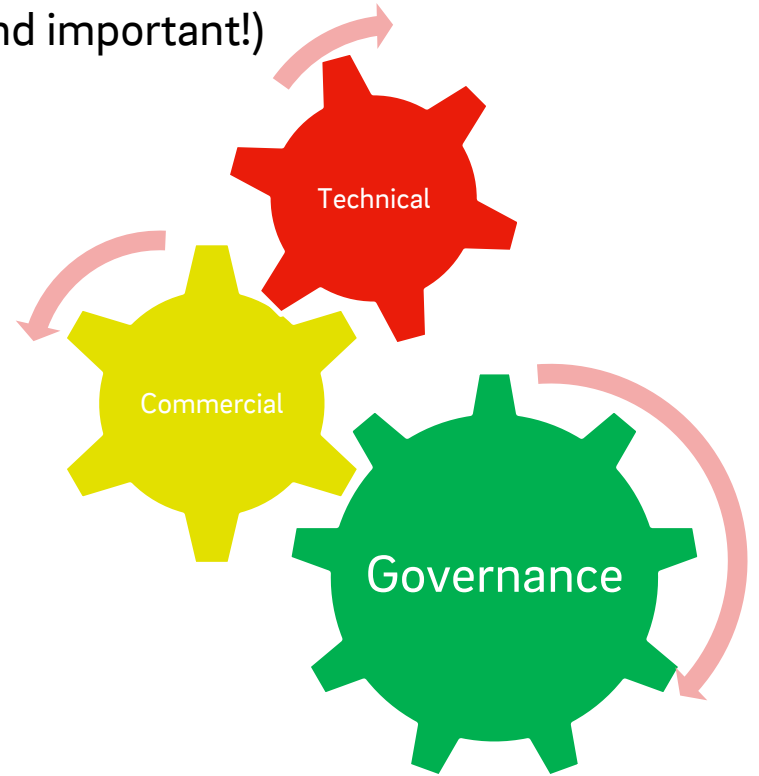


Stage 2: Test site collaboration

Technical and Commercial aspects are “Exciting” (and important!)

But Governance is also vital!

- Approach to HSE
- Standards and certification
- Company structure
- Knowing how to work together

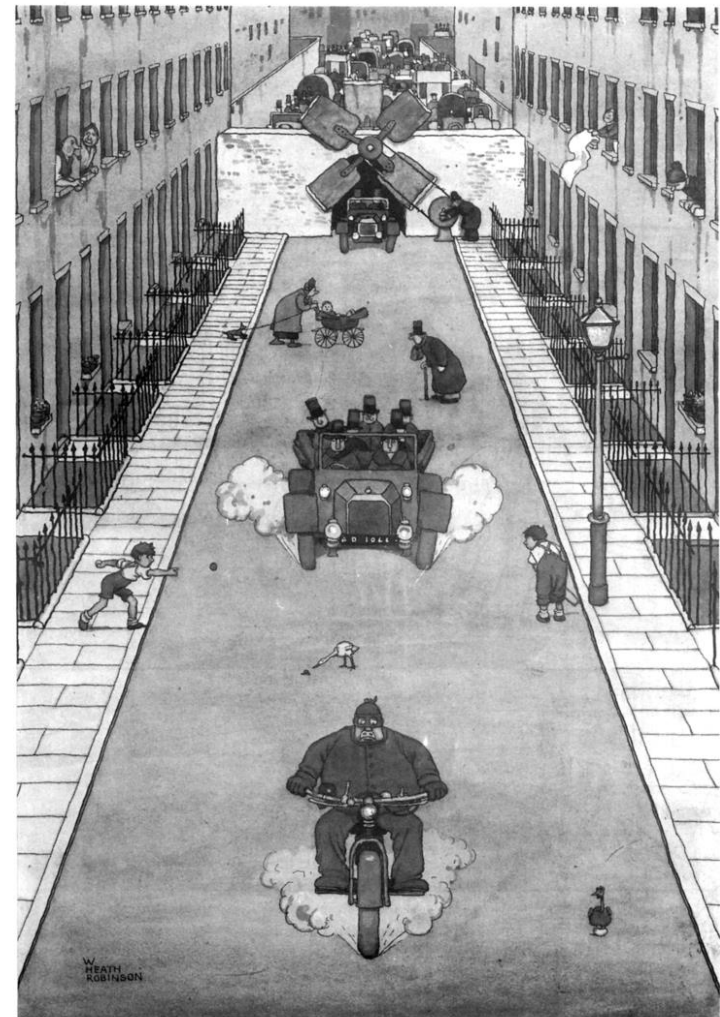
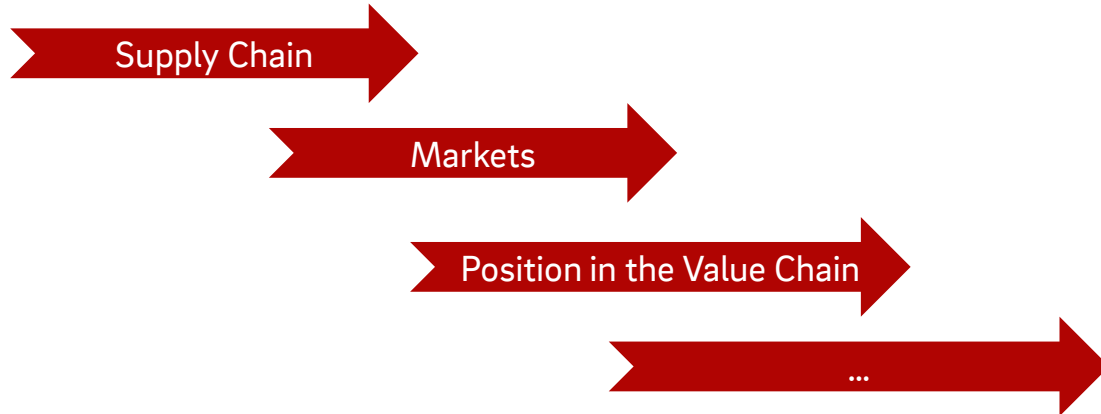


Stage 3: Commercialization

We look forward to seeing kites in our skies.

But there are many obstacles on the road to success.

To take the right direction, AWE companies need to plan the route to commercialization.



The AWE approval assessment consists of 26 different modules

Modules		Topics						
		1	2	3	4	5	6	7
A	AWE Design	General Turbine Characteristics	Main Components Overview	Electrical Performance and SCADA	Tether	AWE Control Basics	Foundation	Airframe
B	Commercial Readiness	Certification Status	Testing and Prototype Status	Supply Chain	Development Questions			
C	HSE	HSE Risk Assessment	Prototype Visit					
D	O&M	O&M Concept	Failure Rates	CMS	Repair	Track record		
E	Quality Assurance (if applicable)	General QA	Factory visit					
F	OFFSHORE specific (if applicable)	Logistics	Foundation	Offshore O&M	Resources during construction and execution – internal Versus external	Typical ground bearing requirements in pre-assembly harbour & layout	Typical installation vessel deck layouts possible	

Conclusions

E.ON see a great potential in AWE

Working with AWE companies – we hope to find the way to success

We can only do this working together



Thank you for listening