INTERNATIONAL RENEWABLE ENERGY AGENCY

IRENA

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Renewable Energy Technologies and Innovation

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Roland Roesch

"Towards a Sustainable Energy Future"
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1 Technology briefs

Present status – IRENA Technology Briefs

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Electricity supply	Thermal energy supply	Enabling technologies	End-use
• Ocean Energy • Concentrating Solar Power • Solar Photovoltaic • …	• Solar Heatin and Cooling residential • Solar heating in industries • …	• Electricity Storage • Thermal Energy Storage • …	• Shipping • Liquid Biofuels • Production of Bio-ethylene • Production of Bio-methanol • …

Power generation - Ocean Energy

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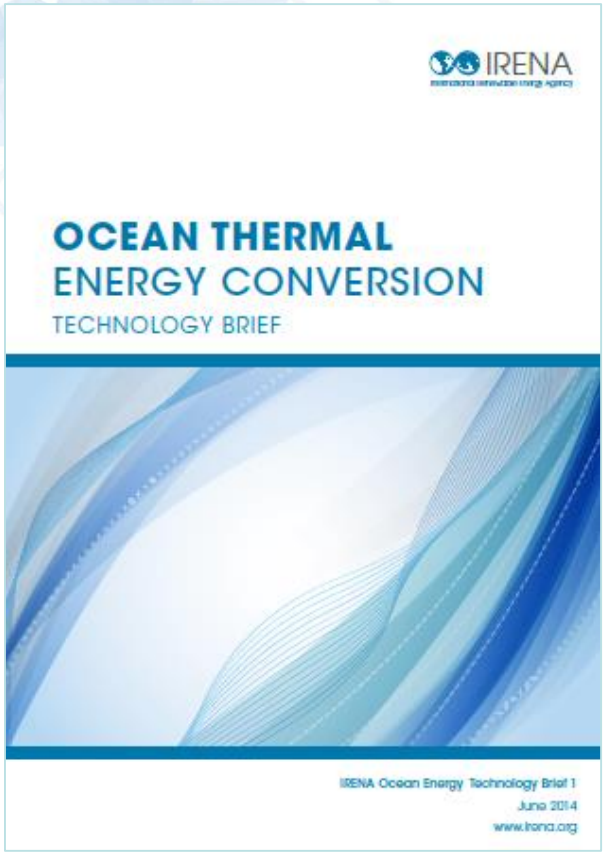
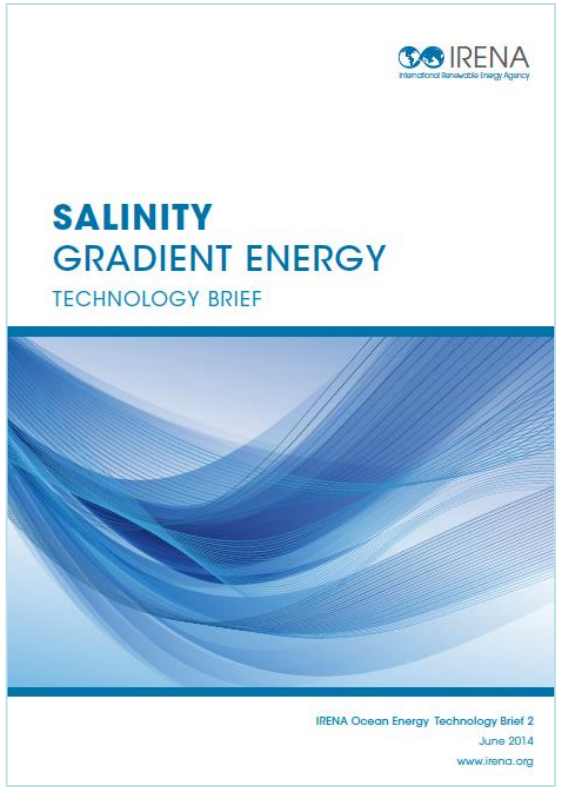
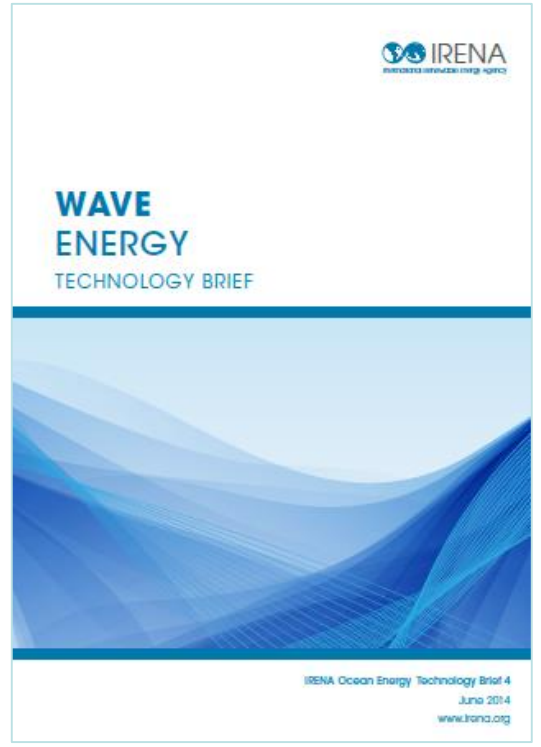
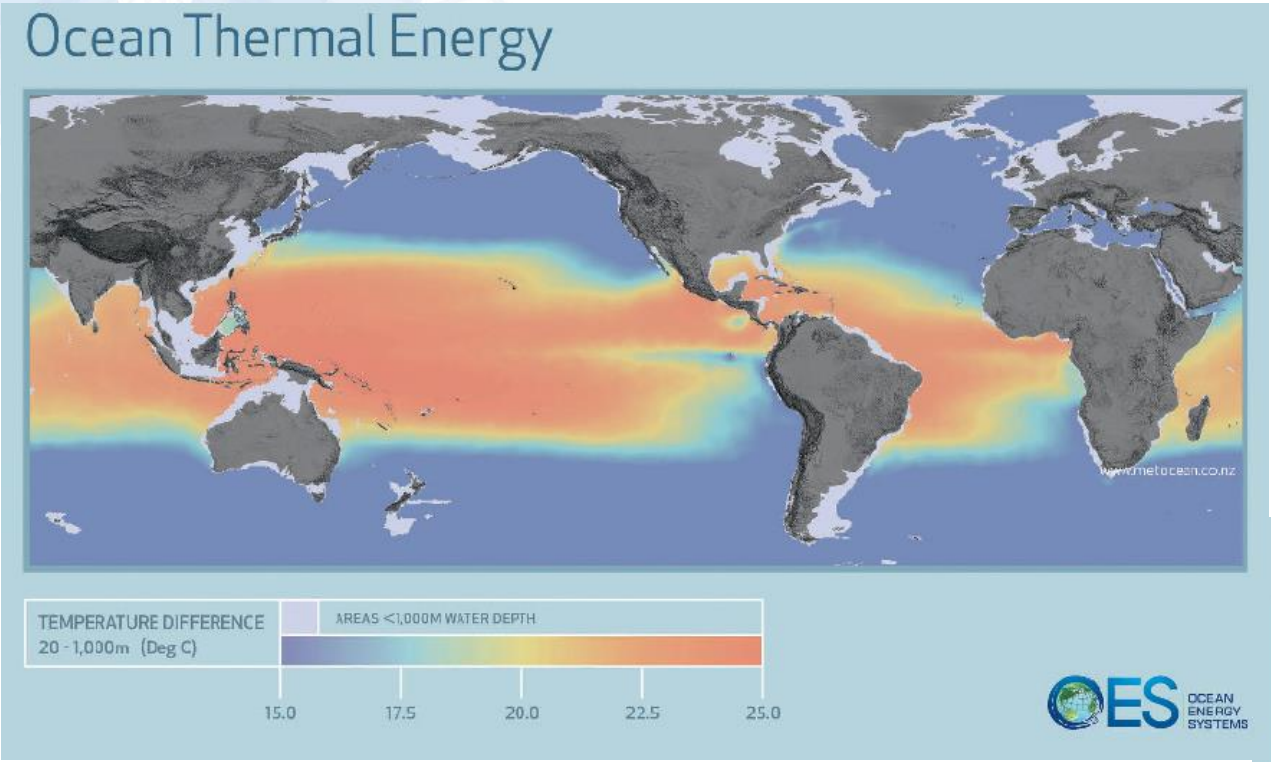
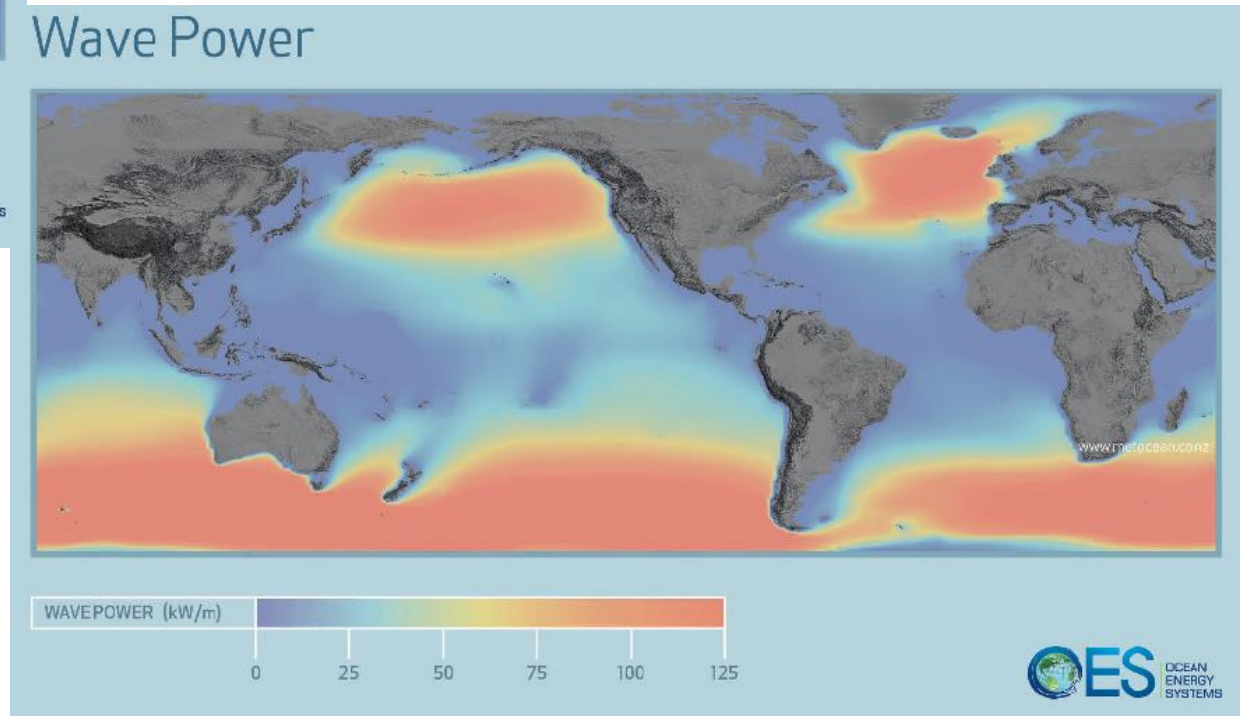






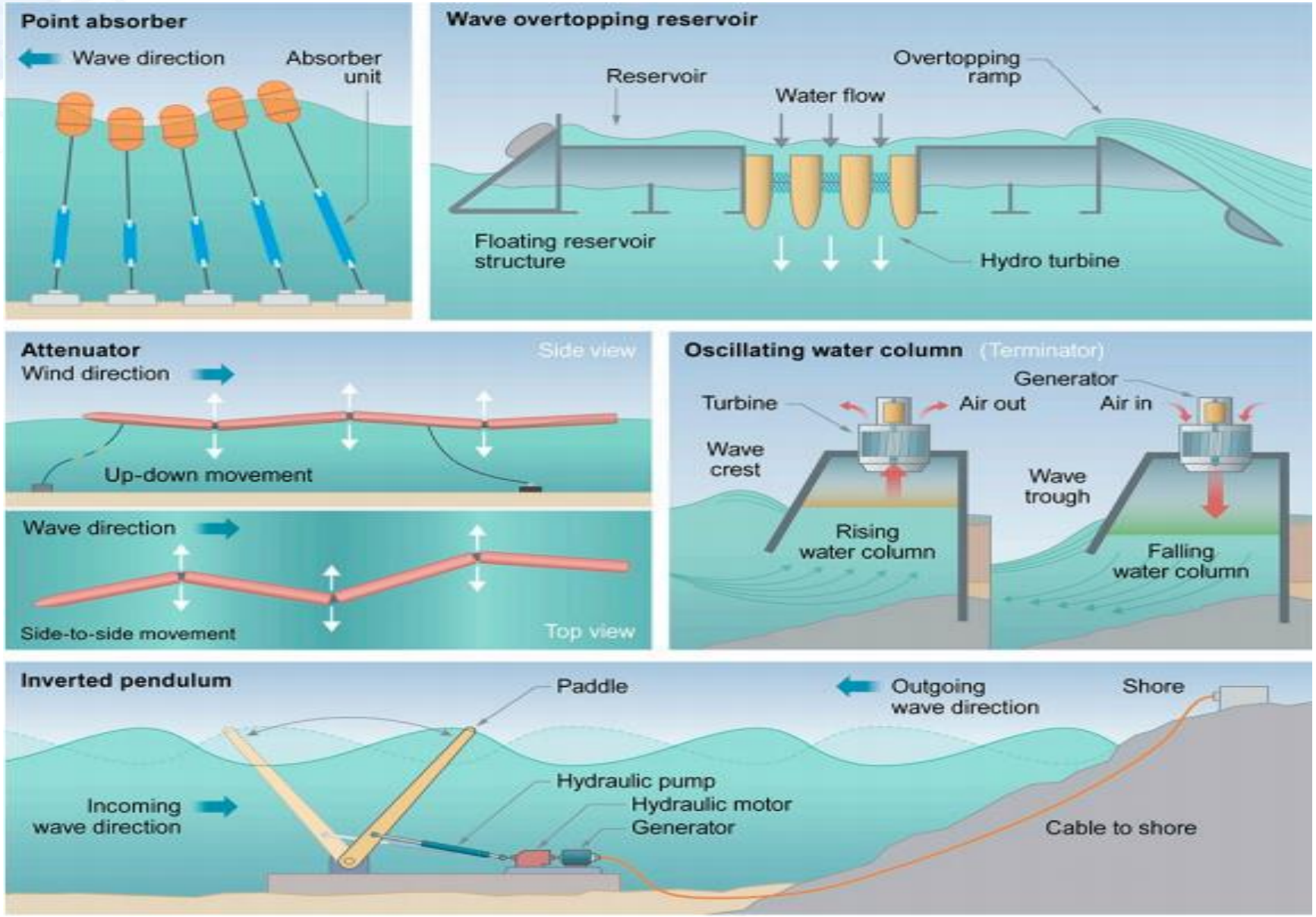
Resources – Ocean Energy





Source: IRENA (2014) Ocean Energy: technology readiness, patents, deployment status and outlook

Wave Energy Conversion Systems



Source: IRENA (2014) Ocean Energy: technology readiness, patents, deployment status and outlook

Wave Energy - indicators

Capital cost [EUR/kW]

- 4,800 – 9,680

O&M Cost [EUR/kW/yr]

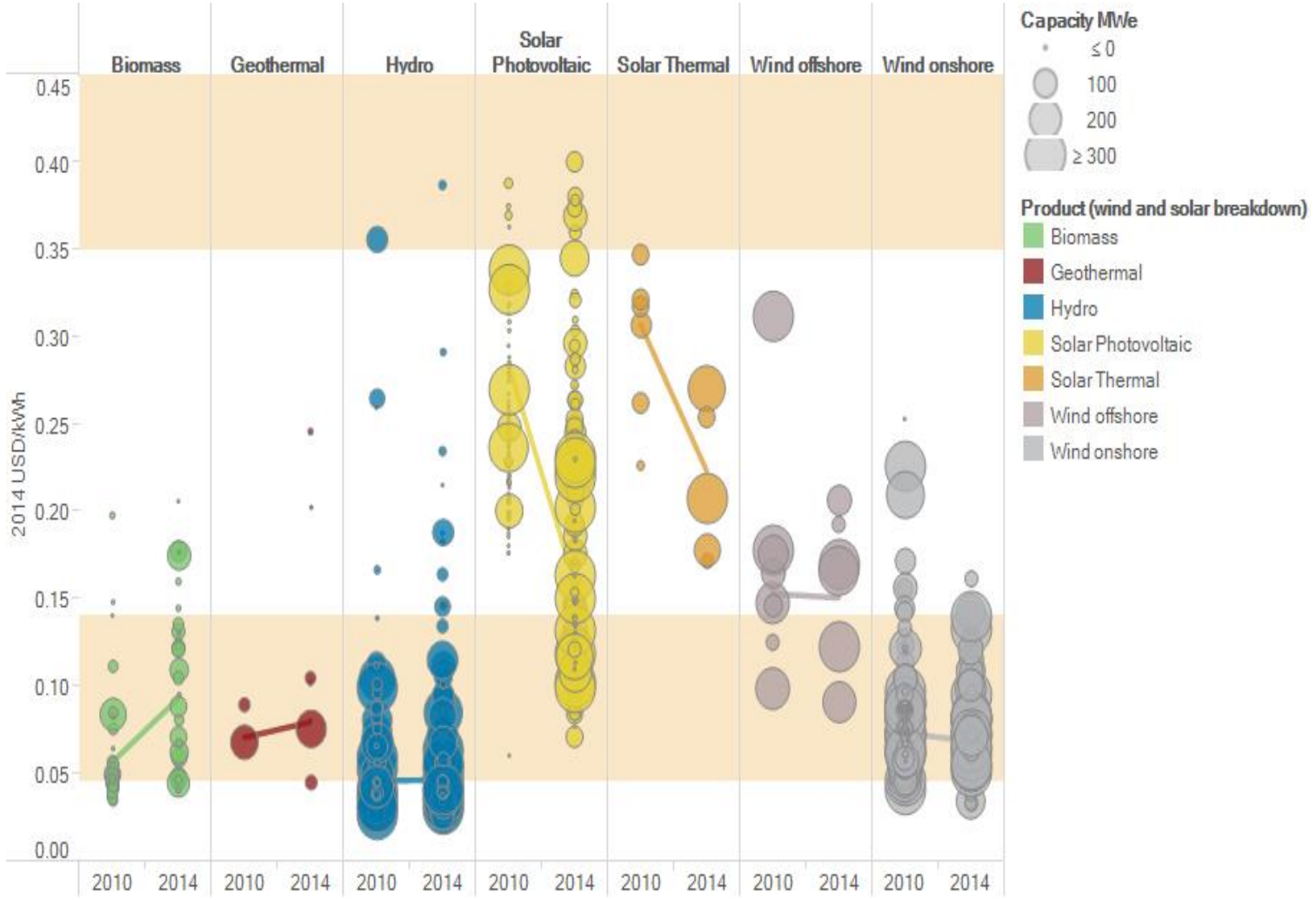
- 48 – 97

Availability [%]

- 75 – 85

LCOE [EUR/MWh]

- 330 – 630



Source: IRENA (2014) Wave energy technology brief

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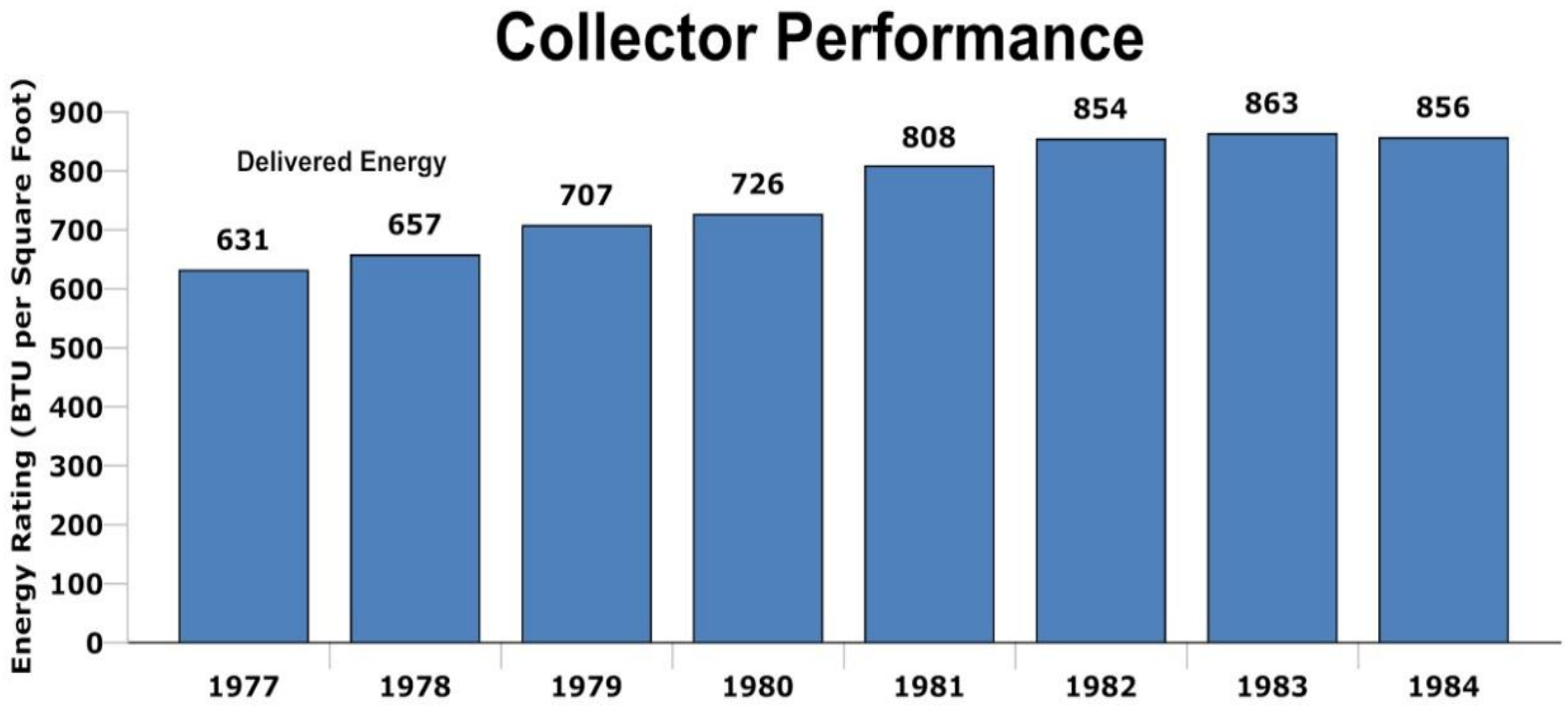
2 Quality and Standards

Market Support – Standards enable benchmarking and further improvement

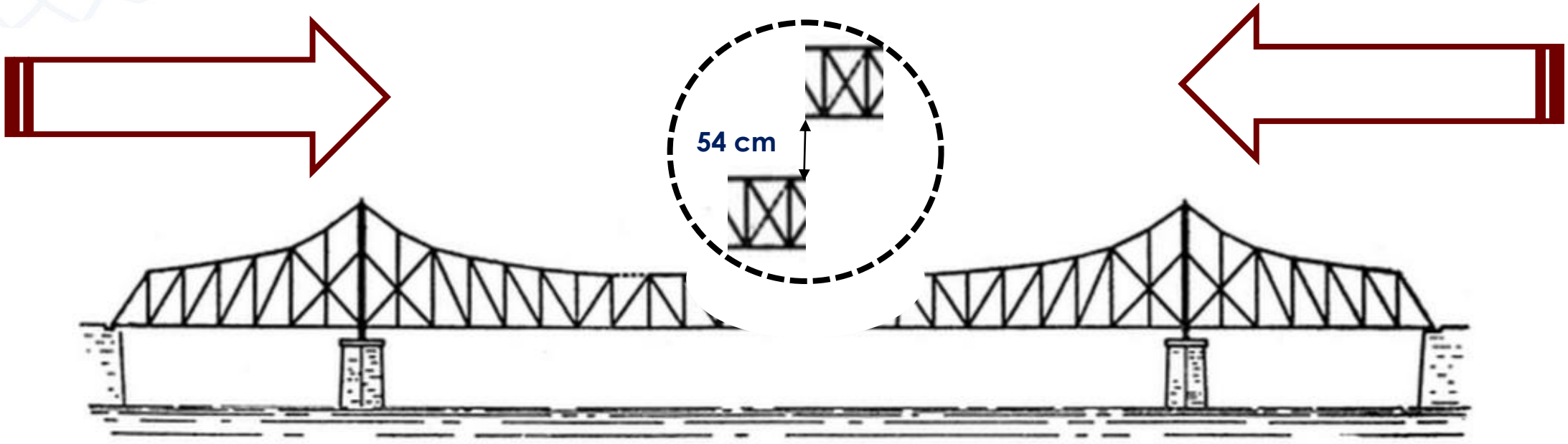
Implementation of quality schemes promotes a faster improvement in technology performance

Solar water heating collectors efficiency improved by 36% between 1977 and 1981 after testing was required in Florida in 1976



IRENA (In Press) "Quality Infrastructure for Small Scale RET"

Harmonisation of standards



Laufenburg bridge between Germany and Switzerland

See level reference:

- Standard used by Germany – North see
- Standards used by Switzerland – Mediterranean see

Adoption of international standards: Power – IEC / Thermal - ISO

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Wind Power

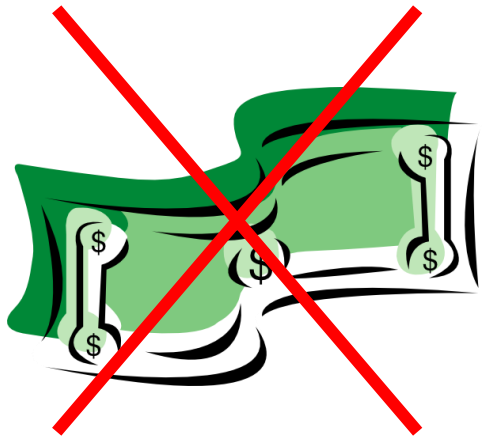
IEC Standard	Standard Title	Status
IEC 61400-2	Wind turbine – Part 2: Small wind turbines for turbines less than 200 m^2	3rd Revision 2013 2nd Revision 2006 1st Revision 1995
IEC 61400-11	Wind turbine generator systems – Part 11: Acoustics noise measurement techniques	2006
IEC 61400-12-1	Wind turbines – Part 12-1: Power performance measurements of electricity producing wind turbines	2006
IEC 61400-14	Wind turbines – Part 14: Declaration of apparent sound power level and tonality values	2005
IEC 61400-22	Wind turbines – Part 22: Conformity testing and certification	2010

Solar Water Heating

Identification of the Standard	Title of the Standard Solar Thermal Products and Components	Status/Comments
Solar Thermal Collectors		
ISO 9806: 2013	Solar energy - Solar thermal collectors - Test methods	Recently revised and published. Considers performance and durability
Solar Thermal Systems		
ISO 9459-3: 2005	Solar heating - domestic water heating systems - Part 3: Outdoor test methods for **system performance characterization** and yearly performance prediction of solar-only systems	Only performance. Daily time steps. Does not treat auxiliary interactions
ISO 9459-4: 2013	Solar heating - domestic water heating systems - Part 4: **System performance** by means of component tests and computer simulation	Only performance. Simplifications discussed in Annex C
ISO 9459-5: 2007	Solar heating - Domestic water heating systems - Part 5: **System performance characterization** by means of whole-system tests and computer simulation	Only performance. Dynamic System Test Method

IRENA (In Press) "Quality Infrastructure for Small Scale RET"

Market Support – Public acceptance and access to sources for financing



Poor Quality

↓

High Risk

↓

Decreased Trust in a Technology

↓

No Finance

"A principle of project finance is that debt should not bear the risk of the technology."

In order to minimize the first technology-related risk, modules have to be certified in accordance with international standards. Unfortunately, it is common knowledge that a successful certification is not enough for predicting the expected lifetime of a module: a failure in a certification process only suggests that a long life is unlikely. Certification is therefore a necessity but not sufficient.

Source: Holz, F. "The myth of PV module manufacturers' bankability in project financing" Deutsche Bank AG

Standards and Quality Infrastructure – Supports Robust Markets

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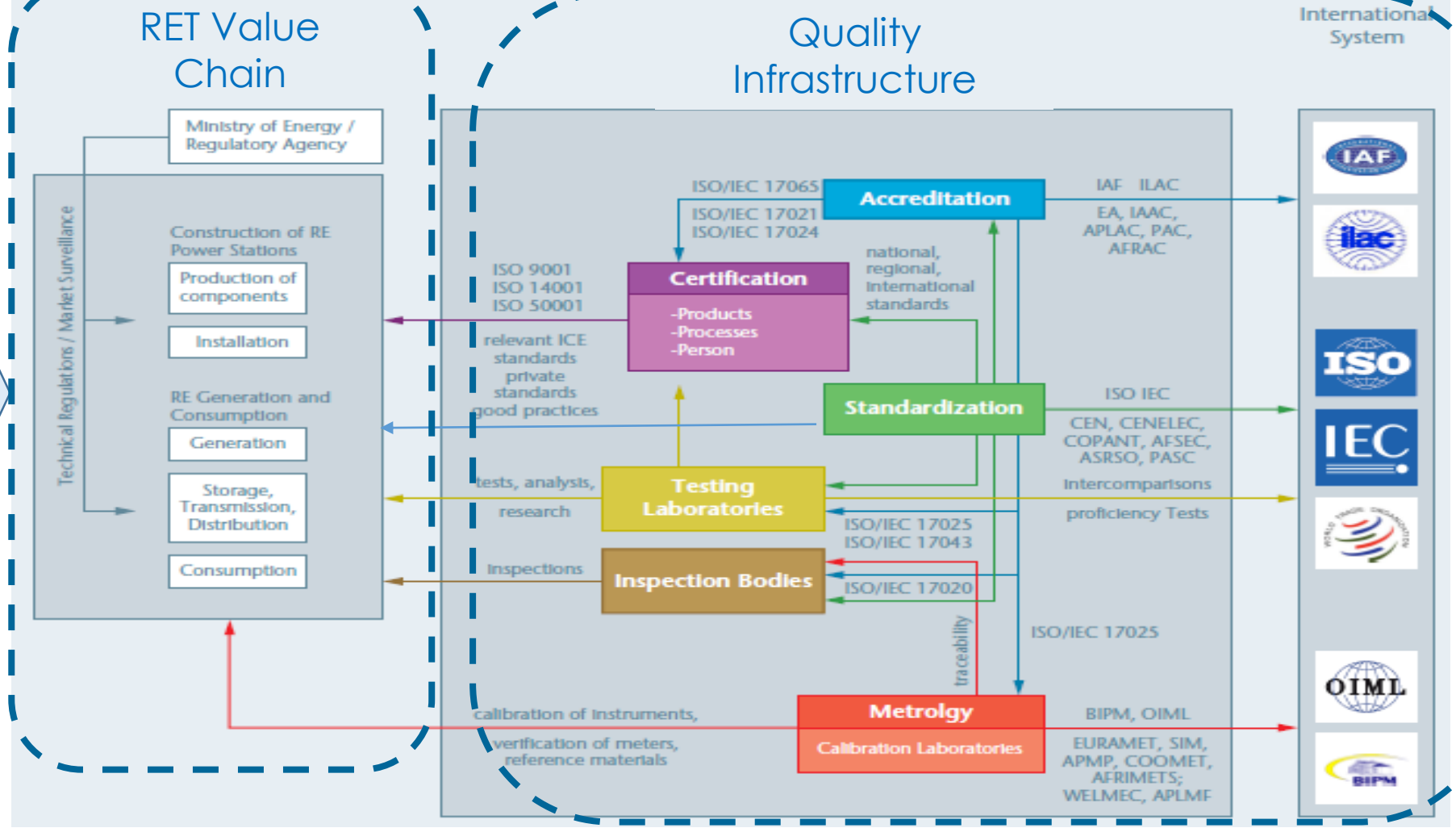
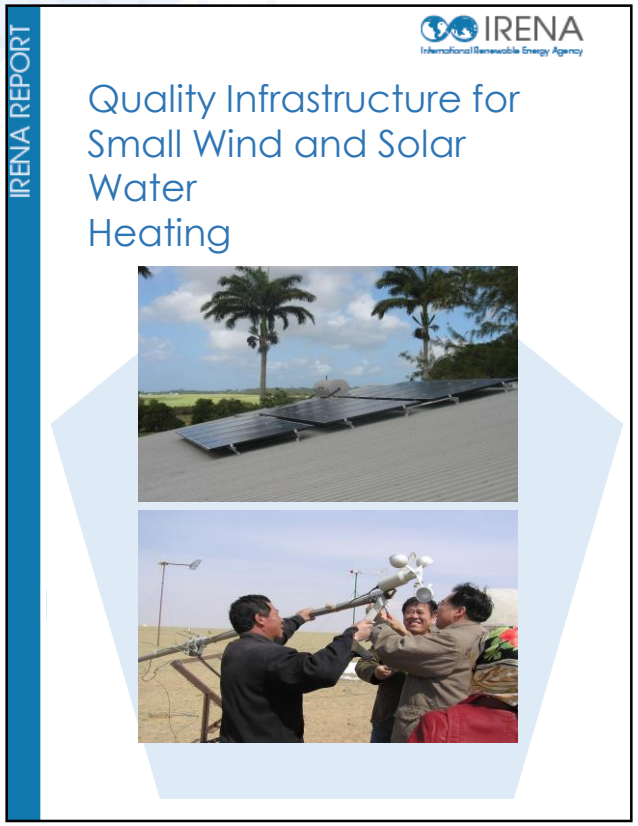
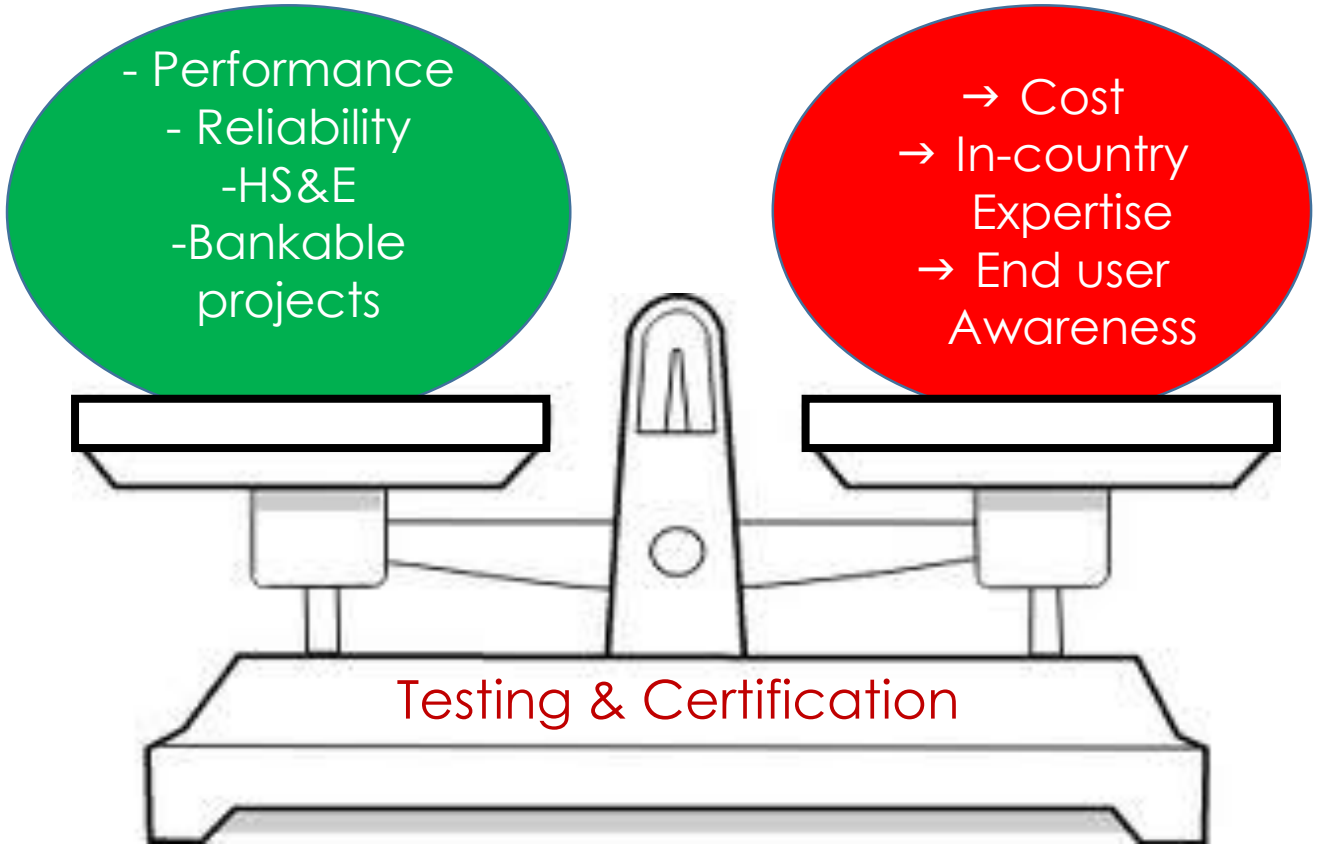
R&D,
IPR,
FiT,
Tax credits,
Soft loans,
Carbon
Markets…



Source: Physikalisch-Technische Bundesanstalt

Quality assurance schemes should be affordable for the local market





IRENA is developing recommendations to establish national quality infrastructure for small wind turbines and solar water heaters based on local market developments

IRENA (In Press) "Quality Infrastructure for Small Scale RET"

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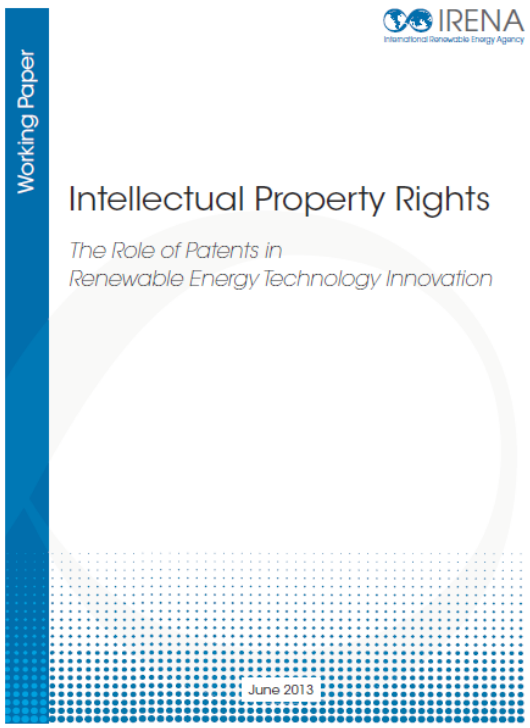
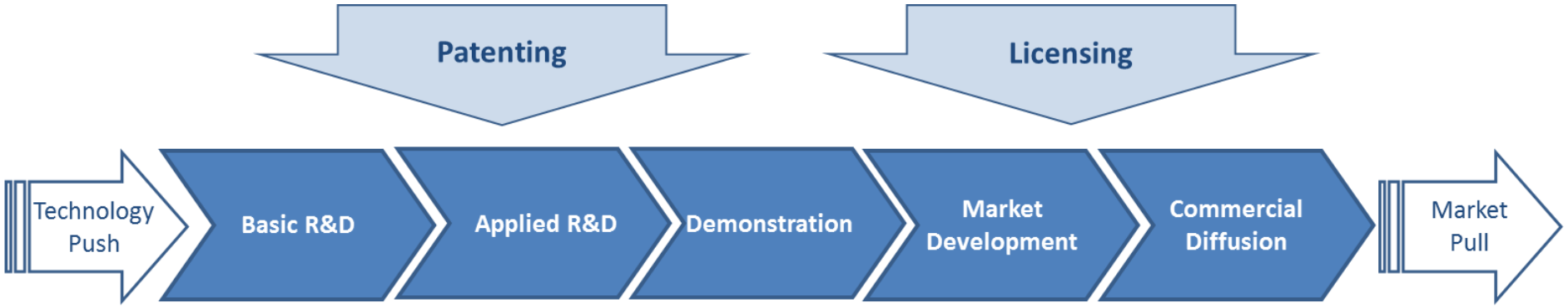
3 IPR – Patents

IPRs - Patents



- The role of patents in RET innovation still needs to be better understood.
  - Different views – Incentivize / Restrain

- Patents seen as an engine for innovation in R&D intensive sectors. Further analysis is still required for RET sector.



Patent information

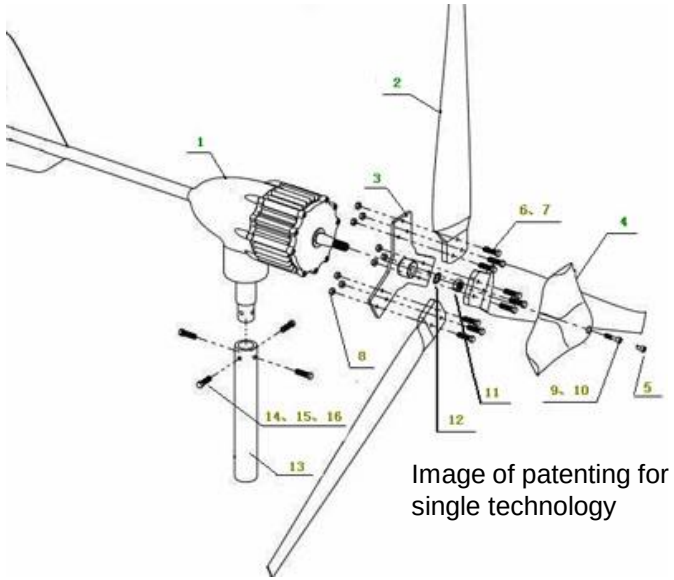


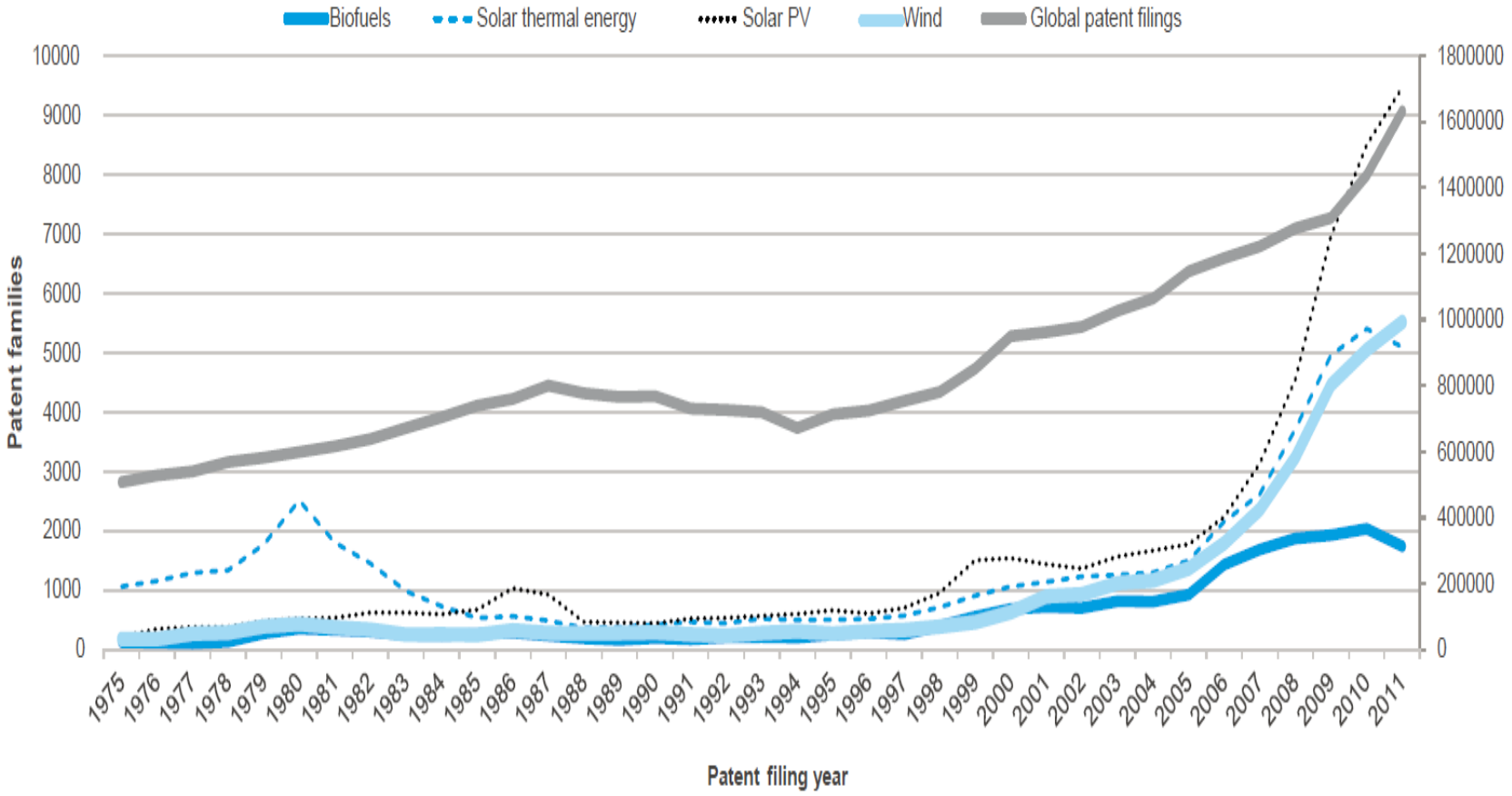
Image of patenting for a single technology

RET patent information can provide:

- Which countries and innovators are active
- Which countries are potential markets
- Trends of technology developments
- International research and co-operation as indicated by co-invention

Governments, through their patent offices, must be stewards of patent quality

RET Patents Landscape - WIPO

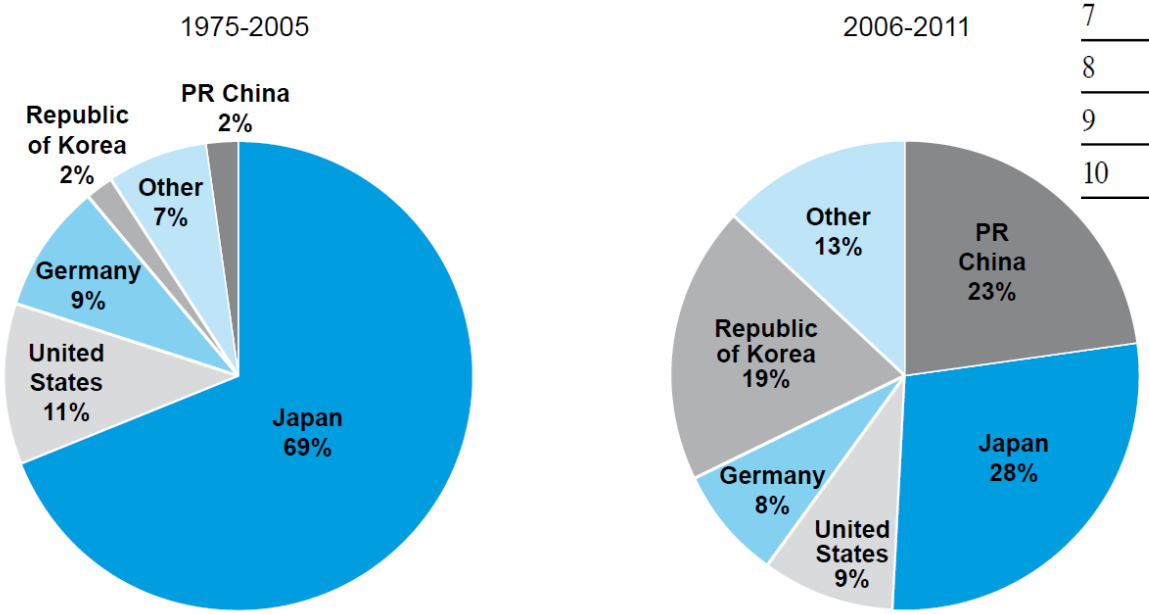


- Volume of patents filed for biofuels, solar thermal, solar PV and wind energy over the period of 2006 – 2011 exceeds the volume of patents filed in these areas in the previous 30 years
- In the period 2006-2011 the average for RET stands at 24% / global average for all technologies is 6%

Source: WIPO (2014) Renewable Energy Technology: Evolution and Policy Implications—Evidence from Patent Literature. Global Challenges Report

PV patents landscape - WIPO

Rank 2006-2011	Rank 1975-2005	Technology Owners	Country/Region of Company HQ
1	20+	▲ LG	Republic of Korea
2	4	▲ Mitsubishi	Japan
3	2	▼ Sharp KK	Japan
4	1	▼ Panasonic	Japan
5	16	▲ Samsung	Republic of Korea
6	5	▼ Kyocera Corp	Japan
7	20+	▲ Kyocera Minolta	Japan
8	11	▲ Fujifilm Corp	Japan
9	8	▼ Hitachi	Japan
10	20+	▲ Hyundai	Republic of Korea



Source: WIPO (2014) Renewable Energy Technology: Evolution and Policy Implications—Evidence from Patent Literature. Global Challenges Report

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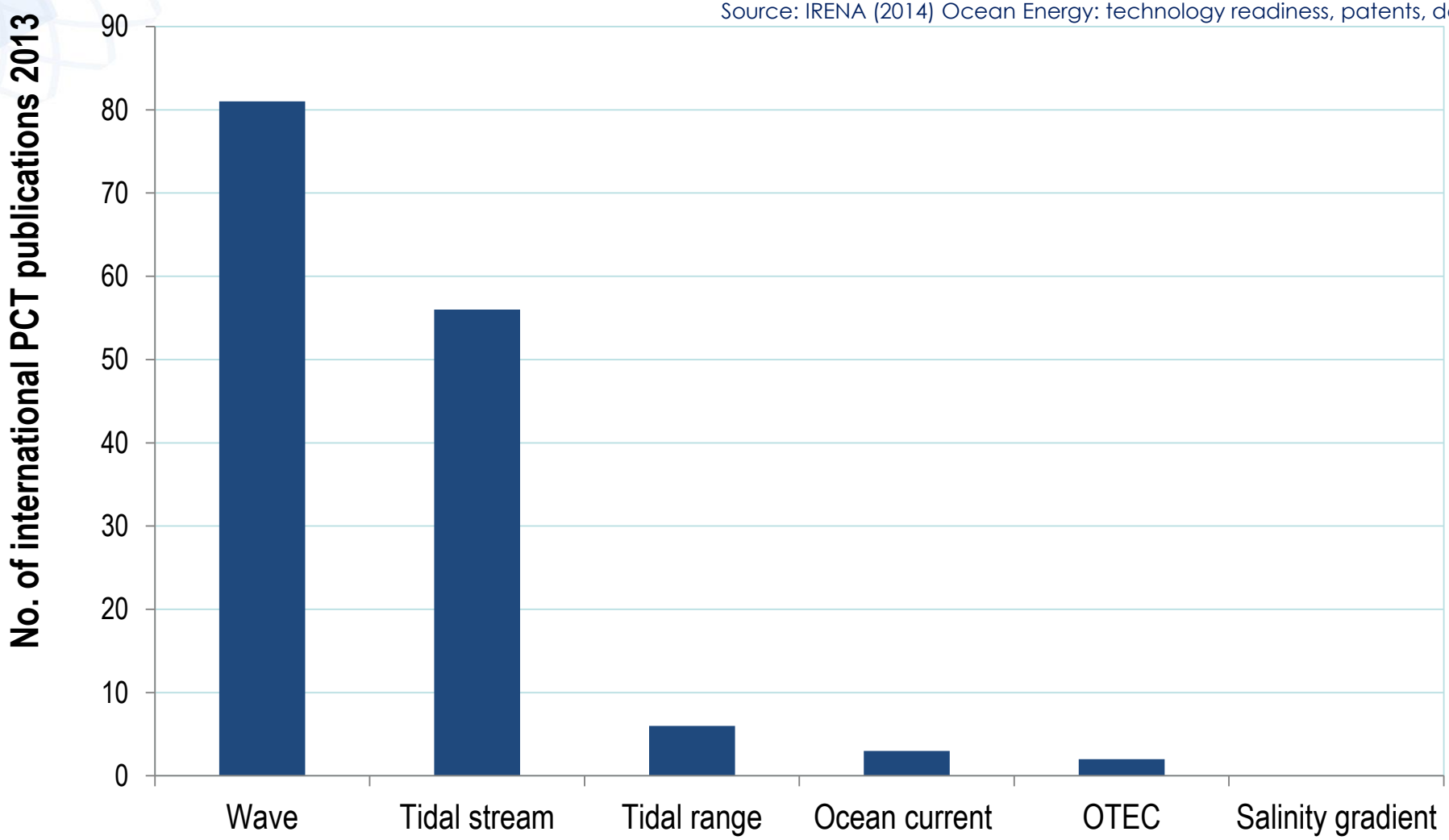
4 Technology Outlooks

IRENA Ocean Energy Technologies Patents Landscape

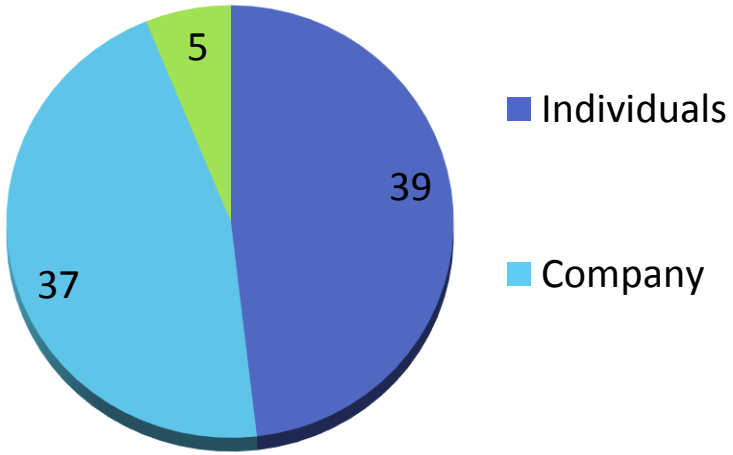
Source: IRENA (2014) Ocean Energy: technology readiness, patents, deployment status and outlook



PCT patents publications in 2013

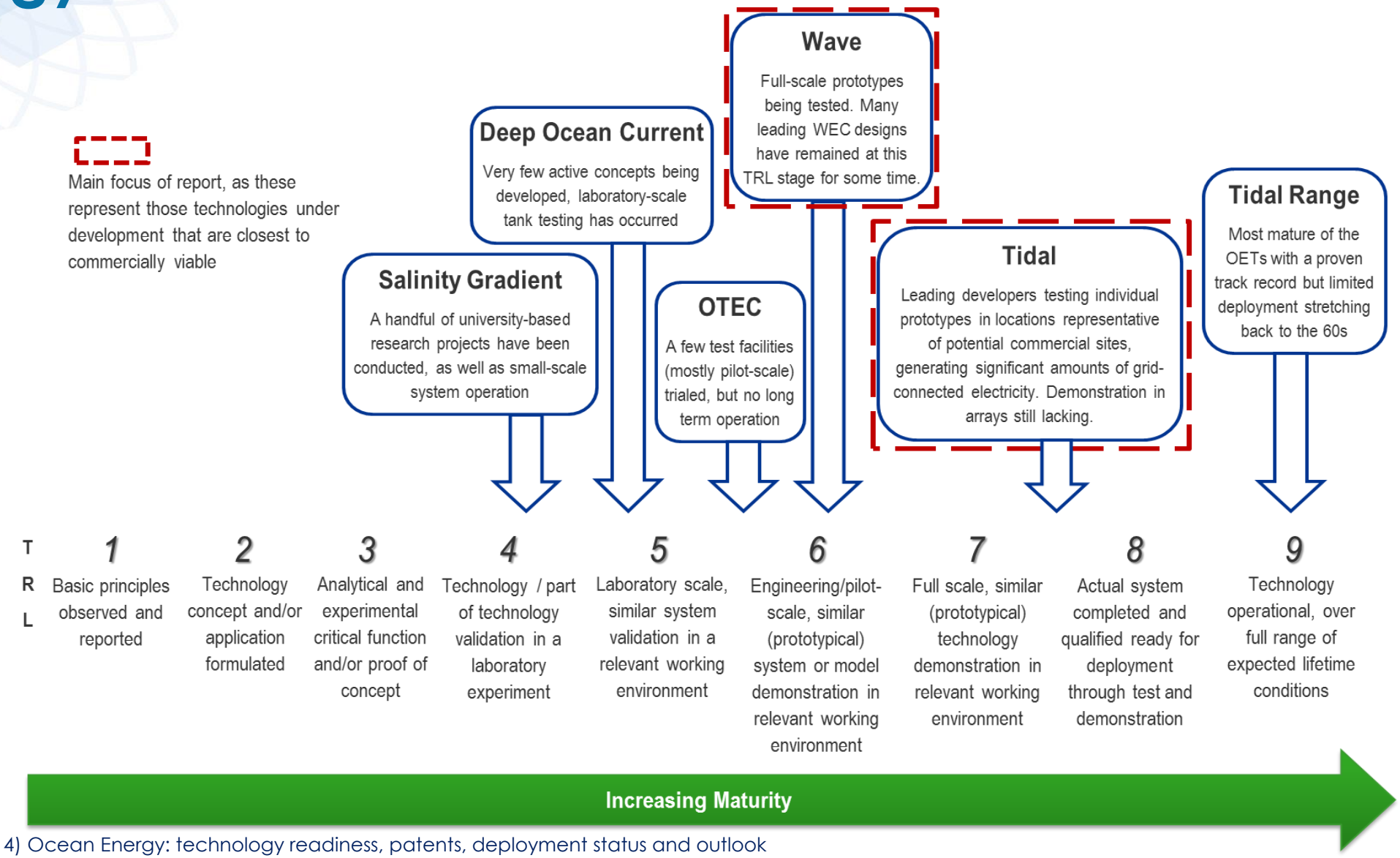
Wave energy converters

PCT Publications in 2013



Source: IRENA (2014) Ocean Energy: technology readiness, patents, deployment status and outlook

Technology Readiness Level – Ocean Energy



Source: IRENA (2014) Ocean Energy: technology readiness, patents, deployment status and outlook

OET short-term development "attractiveness"

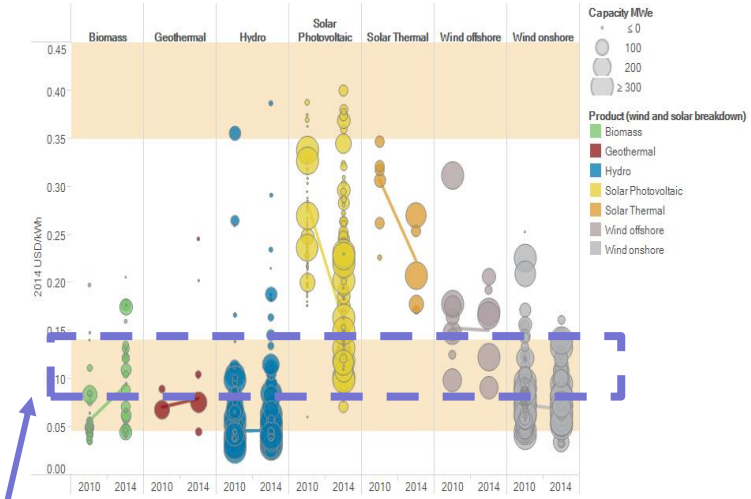
	Technology Readiness Levels	Global Site/ Resource Availability	Level of industrial involvement	Financial investment interest	Relative "attractiveness"
Salinity Gradient					
Deep Ocean Current					
OTEC					
Wave					
Tidal stream					
Tidal Range					

High	Mod	Low

Source: IRENA (2014) Ocean Energy: technology readiness, patents, deployment status and outlook

Ocean Wave Technology Prospect

	Source	2010-2012	2020	2030	2050
Capital cost of farms [EUR/kW]	IEA	5 650	4 070	3 350	1 750
	UK	5 000-9 000	3 000-5 000		2 500-3 000
	ETI[a]/ UKERC	4 840-9 680	2 723-4 235	2 118-2 723	1 513-2 118
Operation & Maintenance cost [EUR/kW/yr.]	IEA	86 (projected to decrease to 47)			
	ETI/ UKERC	48-97	30-73	18-30	12-24
Availability [%]	UK	75-85		90	90-95
	ETI/ UKERC	70-80	90	90-95	95-98
Array load factor [%]	ETI/ UKERC	25-35	32-40	35-42	37-45
Total electricity production cost [EUR/MWh]	IEA	286	207	172	
	UK	213-500		113-226	88-125
	ETI/ UKERC	242-605	121-242	85-121	61-97
Average levelised cost of energy per MWh	E&Y	505	268	148	108
	SI Ocean	330-630[b]	280-350[c]	150-180[d]	
EU Market share, % of global electricity output	JRC	0	<<1	~1-2	> 10



Source: IRENA (2014) Wave energy technology brief

IRENA Innovative Technology Outlook Studies

Mini-grids

Advanced Biofuels

Off-Shore Wind

Technology Outlook Compilation

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5 Interacting Tool

INSPIRE – RE Standards and Patents Platform

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INNOVATION HAS BEEN AND WILL CONTINUE TO BE CRUCIAL TO ACHIEVE A RENEWABLES-BASED FUTURE

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