The IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation: Chapter 11 – Policy, Financing and Implementation

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Rolf Wüstenhagen, Lead Author, Chapter 11
University of St. Gallen (Switzerland)

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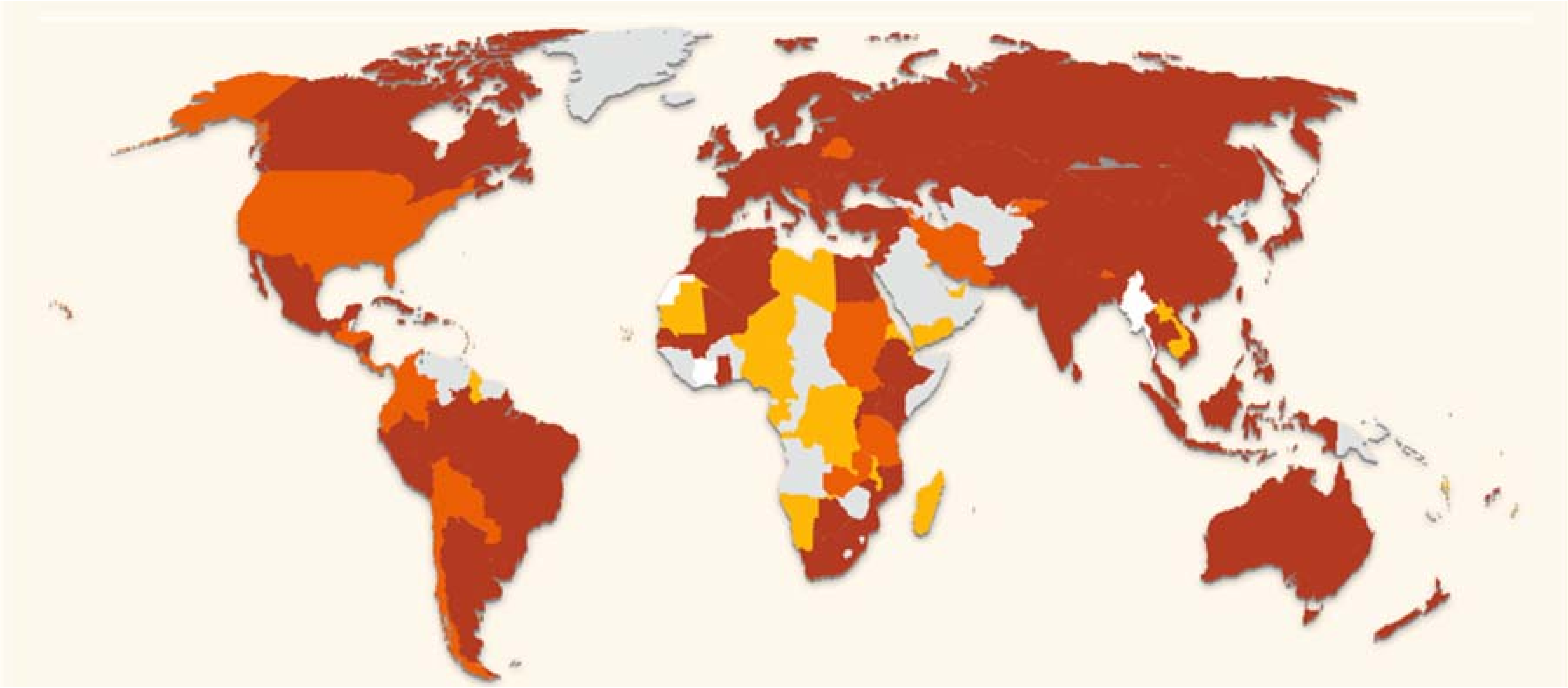
An increasing number and variety of RE policies – motivated by many factors – have driven escalated growth of RE technologies in recent years



Source: SRREN, Figure 11.1

INTERGOVERNMENTAL PANEL ON climate change

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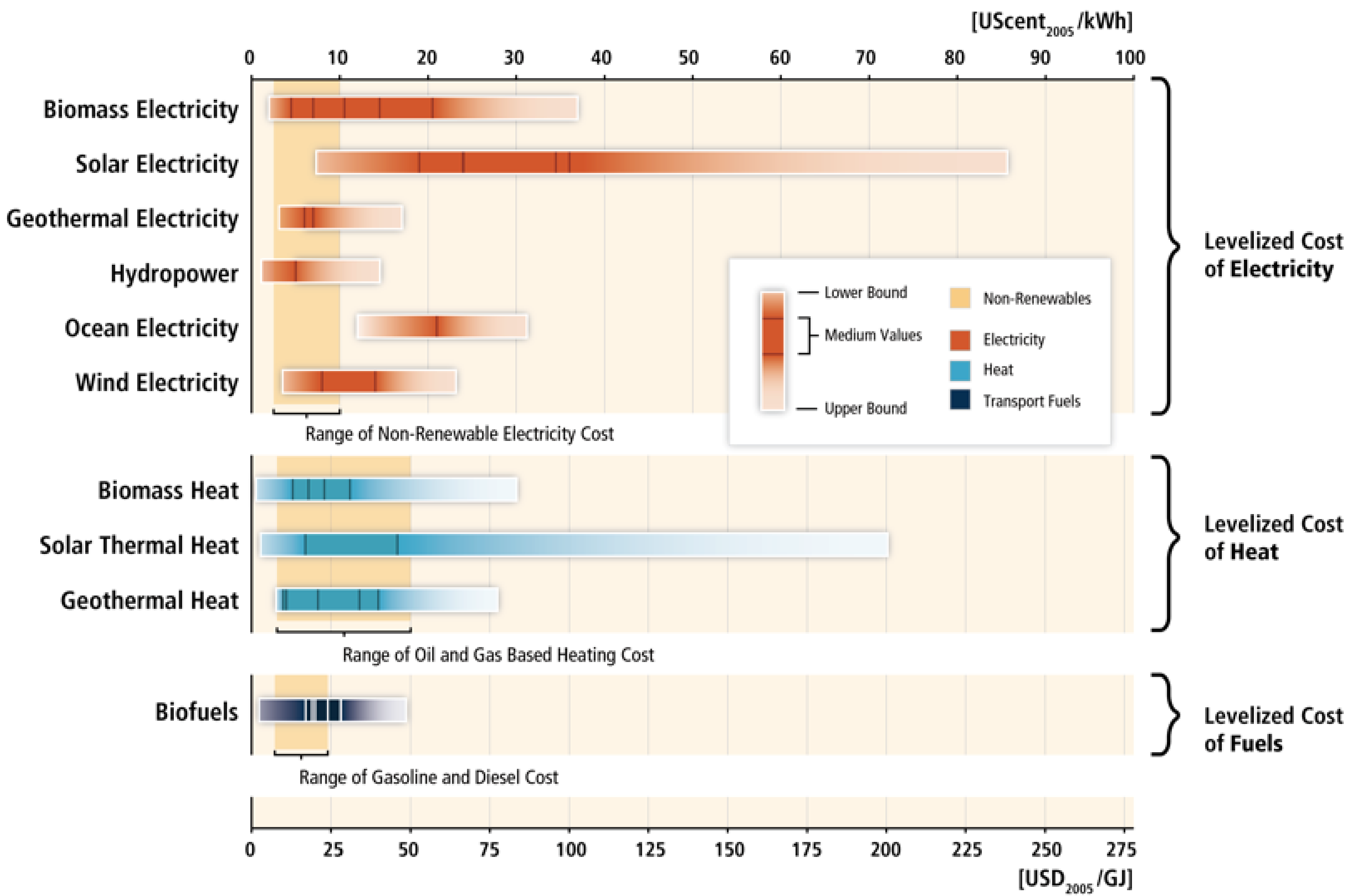
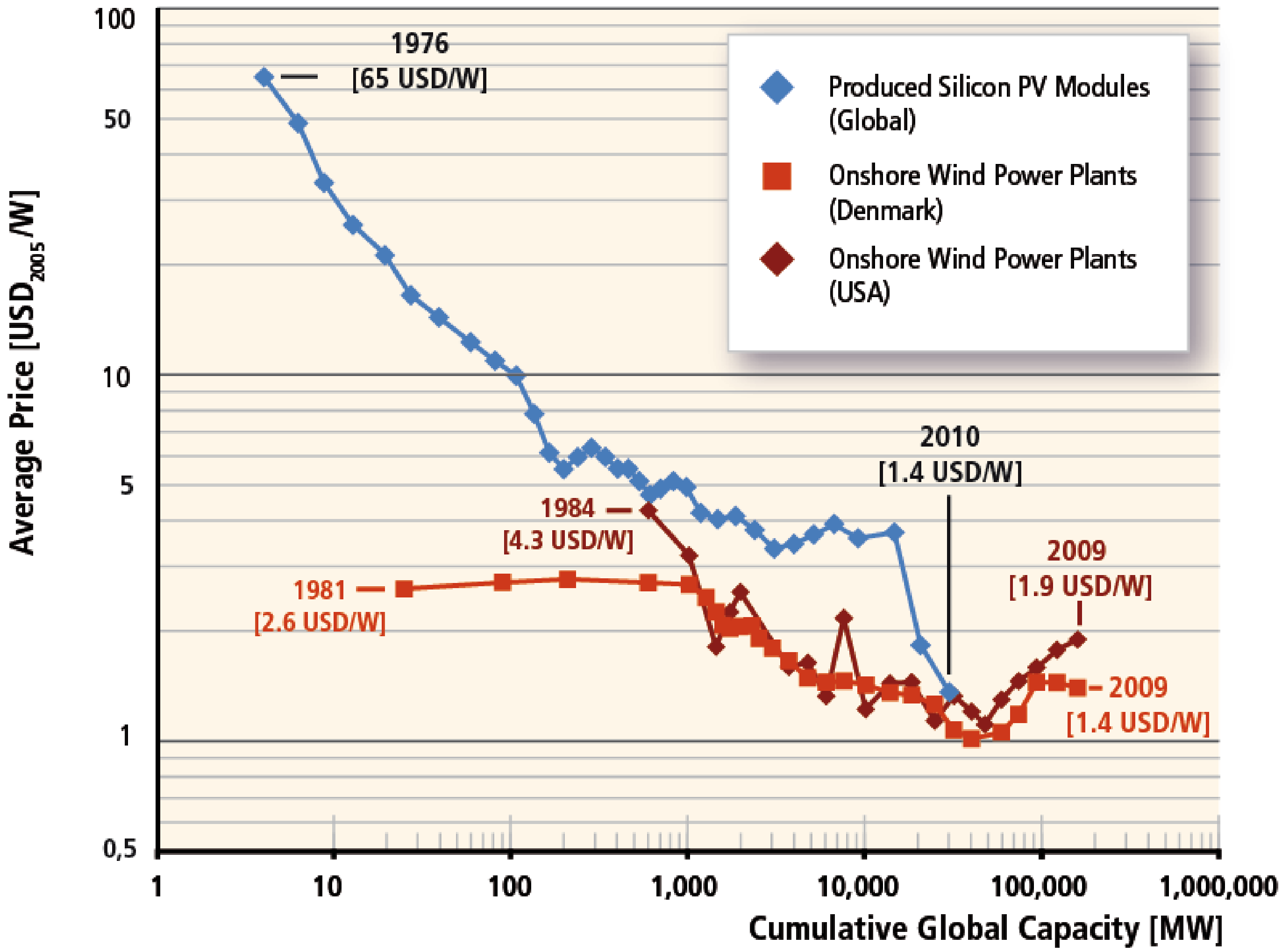
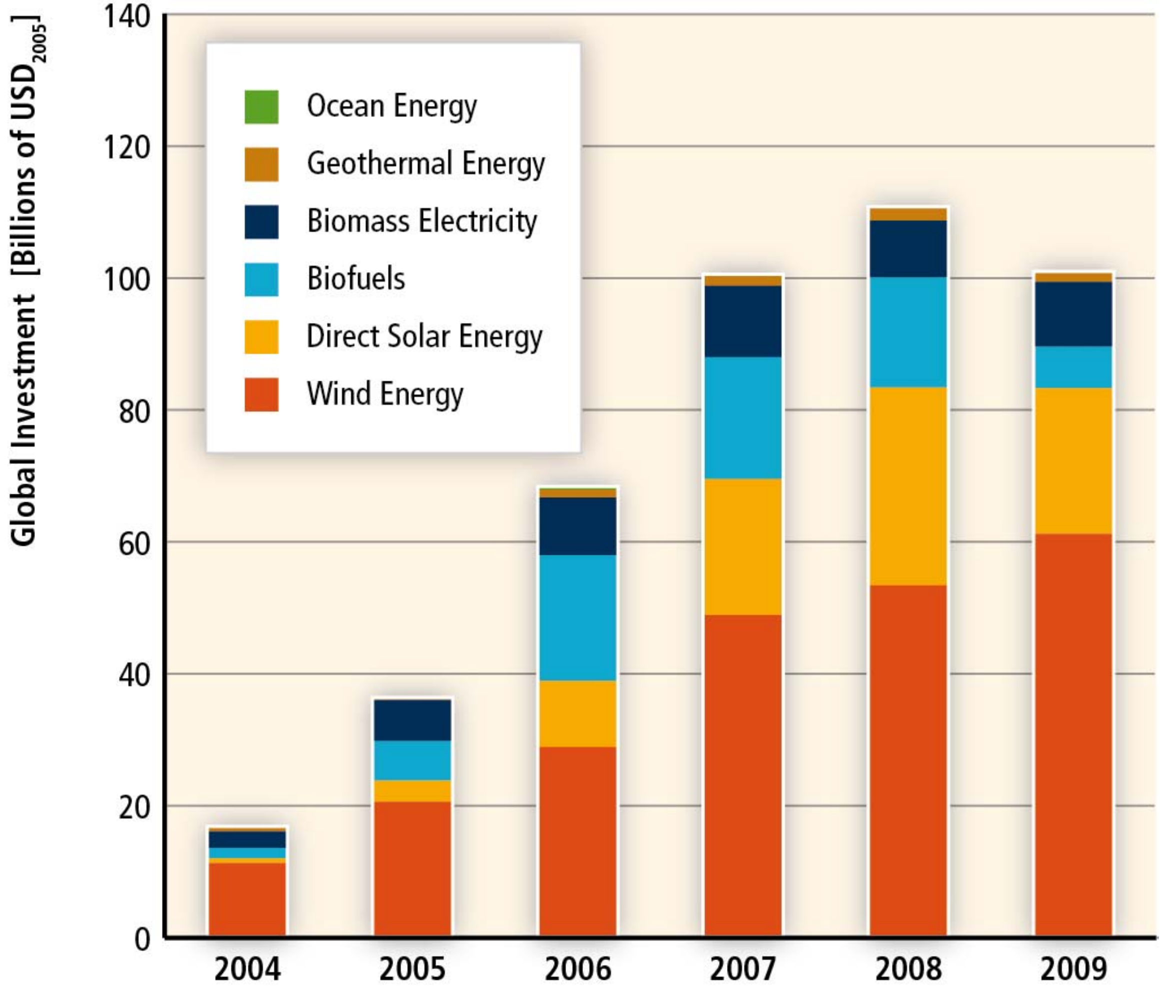
RE costs are still higher than existing energy prices, but in various settings RE is already competitive.



RE costs have declined in the past and further declines can be expected in the future.



Global Investment in RE increased significantly between 2004 and 2008



Source: SRREN, Figure 11.2

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Some policies have been shown to be effective and efficient in rapidly increasing RE deployment.

- Policy frameworks that are transparent and **sustained** can reduce investment risks & facilitate deployment of RE.
  - Several studies have concluded that some feed-in tariffs have been effective and efficient at promoting RE **electricity**. Quota policies can be effective and efficient if designed to reduce risk.
  - Fiscal incentives or obligations have been used to promote renewable **heating and cooling**.
  - A variety of policies have been used to promote **biofuels**.
- The flexibility to **adjust** as technologies and markets evolve is important.
- The **details of design and implementation** are critical in determining the effectiveness and efficiency of a policy.

However, there is no one-size-fits-all policy.

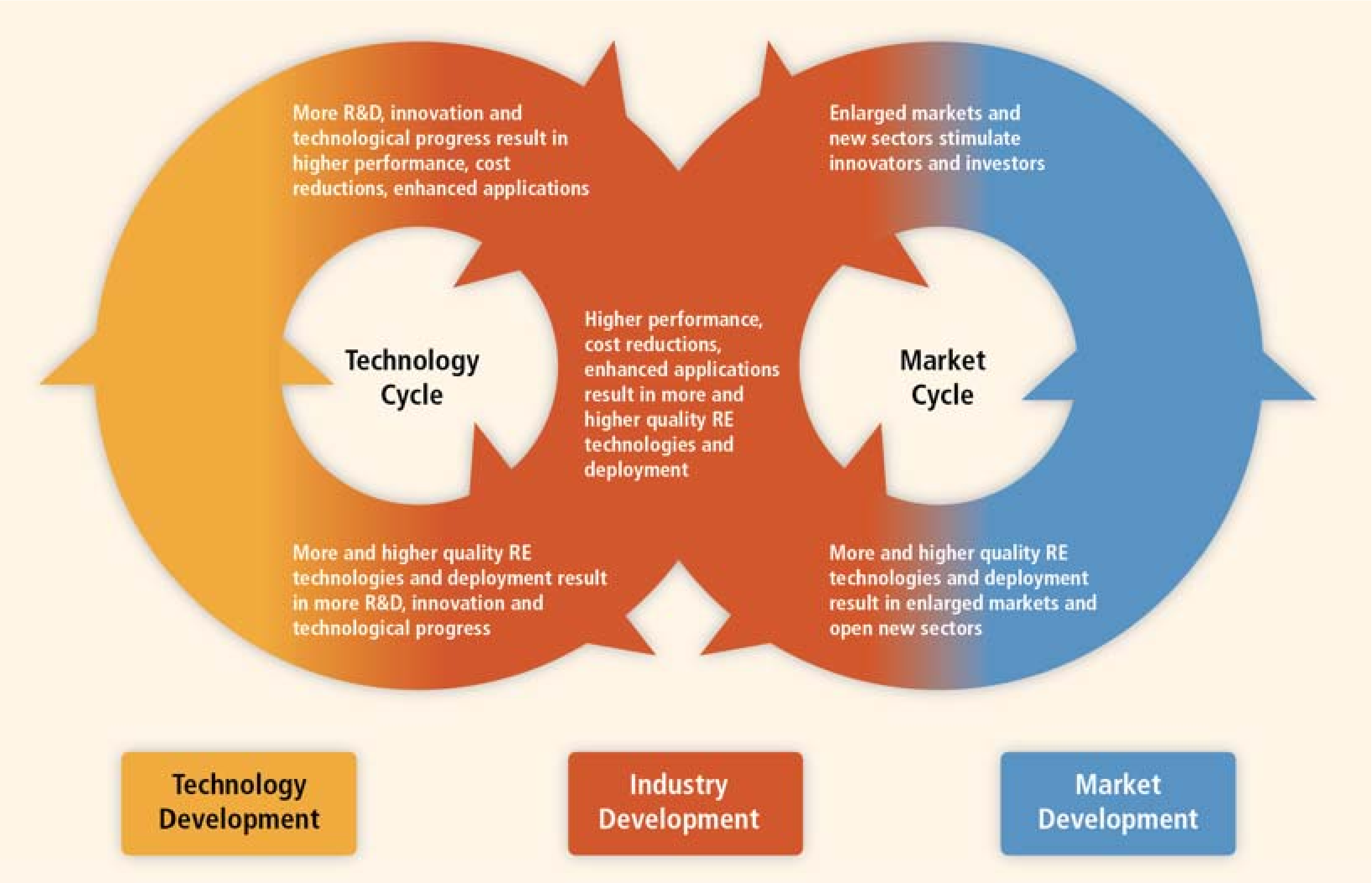
Source: adapted from SRREN SPM, p. 24

Two separate market failures create the rationale for additional RE policies in the presence of climate policy

- 1st market failure: external cost of GHG emissions.
- 2nd market failure: underinvestment in RE technology due to underestimated future benefits or inability to appropriate these benefits.
- In addition to GHG pricing policies, RE specific policies may be appropriate from an economic point of view if the related opportunities for technological development are to be addressed (or if other goals beyond climate mitigation are pursued).
- Potentially adverse consequences such as lock-in, carbon leakage and rebound effects should be taken into account in the design of a portfolio of policies.
- *NB: 'ideal' carbon pricing yet to be implemented*

Source: adapted from SRREN SPM, p. 25; Chapter 11, p. 10

The mutually reinforcing cycles of technology development and market deployment drive down technology costs



Source: SRREN, Figure 11.5, based on IEA, 2003b

‘Enabling’ policies support RE development and deployment

An enabling environment for RE can be created...

- by addressing the interactions of a given RE policy with other policies (e.g., agriculture, transportation, water management and urban planning)
- by easing the ability of RE developers to obtain finance and to successfully site a project
- by removing barriers for grid access
- by increasing education and awareness
- and by enabling technology transfer.

In turn, the existence of an ‘enabling’ environment can increase the efficiency and effectiveness of policies to promote RE.

Source: adapted from SRREN SPM, p. 24

Thank you

Rolf Wüstenhagen, Lead Author, Chapter 11
University of St. Gallen (Switzerland)
rolf.wuestenhagen@unisg.ch

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Backup: Grid Integration of RE

Integration characteristics for a selection of RE electricity generation technologies

Technology		Plant size range	Variability: Characteristic time scales for power system operation	Dispatchability	Geographical diversity potential	Predictability	Capacity factor range	Capacity credit range	Active power, frequency control	Voltage, reactive power control
		(MW)	Time scale	See legend	See legend	See legend	%	%	See legend	See legend
Bioenergy		0.1–100	Seasons (depending on biomass availability)	+++	+	++	50–90	Similar to thermal and CHP	++	++
Direct solar energy	PV	0.004–100 modular	Minutes to years	+	++	+	12–27	<25–75	+	+
	CSP with thermal storage*	50–250	Hours to years	++	+**	++	35–42	90	++	++
Geothermal energy		2–100	Years	+++	N/A	++	60–90	Similar to thermal	++	++
Hydropower	Run of river	0.1–1,500	Hours to years	++	+	++	20–95	0–90	++	++
	Reservoir	1–20,000	Days to years	+++	+	++	30–60	Similar to thermal	++	++
Ocean energy	Tidal range	0.1–300	Hours to days	+	+	++	22.5–28.5	<10	++	++
	Tidal current	1–200	Hours to days	+	+	++	19–60	10–20	+	++
	Wave	1–200	Minutes to years	+	++	+	22–31	16	+	+
Wind energy		5–300	Minutes to years	+	++	+	20–40 onshore, 30–45 offshore	5–40	+	++

* Assuming CSP system with 6 hours of thermal storage in US Southwest.

** In areas with Direct Normal Irradiation (DNI) > 2,000 kWh/m2/yr (7,200 MJ/m2/yr)

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Capacity credit is an indicator for the reliability of a generation type to be available during peak demand hours.

Technology		[...]	Capacity credit range
		[...]	%
Bioenergy		[...]	Similar to thermal and CHP
Direct solar energy	PV	[...]	<25–75
	CSP with thermal storage*	[...]	90
Geothermal energy		[...]	Similar to thermal
Hydropower	Run of river	[...]	0–90
	Reservoir	[...]	Similar to thermal
Ocean energy	Tidal range	[...]	<10
	Tidal current	[...]	10–20
	Wave	[...]	16
Wind energy		[...]	5–40

If a type of generation has a low capacity credit,
the available output tends to be low during high demand periods.

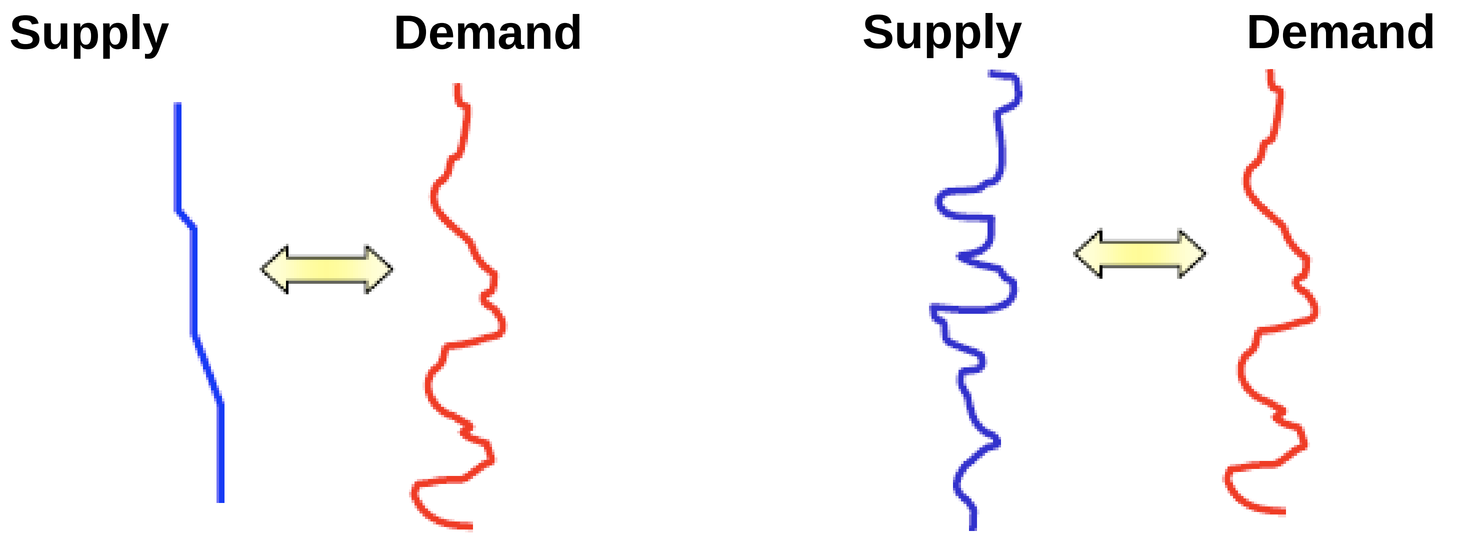
Few, if any, fundamental technical limits exist to the integration of a majority share of RE, but advancements in several areas are needed.

- Transmission and distribution infrastructure
- Generation flexibility
- Energy storage technologies
- Demand side management
- Improved forecasting and operational planning methods

Key challenge for any electricity supply:

Match load and supply in space and time

Conventional Energy System: **Renewable Energy System:**



From **„Base Load“ & „Peak Load“**... ...towards **smart grids**

Source: Wolfram Krewitt † (2008), SRREN Scoping Meeting