Wuppertal Institut

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Meta-analysis and comparison of Japanese and German mid-century deep decarbonization scenarios

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Background

- We are currently analysing and comparing Japanese (JP) and German (GER) mid-century bottom-up decarbonization scenarios.

- Our **key research questions** are:
  - What will be key strategies to achieve deep decarbonization?
  - What strategies will likely be similar in JP & GER?
  - How may individual strategies differ between JP & GER?

- Based on our ongoing analysis, **we aim to** contribute to:
  - An exchange of ideas and visions for deep decarbonization
  - Identifying promising areas for (stronger) cooperation between JP & GER in the area of energy systems research

Overview of the analysed scenarios

Study	Year	Commissioned by	Prepared by	Scenario(s) chosen
JAPAN				
Long-term scenarios for decarbonising Japan	2017	WWF Japan	Research Institute for Systems Technology	Bridge
				100% RE
A joint analysis of Japan's INDC	2015	EU	NIES	LowNUC
A sustainable energy outlook for Japan	2011	Greenpeace International, EREC	DLR (GER), ISEP (JP)	AE[R]
GERMANY				
Successful energy transition (...)	2017	-	J. Nitsch (formerly DLR)	K17 M
Climate Protection Scenario 2050	2015	BMUB	Öko-Institut, Fraunhofer ISI	KS 80
				KS 95
Development of Energy Markets – Energy Reference Forecast,	2014	BMWi	Prognos, EWI, GWS	ZS
Germany in 2050 – a greenhouse gas-neutral country	2014	-	UBA	THGND

Key energy system decarbonization strategies

DEMAND SIDE	• **Energy efficiency improvements**
	• **Behavioural changes**
	• **Electrification**
	Direct electrification
	Indirect electrification (e.g. hydrogen)
SUPPLY SIDE	• **Use of carbon-free energy sources**
	Renewables for electricity generation
	Renewables for transport and heating
	Nuclear power
	• **Import of carbon-free energy sources**
	Biomass
	Electricity
	Hydrogen / Synthetic fuels
	• **Use of CCS technology**
	For emissions from power plants
	For emissions from industrial plants

Key energy system decarbonization strategies and how they are pursued in Japanese energy scenarios by 2050

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	Scenarios →	Bridge	LowNUC	AE[R]	100% RE
	2050 energy-related per capita GHG emissions →	2.0 t	1.9 t	1.4 t	0 t
DEMAND SIDE	• **Energy efficiency improvements**	++	+++	+++	++
	• **Behavioural changes**	+	o	+	+
	• **Electrification**				
	Direct electrification	+	+++	+++	+
	Indirect electrification (e.g. hydrogen)	++	+	+	+++
SUPPLY SIDE	• **Use of carbon-free energy sources**				
	Renewables for electricity generation	++	++	++	+++
	Renewables for transport and heating	++	+	+++	++ ??
	Nuclear power	o	o	o	o
	• **Import of carbon-free energy sources**				??
	Biomass	o	o	o	o
	Electricity	o	o	o	o
	Hydrogen / Synthetic fuels	o	o	o	o
	• **Use of CCS technology**				
	For emissions from power plants	o	++	o	o ??
	For emissions from industrial plants	o	o	o	o

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Key energy system decarbonization strategies and how they are pursued in German energy scenarios by 2050

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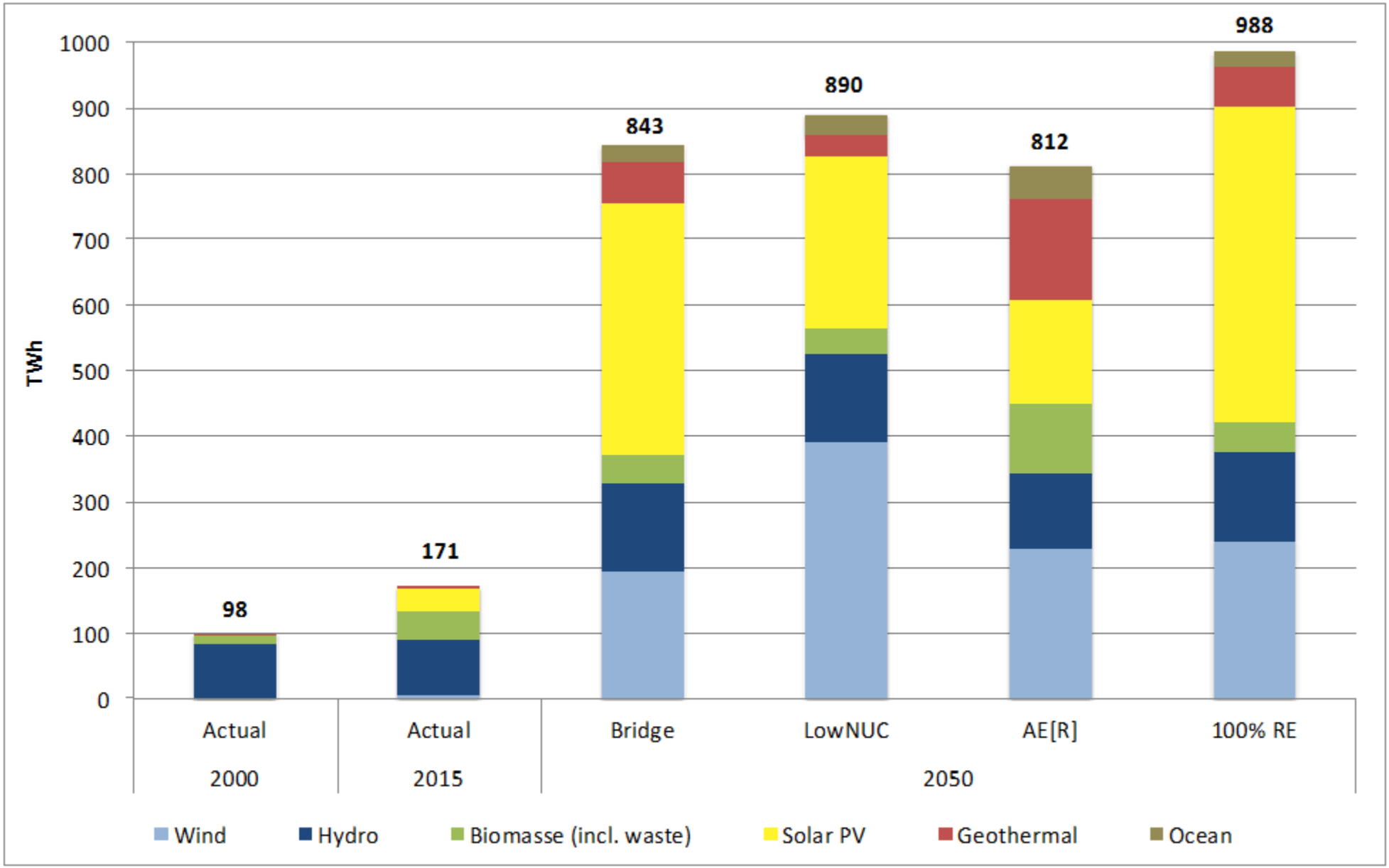
	Scenarios →	ZS	KS 80	K17 M	KS 95	THGND
	2050 energy-related per capita GHG emissions →	2.7 t	2.1 t	0.6 t	0.5 t	0 t
DEMAND SIDE	• **Energy efficiency improvements**	++	++	++	+++	+++
	• **Behavioural changes**	0	+	++	+++	+
	• **Electrification**					
	Direct electrification	+	++	++	+++	++
	Indirect electrification (e.g. hydrogen)	0	0	++	+	+++
SUPPLY SIDE	• **Use of carbon-free energy sources**					
	Renewables for electricity generation	+	++	+++	+++	++
	Renewables for transport and heating	+++	++	+++	++	0
	Nuclear power	0	0	0	0	0
	• **Import of carbon-free energy sources**					
	Biomass	++	0	0	0	0
	Electricity	+	++	+++	+	+++
	Hydrogen / Synthetic fuels	0	0	0	++	
	• **Use of CCS technology**					
	For emissions from power plants	0	0	0	0	0
	For emissions from industrial plants	0	0	0	++	0

AGREEMENT **SOME DISAGREEMENT** **DISAGREEMENT**

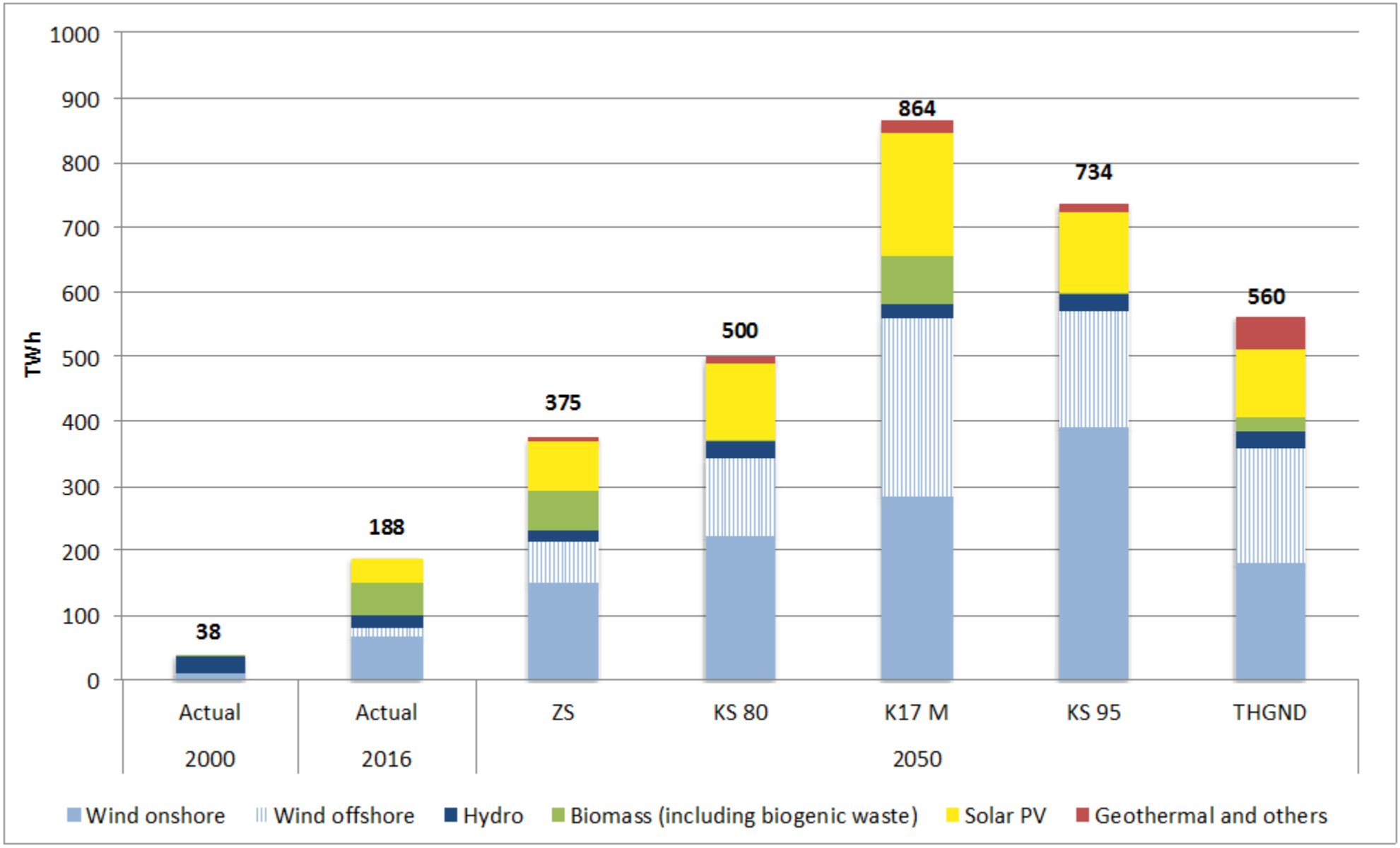
Summary of key findings

- **Broad agreement** among JP and GER scenario on the key role of:
  - Strong energy efficiency improvements
  - Electrification
  - Considerable further RES-E expansion (see figures)

Role of RES-E: Electricity generation from renewable energy sources in the analysed Japanese scenarios



Role of RES-E: Electricity generation from renewable energy sources in the analysed German scenarios

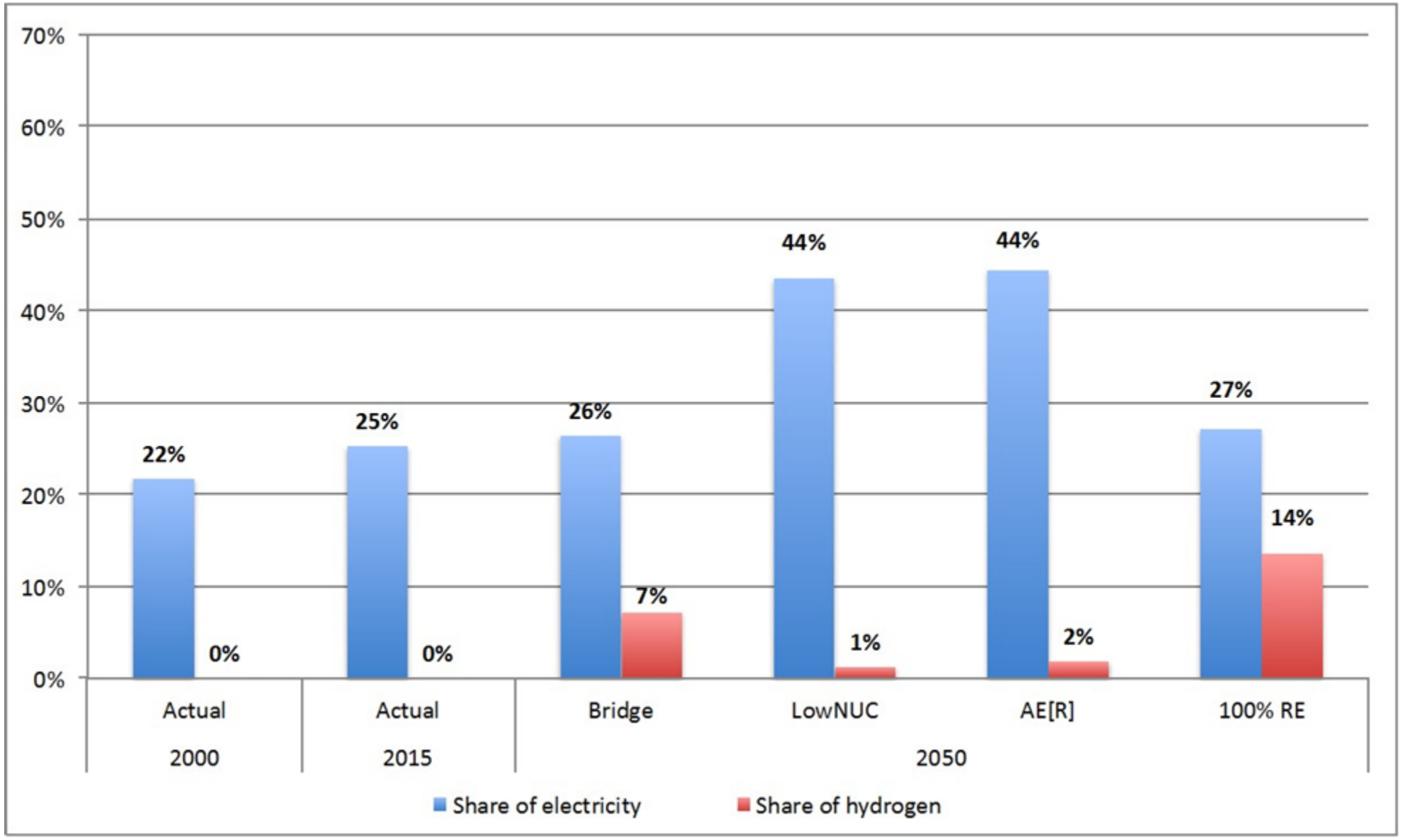


Summary of key findings

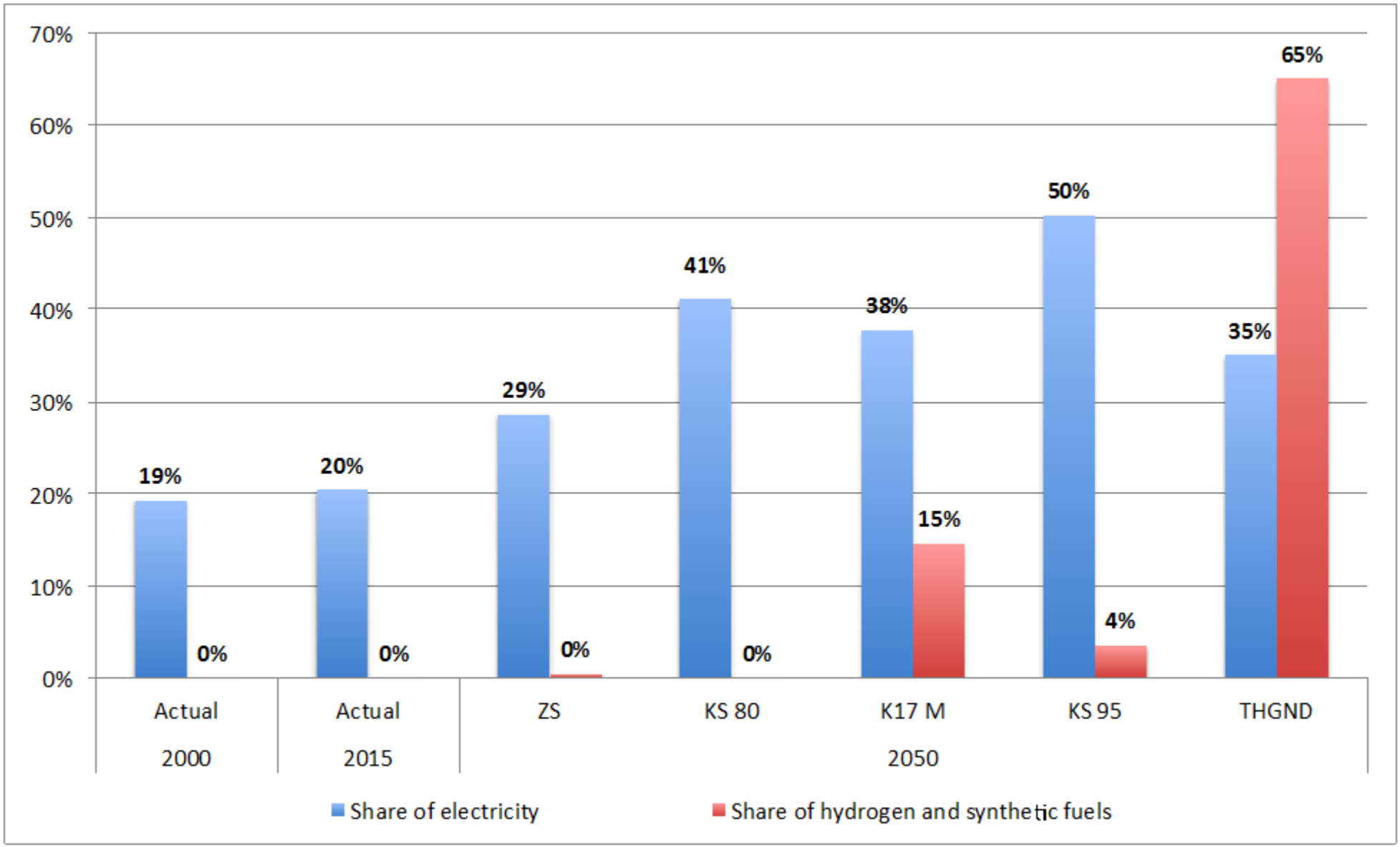
- **Broad agreement** among JP and GER scenario on the key role of:
  - Strong energy efficiency improvements
  - Electrification
  - Considerable further RES-E expansion

- **Disagreement** among both JP and GER scenarios on:
  - Role of CCS
  - Contribution of biomass to future energy supply
  - Role of behavioural changes
  - Relative importance of direct versus indirect electrification (see figures)

Role of electrification: Share of electricity and of H_2 in total final energy demand in the analysed Japanese scenarios



Role of electrification: Share of electricity and of H_2* in total final energy demand in the analysed German scenarios



* Including synthetic fuels

Conclusion: Key research questions and promising areas of joint JP-GER energy systems research

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- **Key research questions** that follow from our analysis**:**
  - What is the optimal mix of direct versus indirect electrification?
  - What is the mitigation potential of behavioural changes?
  - Is there a need for CCS/CCU to achieve deep decarbonization?
  - Do JP & GER need carbon-free energy imports? If so, how much and from where?
  - Will a continued use of nuclear power be an opportunity or a hindrance for deep decarbonization in JP?

- **Key areas of joint JP-GER energy systems research** could be:
  - Need for and chances of a stepwise introduction of H_2.
  - Issues related to the decarbonization of materials processing industries.
  - Economic, technological and social issues related to energy imports.

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Thank you!

For further information:
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