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Energy Innovation Scoreboard – A Pilot Framework with a Focus on Renewables

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"Modelling and Analyses
in R&D Priority-Setting and Innovation"

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Motivation

- First thoughts on a framework to improve knowledge on energy innovation with a focus on renewables
- Input for discussion in IEA Expert Group
- Stimulate discussion on usefulness and feasibility
- Stimulate discussion on choice of indicators, data availability and data gaps
- Role of energy R&D for a transformation of the energy system
- Improve monitoring of energy innovation and compare energy innovation capabilities of countries

Objectives

- Proposal of an energy innovation scoreboard embedded in a conceptual framework of the energy system
- Screening of internationally comparable databases with respect to the availability of data for relevant indicators
- Compilation of relevant data

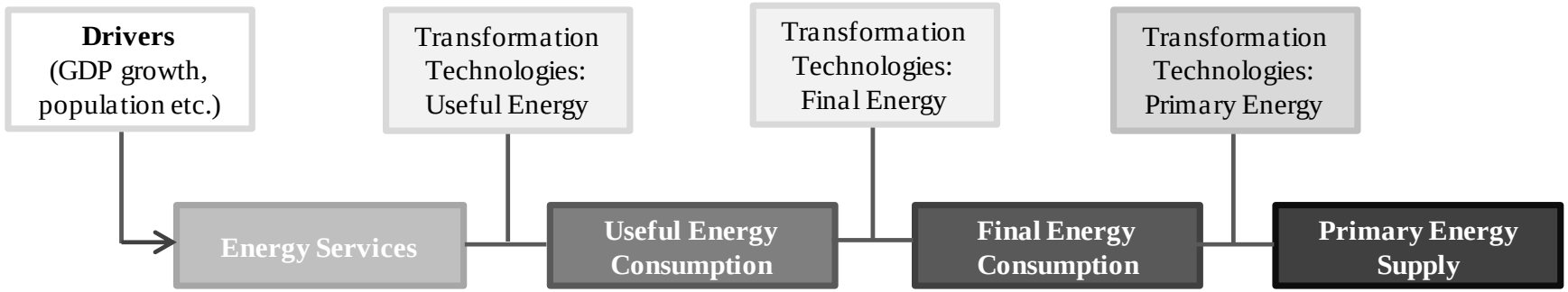
Starting point:

- Existing innovation scoreboards

Conceptual framework (1)

- Challenges for current energy system
  - Energy fuels nearly all aspects of our economies and societies with adverse effects on climate, environment and health
  - Use of energy is also related to competitiveness issues
  - Transformation of the energy system – no broad consensus on guidelines for transformation

Conceptual framework (2)



Source: Köppl et al 2014. *Energy Transition in Austria: Designing Mitigation Wedges.* Energy & Environment, Vol. 25/2, p. 281–304

- Perspective of the energy system as complex system starting with welfare relevant energy services
- Illustration of wide range for transformation potentials

Why innovation scoreboards

- Aim and advantages of scoreboards
  - Scoreboards are more adequate to cover multidimensional aspects like context indicators or the diffusion phase
  - Cover process instead of single input indicators like R&D expenditure
  - Provide a comparative assessment of innovation performance
  - Scoreboard indicators provide potential basis to condense information to composite indices

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What needs to be considered

- Indicators included should be thoroughly argued
- Structured presentation to make broad information manageable
- Selection of criteria often involves stakeholder process
- General quality criteria as stated by OECD:
  - Relevance
  - Accuracy
  - Timeliness
  - Accessibility
  - Interpretability and coherence

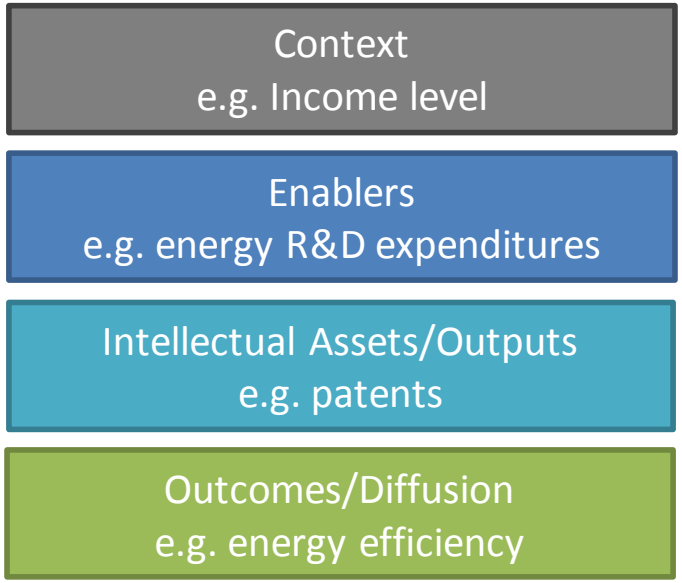
Structure of a Pilot Energy Innovation Scoreboard (1)

Role model IUS – but various differences

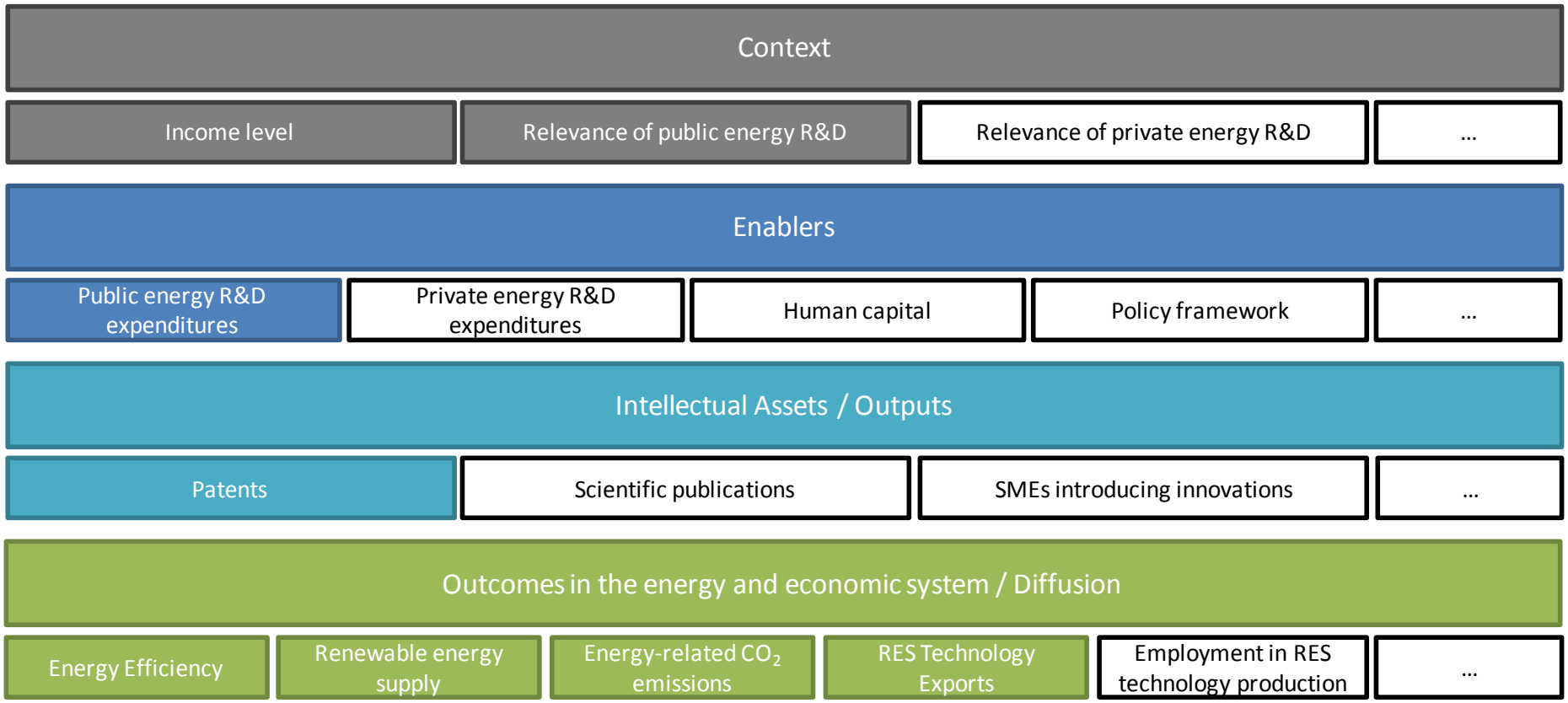
- Complementary to EU's Innovation Union Scoreboard
- Aggregate focus versus firm level
  - Focus on public energy R&D expenditure
  - Firm level R&D and innovation not covered at this stage
- Differentiation between output and outcome
  - Output addresses effects of innovation like patents
  - Outcome covers economic impacts and impacts in the energy system

Structure of a Pilot Energy Innovation Scoreboard (2)

- Integrated view of the innovation system, covering
  - Enablers and Intellectual Assets / Outputs as key elements of the innovation process
  - Context indicators and outcome indicators describing progress towards a transformation of the energy system



Relevant Dimensions of Energy Innovation

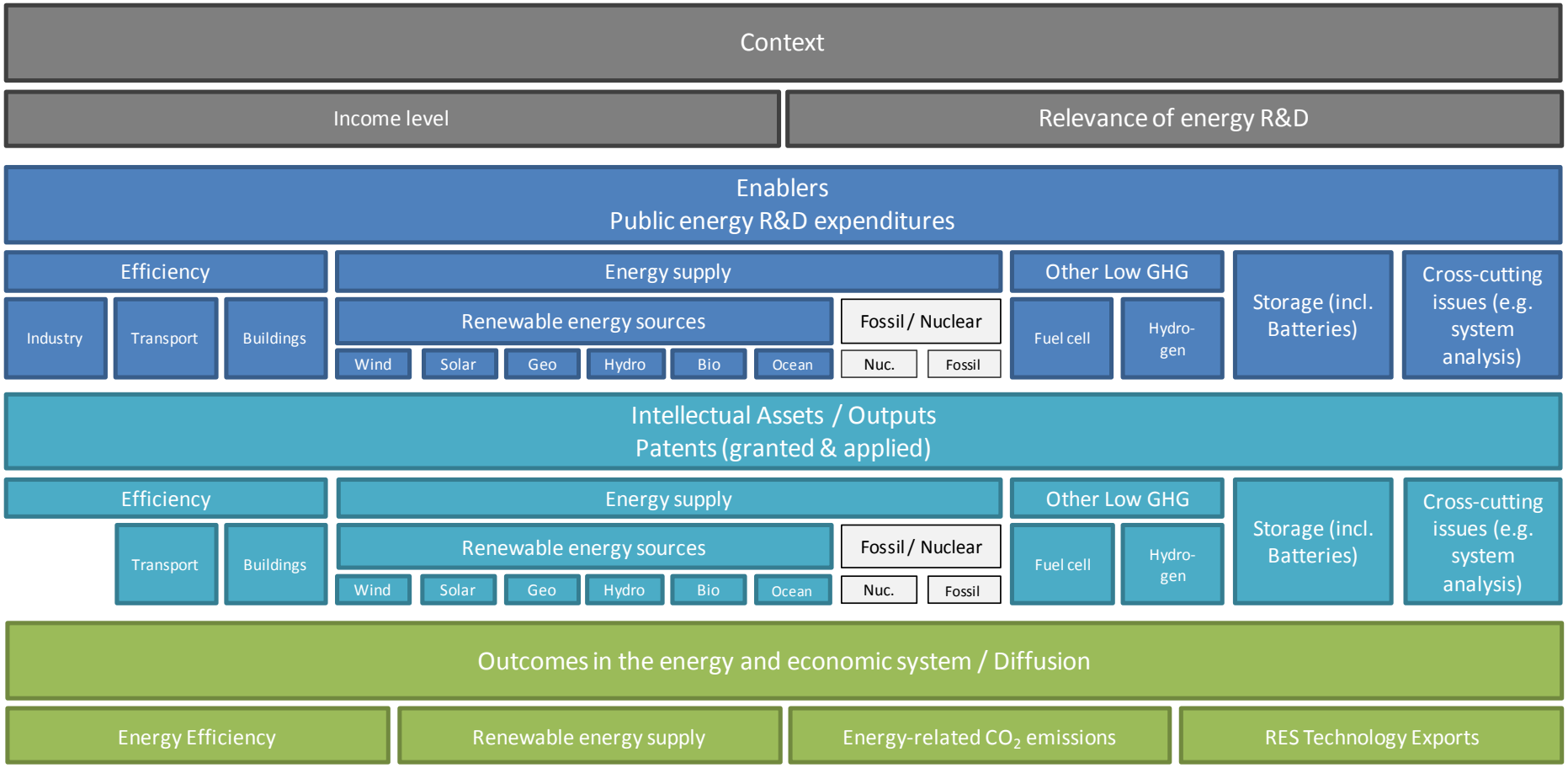


Disaggregation of data reflecting different levels of the energy system

Disaggregation of IEA data on public energy R&D expenditures

ENERGY EFFICIENCY	FOSSIL FUELS	RENEWABLE ENERGY SOURCES	NUCLEAR	HYDROGEN AND FUEL CELLS	OTHER POWER AND STORAGE TECHNOLOGIES	OTHER CROSS-CUTTING TECHS/RESEARCH
Industry	Oil and gas	Solar energy	Nuclear fission	Hydrogen	Electric power conversion	Energy system analysis
Res. and comm. buildings, appliances and equipment	Coal	Wind energy	Nuclear fusion	Fuel cells	Electricity transmission and distribution	Basic energy research not allocated
Transport	CO2 capture and storage	Ocean energy			Energy storage	Other
Other energy efficiency		Biofuels				
		Geothermal energy				
		Hydroelectricity				
		Other renewable energy sources				

Disaggregate structure of a pilot RES EIS



Data sources for a pilot RES EIS

- GDP: OECD National Accounts Database
- Population: OECD Population Statistics
- Public R&D: OECD Research and Development Statistics
- Energy R&D Expenditure: IEA Energy R&D Statistics
- Patents: OECD Patents Statistics
- Energy flows: IEA Energy Balances
- GHG emissions: IEA CO_2 Emissions from Fuel Combustion
- RES Technology Exports: UN COMTRADE Database

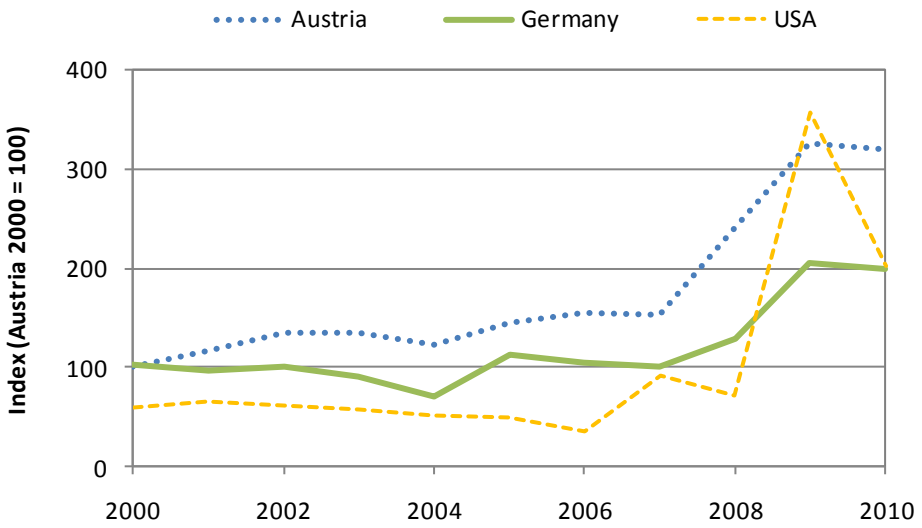
Data availability

Stage of innovation	Dimension / Indicator			Number of countries	Time period total
Context	GDP per capita			34	1970-2012
	% of energy R&D in total public R&D			14	1975-2011
Enablers	**Public energy R&D expenditures** Public energy R&D expenditure per GDP	Energy efficiency	Buildings	20	1975-2011
			Transport	20	1975-2011
			Industry	20	1975-2011
		Rewable energy suply	Wind	20	1975-2011
			Solar	20	1975-2011
			Geothermal	20	1975-2011
			Hydro	20	1975-2011
			Biomass	20	1975-2011
			Ocean	19	1975-2011
		Other low GHG technoglogies	Fuel cells	13	2004-2011
			Hydrogen	23	2004-2011
		Storage		20	1975-2011
		Cross cutting issues (incl. energy system analysis)		18	1975-2011
Intellectual Assets / Outputs	**Patents** Number of patents applied or granted per GDP	Energy efficiency	Buildings	34	1999-2010
			Transport	34	1999-2010
		Rewable energy suply	Wind	34	1999-2010
			Solar	34	1999-2010
			Geothermal	34	1999-2010
			Hydro	34	1999-2010
			Biomass	34	1999-2010
			Ocean	34	1999-2010
		Other low GHG technoglogies	Fuel cells	34	1999-2010
			Hydrogen	34	1999-2010
		Storage		34	1999-2010
Outcome in the energy and economic system / Diffusion	Energy efficiency - GDP per total final energy consumption			34	1970-2011
	Share of RES in Primary Energy Supply			34	1970-2011
	Energy-related CO_2 emissions			34	1970-2011
	Share of RES technology exports in total exports			34	1970-2011

Exemplary Indicators:
Enablers and Intellectual Assets

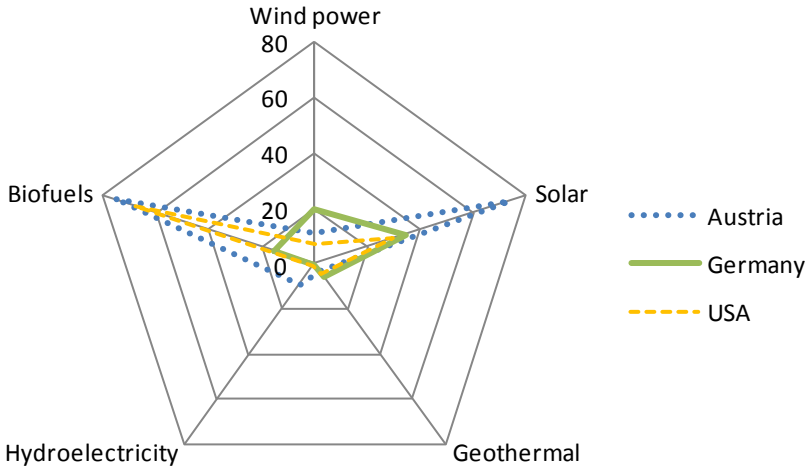
Enablers: Public RES R&D expenditures in AT, DE & the US (I)

- Development of public RES R&D expenditure per GDP



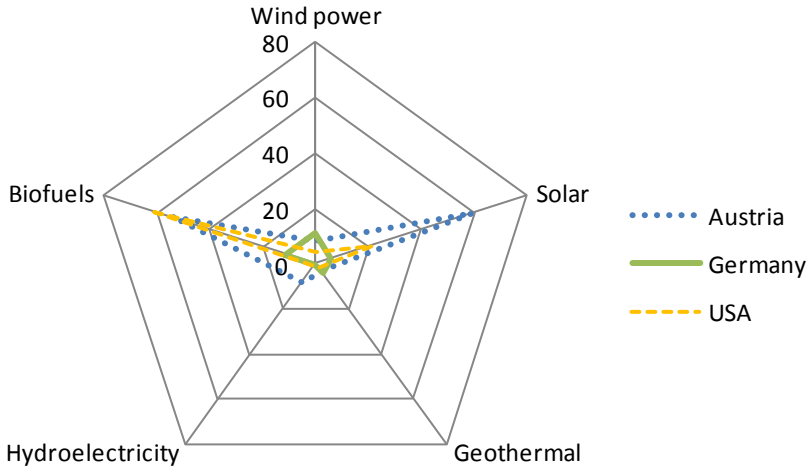
Enablers: Public RES R&D expenditures in AT, DE & the US (II)

- Structure of public RES R&D expenditure in 2010



Unit: $ / M $

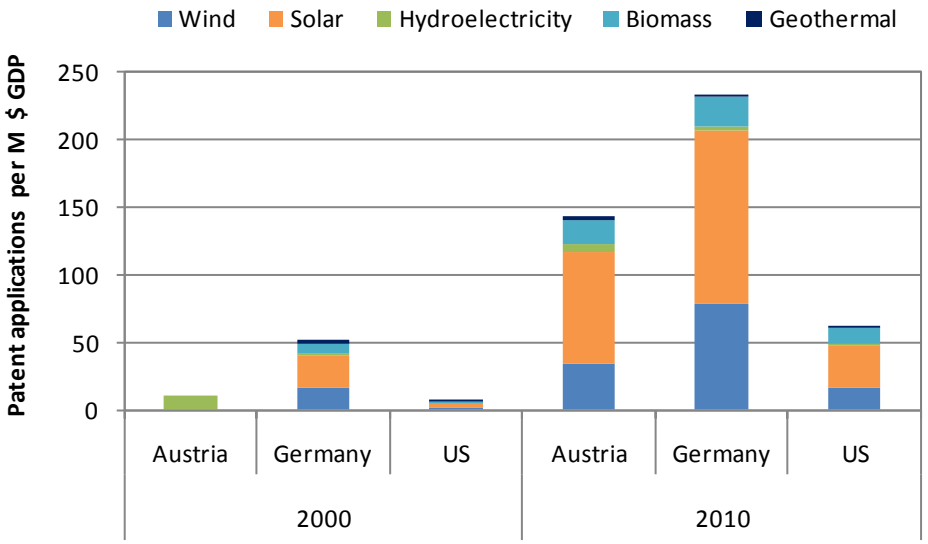
- Public RES R&D expenditure 2010 compared to 2000



Unit: $ / M $

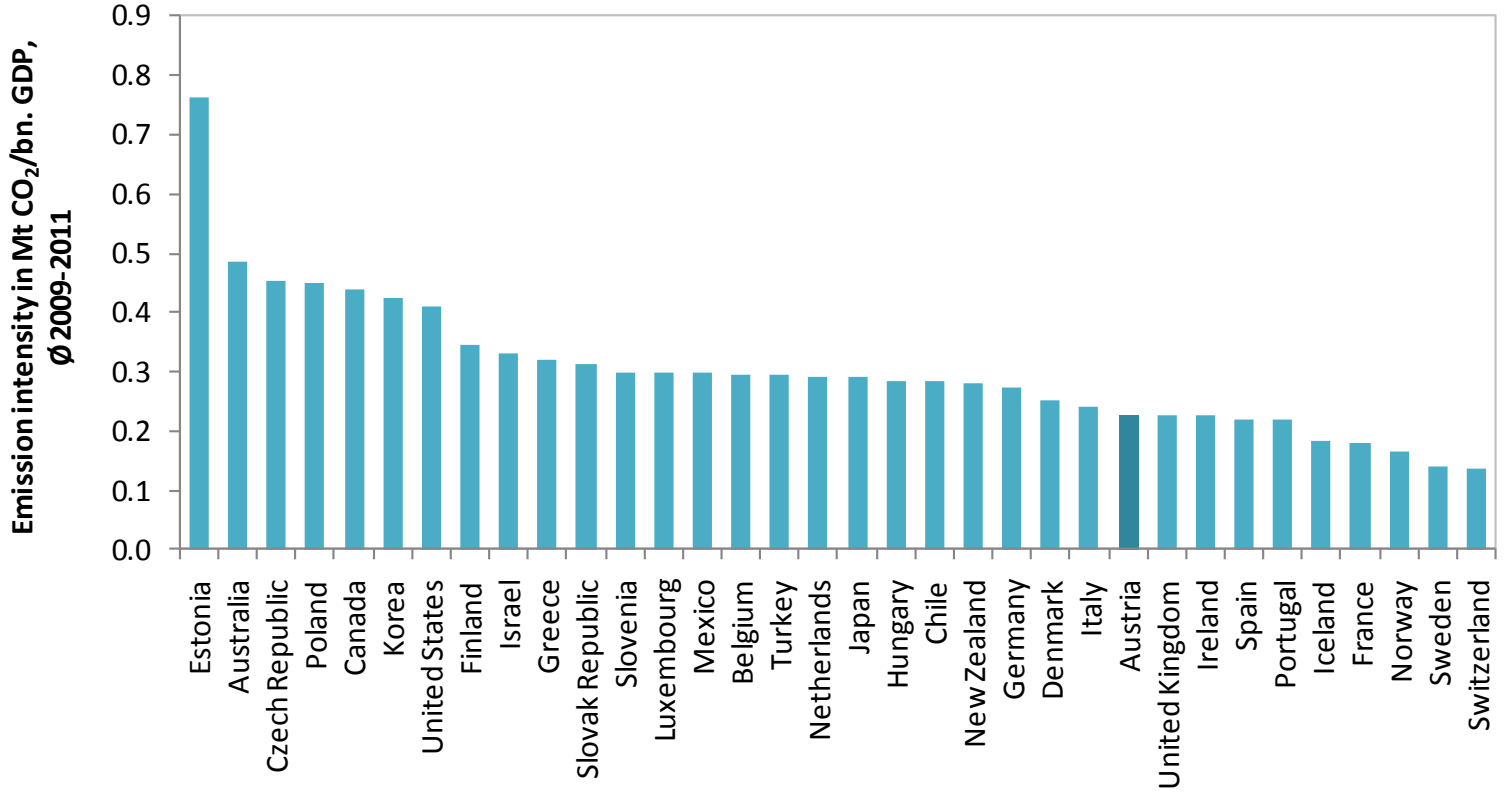
Intellectual Assets: RES patent applications in AT, DE & the US

- Development of RES patent applications per GDP

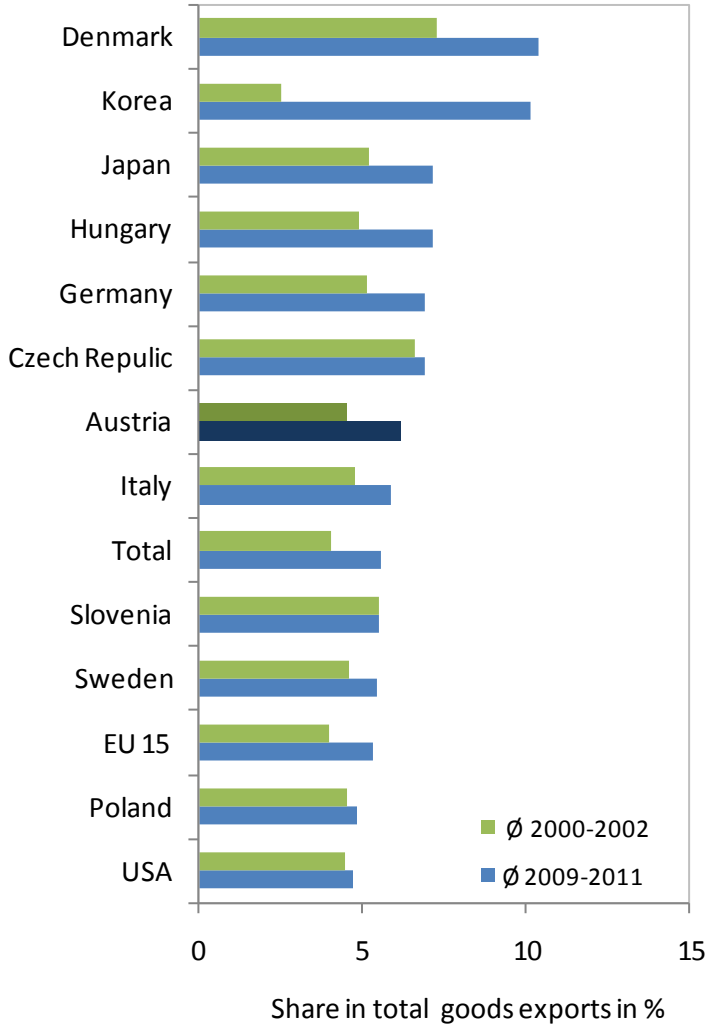


Exemplary Indicators:
Outcomes in the energy and economic system / Diffusion

Outcomes: Emission intensity in selected OECD countries



Outcomes: Share of RES goods in total goods exports



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Concluding remarks

- Pilot RES Energy Innovation Scoreboard as stimulator for discussion
- Energy innovation scoreboard should rest on agreed conceptual framework
- Indicators included should be thoroughly argued and discussed with stakeholders
- Implementation faces challenges:
  - Lack of firm level data
  - Limited regional coverage for public energy R&D
  - Lack of specific data on human capital
  - ...

Thank you!

“Pilot Energy Innovation Scoreboard”

Claudia Kettner, Angela Köppl, Thomas Steffl and Hannes Warmuth (2014)

http://www.wifo.ac.at/publikationen?detail-view=yes&publikation_id=47104

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