GWS SPECIALISTS IN EMPIRICAL ECONOMIC RESEARCH

WHO BENEFITS FROM CLIMATE INVESTMENTS?

It depends.

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Introduction

- Latest since Paris COP 21: the world has to turn serious in its efforts in climate change mitigation (even though some seem to think otherwise…).
- 187 nations representing 98 percent of the world's greenhouse gas emissions, submitted their Intended Nationally Determined Contributions (INDC).
- Fulfilling these commitments of limiting warming to below 2 degrees Celsius will spur a huge clean energy investment opportunity.
- Even today, investment in clean energy surpassed investment in fossil fuels.

Intro cont‘d

- RE accounts for 55.3% of the new electricity generating capacity added worldwide in 2016 and solar power dominates new installations (Frankfurt School-UNEP Centre/BNEF 2017).
- 2016 strong year for energy smart technologies ($41.6 billion, up 29% Frankfurt School-UNEP Centre/BNEF 2017).
- To meet future targets, we will need more!

Intro cont‘d

The investment gap….

- The Economist titled in 2015 “Germany is investing too little—hurting Europe, the world and itself “.
- This translates into the concern that Germany will live off the depreciating stock of infrastructure in the near future.
- So-called green investment could therefore fill this gap

The Modeling Approach

The Model

- Macroeconomic energy and environmental model
  - Based on official statistics (SNA, time series of IOT)
  - Bottom-up (63 sectors)
  - Fully interdependent
  - Energy balance systematic
  - Parameters econometrically derived from historical time series, no neoclassical general equilibrium
  - Open for expert information
- Suitable for simulation of direct and indirect effects
  - Esp. counterbalancing effects
  - Results are net after all adaption processes

The Scenario

Lead markets:

- Renewables
- Buildings
- Digitalization and energy efficiency

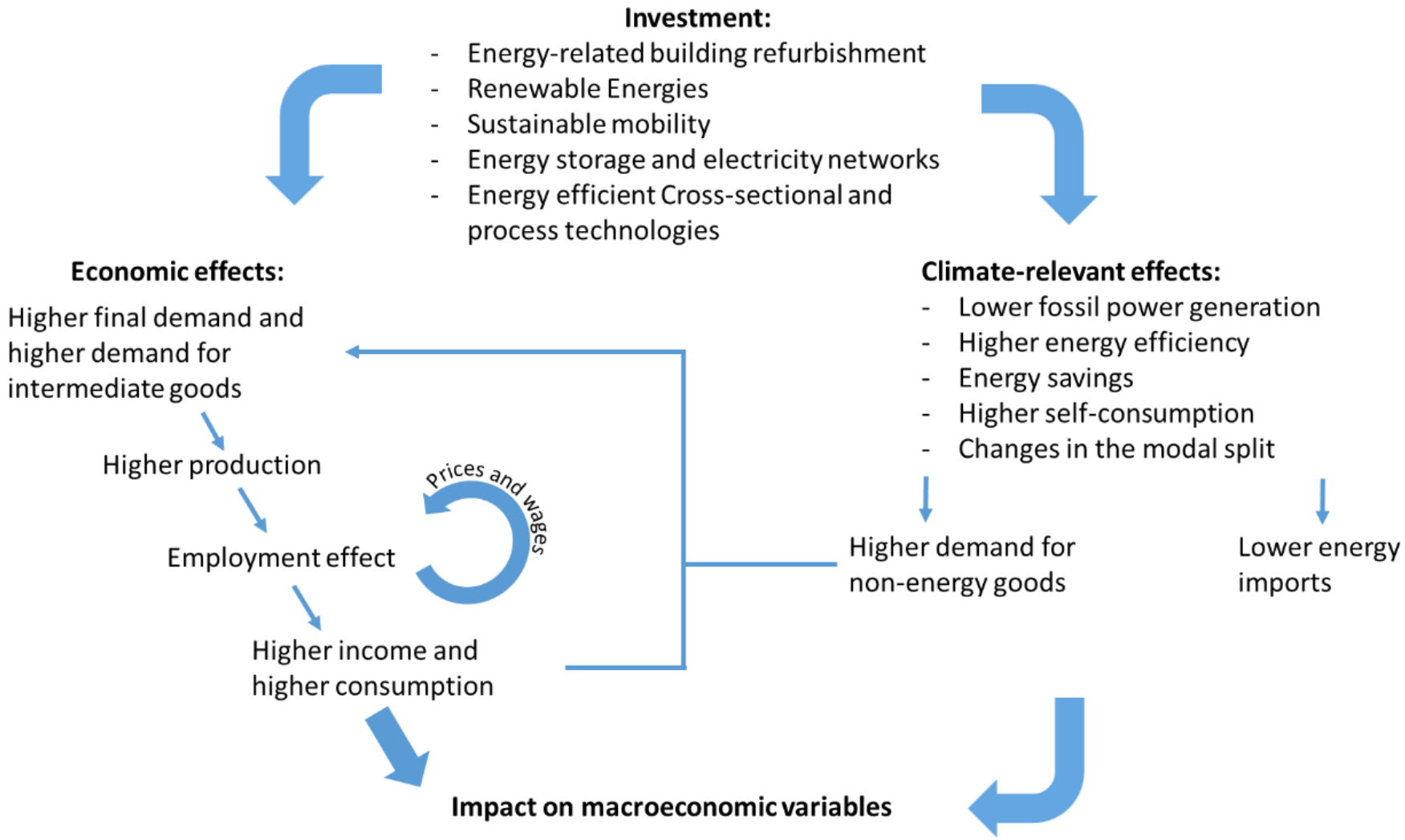
Total investment

- 12 billion in equipment
- 34 billion in buildings

Time horizon

2015 – 2030

Effects of investment targeted at GHG mitigation and green infrastructure



Source: GWS

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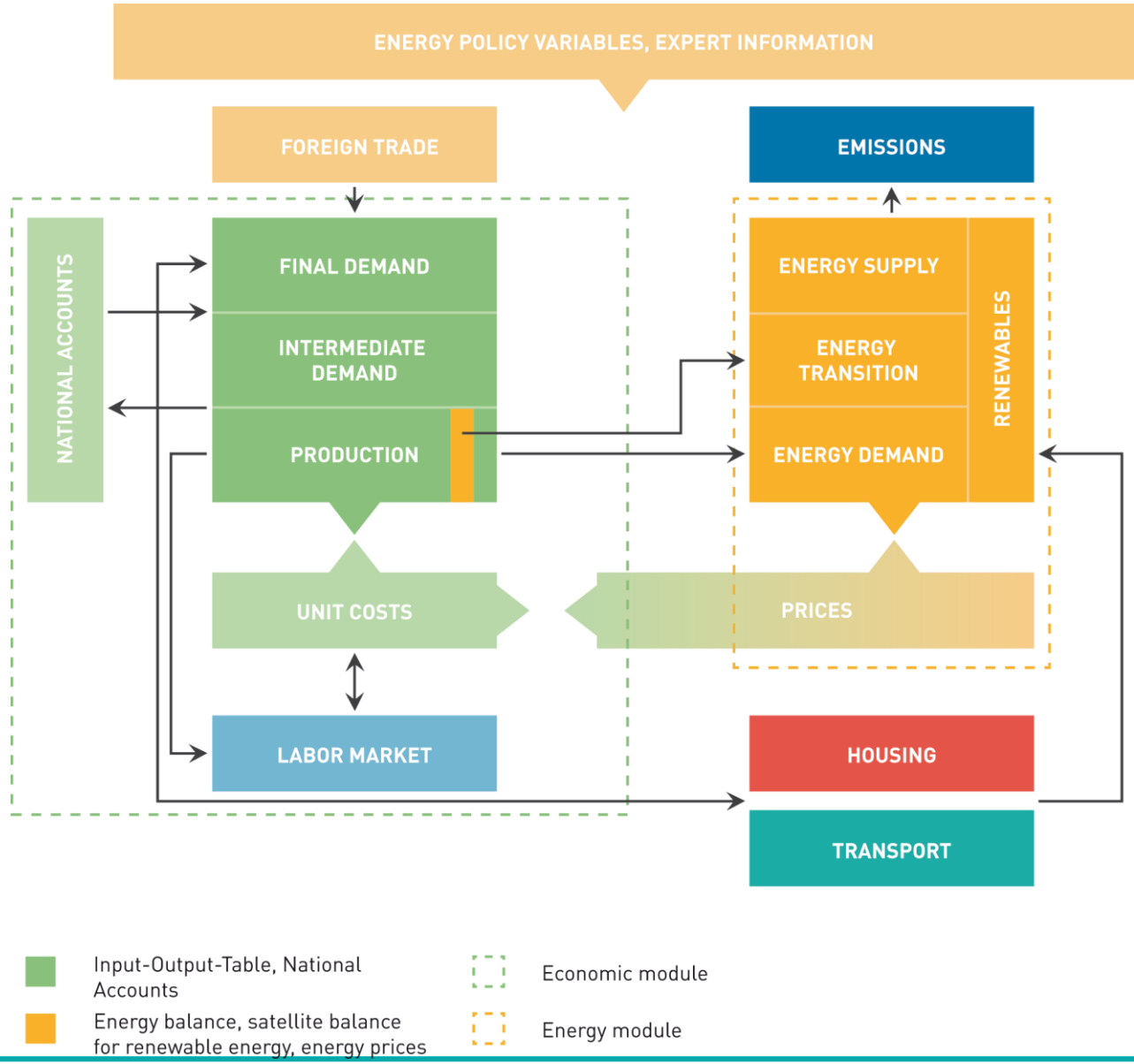

ENERGY POLICY VARIABLES, EXPERT INFORMATION
FOREIGN TRADE
EMISSIONS
NATIONAL ACCOUNTS
FINAL DEMAND
INTERMEDIATE DEMAND
PRODUCTION
ENERGY SUPPLY
ENERGY TRANSITION
ENERGY DEMAND
RENEWABLES
UNIT COSTS
PRICES
LABOR MARKET
HOUSING
TRANSPORT
Input-Output-Table, National Accounts
Energy balance, satellite balance for renewable energy, energy prices
Economic module
Energy module

Data and detailed modeling (1/3)

Investment scenario:

- Renewables
  - ⇨ Wind and solar
- Buildings
  - ⇨ Insulation residential
  - ⇨ Insulation public buildings
- Efficiency
  - ⇨ Digitalization
- Transport
  - ⇨ Bike lanes
  - ⇨ Rails

Who pays for additional costs?

- Feed-in tariff – all non-exempt users
- Building owner – increases costs of housing, rents or public expenditure
- Firms, payback time < lifetime of appliance
- Public budget

Data and detailed modeling (2/3)

- Studies estimate that "Industry 4.0" can achieve energy efficiency levels of 3.5% - 30%, here set to 15%.
- Pay-back time of less than 4 years
- Market potential of 25 billion Euros
- Very low penetration rate of digital solutions in the industry of 1% in 2015,
- annual growth of 17% in the reference scenario and 31% annual growth in the investment scenario, later less.
- In 2030, the penetration rate of digital solutions will reach 10% in the reference scenario, and 50% in the investment scenario.

Data and detailed modeling (3/3)

Storage investment

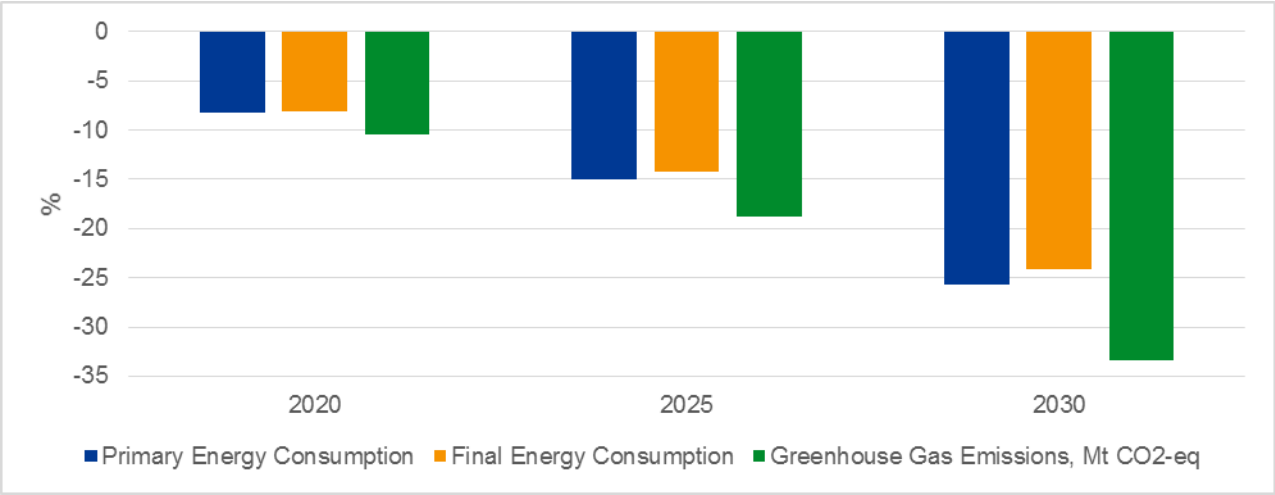
- Investments in the grid sector in the reference scenario amount to 4 billion Euros annually in Germany.
- Grid development includes expansion as well as replacement
- Total storage capacity will amount to 5.5 GW in 2030.
- Price reduction of electricity storage of 2.5% per year and a starting price of 1.800 Euro/kW in 2015, an annual investment sum of 613 million Euros in 2030 is the result.

Results – Economic effects

- Advantageous overall economic development

- GDP: 2020 1.4% higher, 2030 2.4%.
- Employment +220,000
- More consumption due to more income, more employment
- More imports due to more production

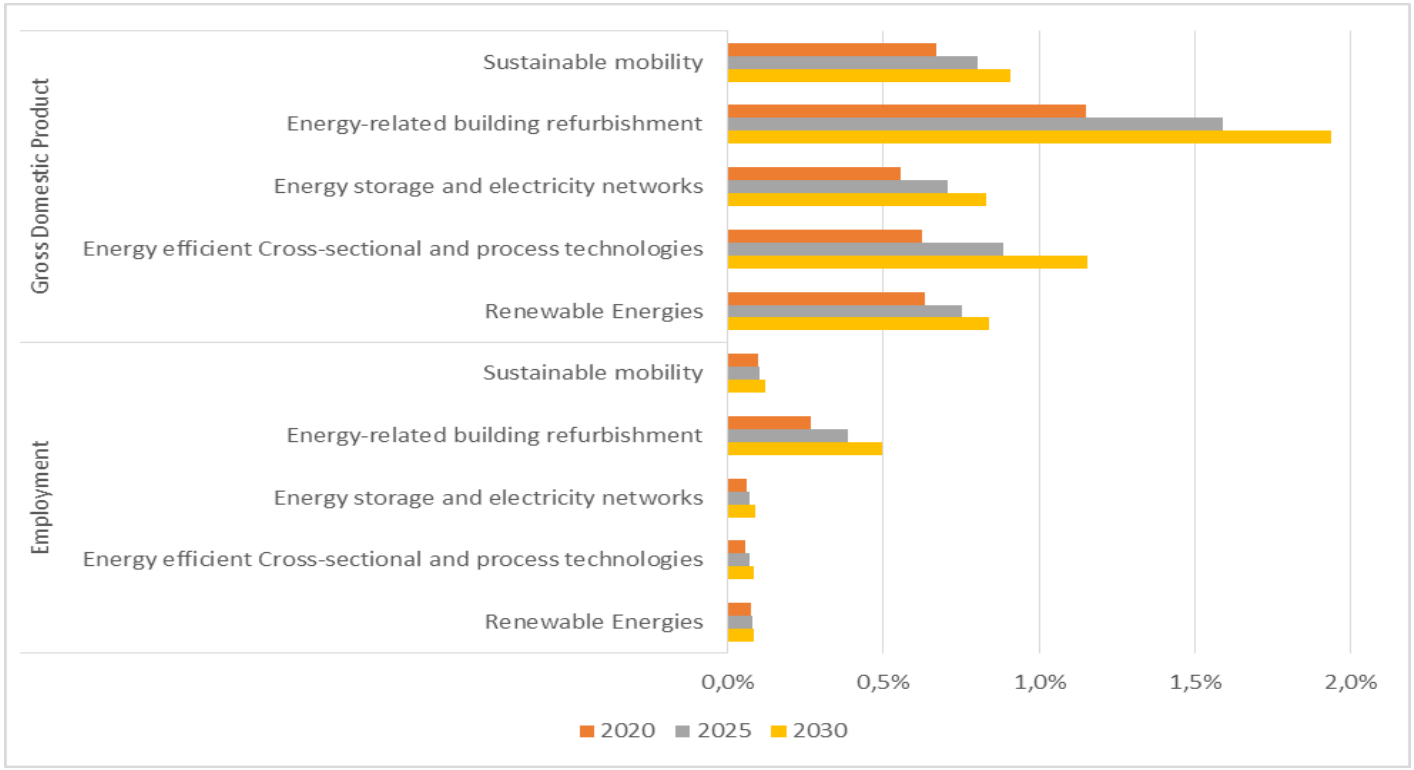
	Absolute deviation (in bn. Euro)			Relative deviation (in percent)		
	2020	2025	2030	2020	2025	2030
Private final consumption Expenditure	21,5	34,5	49,7	1,3	2,0	2,7
Government final consumption expenditure	-0,4	-0,4	-0,7	-0,1	-0,1	-0,1
Investment (equipment)	9,9	12,7	17,8	2,8	3,3	4,1
Investment (buildings)	16,9	25,5	34,3	6,2	10,3	13,5
Exports	4,3	4,8	2,1	0,3	0,2	0,1
Imports	9,5	13,7	20,9	0,7	0,8	1,0
GDP	42,5	62,5	80,6	1,4	2,0	2,4



Environmental indicators on target:

- Less primary energy consumption
- Less final energy consumption
- Less GHG emissions
  - ⇨ However: additional growth leads to „rebound“ (less less of all…)

Sub-scenarios in detail

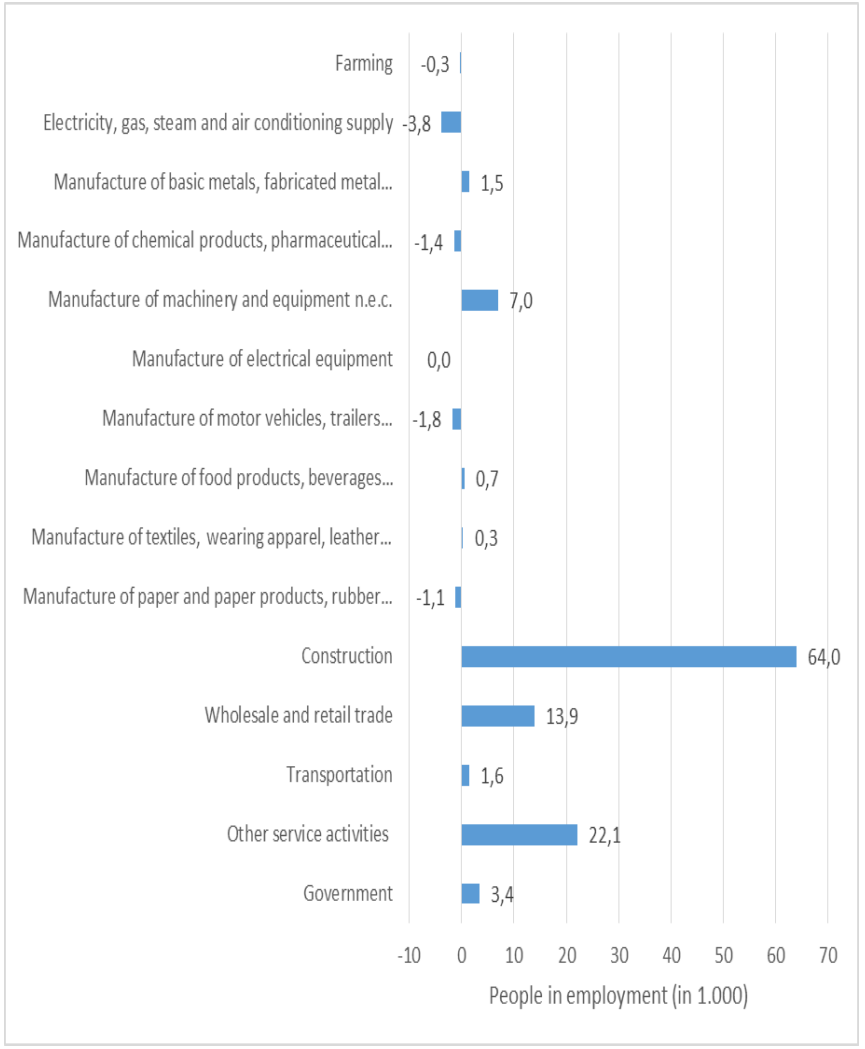


- Most jobs and GDP from buildings
- Increasing positive contribution to GDP from all
- Employment effects small (total employment **32 Million**)

Results – jobs in different economic sectors

- Construction followed by services
- The latter involved in any increase in economic activity through the intermediate goods structures.
- construction receives additional demand via IO, e.g. from the expansion of renewable energy.
- The manufacturing sector mixed
  - ⇨ wages and salaries rising
  - ⇨ labor market is becoming tenser
- E.g. automotive reacts to rising wages and receives no direct or indirect impulses from the scenario
- Machinery faces additional demand and higher wages.

Winners and losers



Conclusions

- The results of the economic model calculations show positive overall economic responses to a scenario that is increasingly investing in climate protection measures.
- The resulting growth effects are not particularly large, expressed as changes in GDP. Largest specific impact in efficiency increases, in particular in industry.
- Because: produced in Germany and short payback periods
- The latter enhances in the positive effects in the economic cycle, since what is saved in energy expenditure can be spent again for other purposes. The energetic building renovation pays for itself in the long term, so the savings are also used for the counter-financing of the investment over a longer period. Renewable energy leads to revenues from the operators, but in the short to medium term, they increase the prices for those consumers who are burdened with them. This reduces the effect on GDP.
- In terms of employment, labor intensity in the construction industry overlays all other effects. Infrastructure investment in the "Sustainable Mobility" therefore has the largest impact on employment, followed by the energetic building renovation. Also with regard to employment, the expansion of renewable energy has relatively little effect.

Conclusions cont‘d

- This paper contributes a cross sectional view and brings together bottom-up analyses of different measures, the discussion on the benefits of industry 4.0 and digitalization and the debate on raising the investment rate in Germany.
- Limits of the current analysis points at further research needs:
  - ⇨ Several markets such as agriculture were not taken into account.
  - ⇨ No suggestions on policy instrument to attract such large amounts of capital. This will be an important direction of future research.

Thank you for your attention.

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