Risks of low-carbon transition in Poland Warsaw, October 12, 2017 Centrum Konferencyjne Ogrodowa 58 (VIP room)



Energy-driven pathways and long-run economic growth: A Fuzzy Cognitive Mapping risk analysis

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Two policy strategies and their "stories"



Deployment of Intermittent Renewable Energy Sources and long-run economic growth

- 1. The labour loss
- 2. The energy security
- 3. The barriers of entry
- 4. Development of competences
- 5. Low EU-ETS prices

Support for Coal-Based Power and Long-run Economic Growth

- 1. International reputation
- 2. Maintaining competitiveness in coal technologies
- 3. The lock-in and the waste of coal R&D effort
- 4. Dependence on imported coal
- 5. High EU-ETS prices







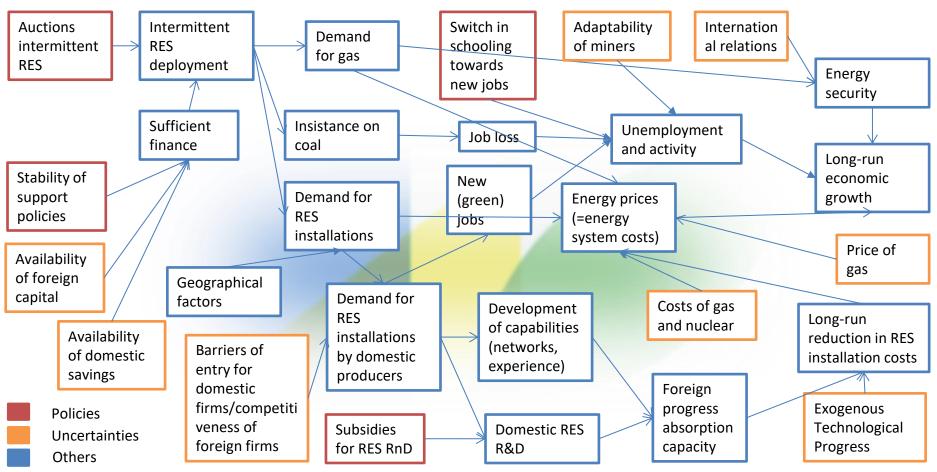
Deployment of Intermittent Renewable Energy Sources and long-run economic growth





Deployment of Intermittent Renewable Energy Sources



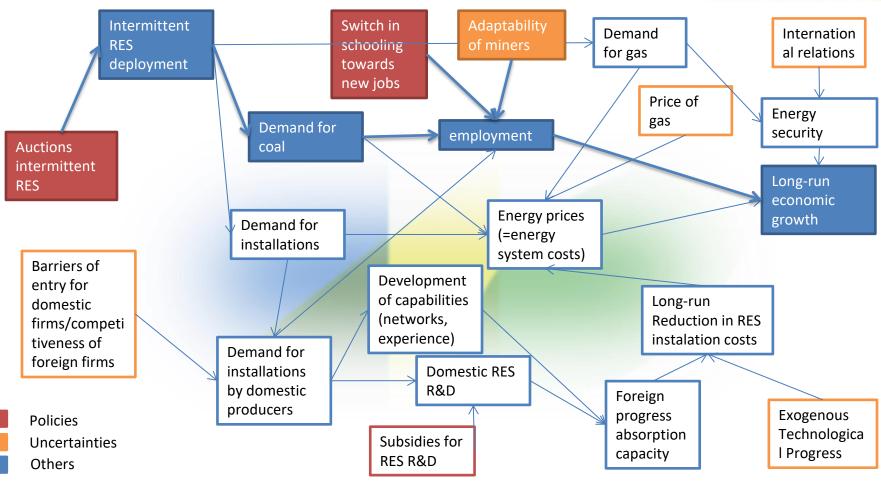






THE LABOUR LOSS STORY



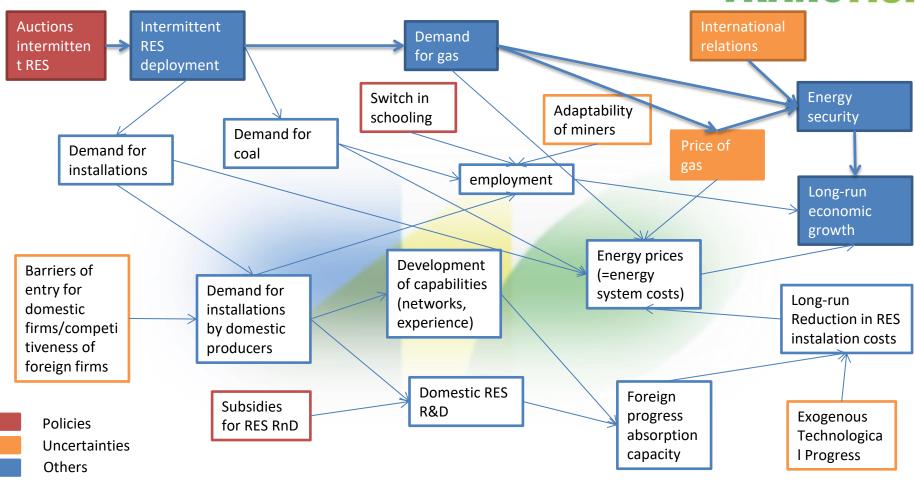






THE ENERGY SECURITY STORY









THE BARRIERS OF ENTRY STORY **TRANSrisk Demand** International for gas relations **Auctions** Energy Switch in Intermittent intermitten Adaptability security schooling **RES** Price of t RES of miners deployment gas Demand for employment coal Demand for Long-run installations economic **Energy prices** growth (=energy Barriers of system costs) Development Demand for of capabilities Long-run installations (networks, firms/competi **Reduction in RES** by domestic experience) tiveness of instalation costs producers Foreign **Domestic RES** Exogenous progress **Policies** R&D



Uncertainties

Others

Subsidies

for RES RnD



Technologica

I Progress

absorption

capacityE

DEVELOPMENT OF COMPETENCES STORY **TRANSrisk** Demand Auctions for gas Switch in Intermittent intermitten schooling RES Energy Adaptability Internation t RES deployment security of miners al relations Demand for coal Price of gas employment Long-run economic Demand for growth Energy prices installations (=energy system costs) Barriers of Development entry for Demand for of capabilities Long-run domestic installations (networks, **Reduction in RES** firms/competi experience) by domestic instalation costs tiveness of producers foreign firms Foreign **Domestic RES** progress **Policies** Subsidies R&D absorption for RES RnD Uncertainties capacity l Progress Others







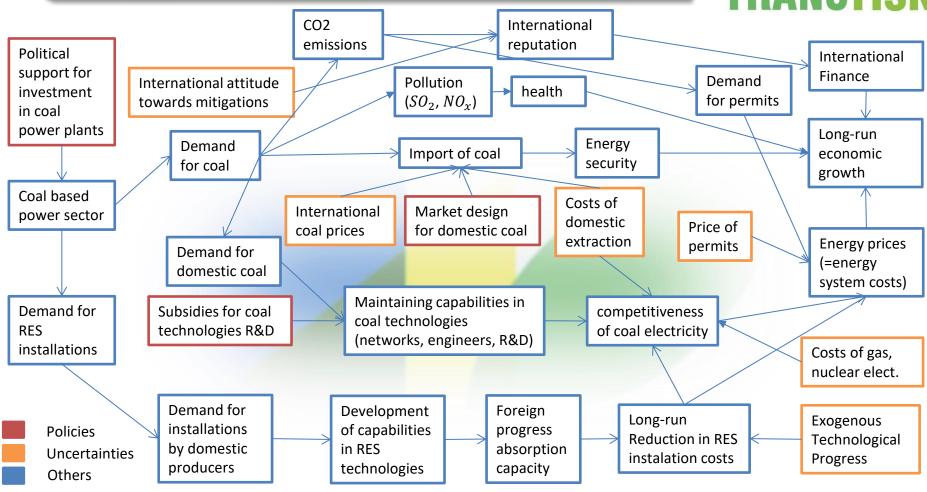
Support for Coal-Based Power and Long-run Economic Growth





SUPPORT FOR COAL BASED POWER









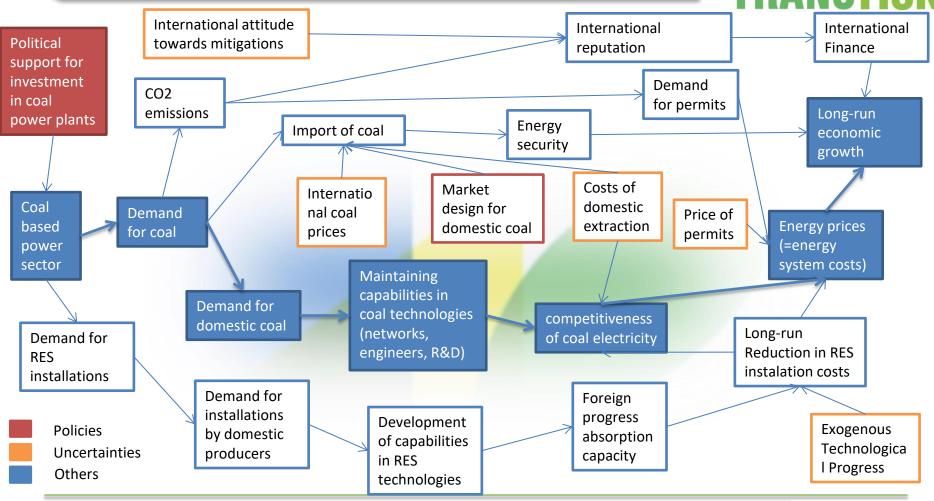
INTERNATIONAL REPUTATION STORY **TRANSrisk** International **Political** International attitude International reputation support for **Finance** Demand investment for permits in coal Long-run power plants economic growth CO₂ Import of coal Energy Price of security emissions permits Coal based Market Internatio Costs of power design for **Energy prices** nal coal domestic sector domestic coal (=energy prices extraction **Demand** system costs) for coal Maintaining capabilities in competitiveness coal technologies Demand for Demand for Long-run of coal electricity (networks, domestic coal **RES** Reduction in RES engineers, R&D) installations instalation costs Demand for Development Foreign installations **Policies** Exogenous of capabilities progress by domestic Technologica Uncertainties in RES absorption producers **I Progress** technologies capacity Others





MAINTAINING COMPETITIVENESS IN COAL TECHNOLOGIES









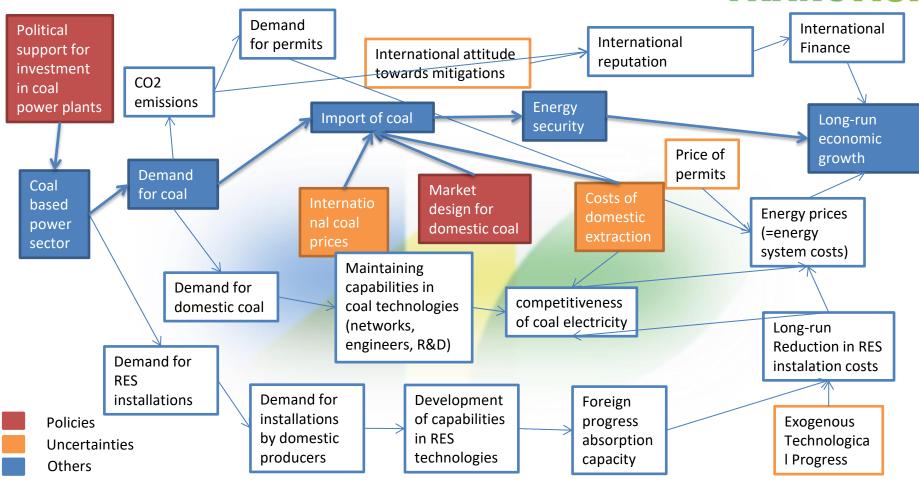
THE LOCK-IN STORY AND THE WASTE OF COAL R&D EFFORT **TRANSrisk** International International International attitude **Political** Finance reputation towards mitigations support for CO2 investment Long-run Demand emissions in coal economic for permits power plants growth Import of coal Energy Price of security permits **Demand** Coal Internatio for coal based Market nal coal Costs of design for power prices **Energy prices** domestic domestic coal sector Demand for (=energy extraction domestic coal system costs) Maintaining capabilities in competitiveness Subsidies for coal technologies of coal electricity (networks, coal Long-run Demand for technologies engineers, R&D) **Reduction in RES** RES R&D instalation costs installations Demand for Development Foreign installations **Policies** of capabilities progress by domestic Uncertainties in RES absorption producers technologies Others capacity **I Progress**





DEPENDENCE ON IMPORTED COAL STORY









HIGH EU-ETS PRICES STORY **TRANSrisk** International attitude International International towards mitigations reputation Finance CO₂ Energy emissions Import of coal Demand security for permits Long-run economic growth Costs of Market Internatio Price of design for domestic nal coal Political domestic coal extraction prices Demand support for **Energy prices** for coal investment (=energy Demand for in coal system costs) competitiveness domestic coal power plants Maintaining of coal electricity capabilities in Subsidies for coal technologies Coal Long-run coal (networks, **Reduction in RES** based technologies engineers, R&D) instalation costs power R&D sector Foreign Demand for Development Exogenous Demand for **Policies** Technologica of capabilities progress installations **RES** Uncertainties absorption in RES **I Progress** by domestic installations capacity technologies Others producers







Fuzzy Cognitive Mapping Exercise

Eliciting your knowledge





What is the purpose?



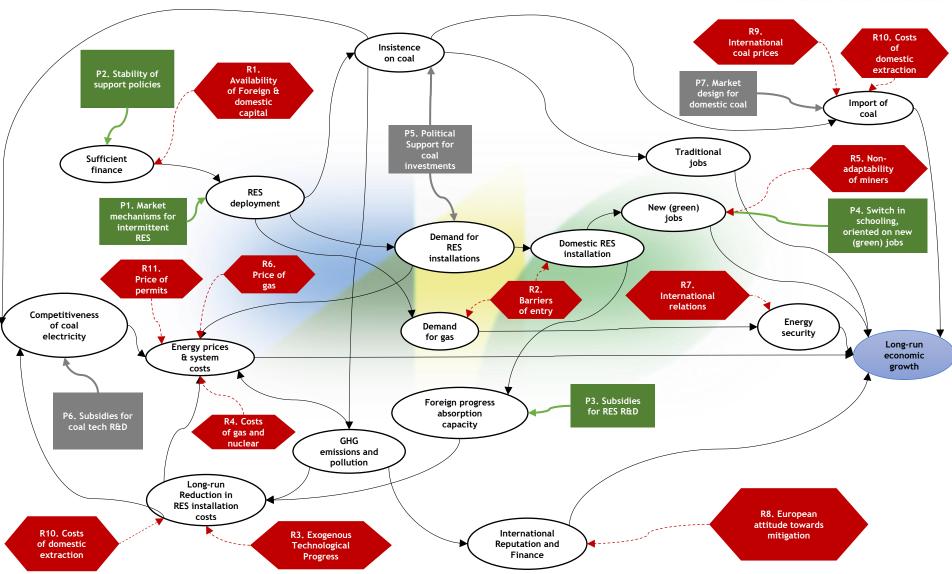
- Capturing stakeholder-driven narratives: what impact do Polish stakeholders think policies and risks have on the Polish economy?
- Using stakeholders' knowledge towards understanding which of the two pathways (RES or COAL) is more beneficial to Poland's economic growth.
- 3 Simulating that knowledge to stress-test the two pathways against different risk-driven scenarios.
- Informing stakeholders of the results in a way that helps understand which route we should follow
- On a second level, appreciating which of the policies/directions of each pathway are more beneficial for the success of the pathway





Low-carbon transition: Global Map





Filling in the Stakeholder Input Table



- Please fill in each white (blank) cell of the table, by indicating the type and level of impact that the row concept (on the right) has on the column concept (on the top), and disregarding all other cells.
- A positive impact means that a positive change on the row concept will have a positive effect on the column concept, whereas a negative impact means that a positive change on the row concept will have a negative effect on the column concept.
- Also, please use the following set of variables:

```
+ = positive, very weak impact
++ = positive, weak impact
+++ = positive, strong impact
++++ = positive, very strong impact
-- = negative, very weak impact
-- = negative, weak impact
-- = negative, strong impact
-- = negative, very strong impact
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Leave blank if you deem there is no connection between the two concepts.

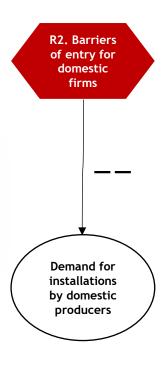




Stakeholder Input Table: Example



| | Intermittent RES deployment | Sufficient finance | Demand for coal | Demand for RES installations | Demand for installations by domestic producers | Employment | Demand for gas | Energy security | Energy prices (=energy system costs) | Foreign progress absorption capacity |
|---|--------------------------------|--------------------|-----------------|---------------------------------|---|------------|----------------|-----------------|--------------------------------------|---|
| R1. Availability of foreign and domestic capital | | | | | | | | | | |
| R2. Barriers of entry for domestic firms/competitiveness of foreign firms | | | | | | | | | | |
| R3. Exogenous Technological Progress | | | | | | | | | | |
| R4. Costs of gas and nuclear | | | | | | | | | | |
| R5. Adaptability of miners | | | | | | | | | | |
| R6. Price of gas | | | | | | | | | | |
| R7. International relations | | | | | | | | | | |
| R8. International attitude towards mitigations | | | | | | | | | | |







Example: Smart meters in Greece



| | Installation of smart meters | Costs for end-users, owners | Public acceptance of energy saving measures | Social compliance and behavioural change | Better energy monitoring and control of utility bills | Rebound effect | Energy saving and efficiency |
|---|---------------------------------|--------------------------------|---|--|---|----------------|---------------------------------|
| P6. Deployment of smart metering systems | ++++ | | | | | | |
| R2. Political instability | _ | | | | | | |
| R3. B <mark>ureaucracy</mark> | | | | | | | |
| R4. Demanding regulatory framework in relation to market maturity | _ | | | | | | |
| R5. Inadequate banking sector | _ | | | | | | |
| R6. Social <mark>opposition</mark> | _ | | | | | | |
| R7. Inexperienced personnel - poor technical skills | | | | | | | |
| Installation of sm <mark>art meters</mark> | | + | | | ++ | | |
| Costs for end-users, owners | | | | | | | |
| Public acceptance of energy saving measures | | | | +++ | | | |
| Social compliance and behavioural change | | | | | | | ++ |
| Better energy monitoring and control of utility bills | | | + | | | + | |





Example: Smart meters in Greece



