# Innovation, Technology and Employment: Energy

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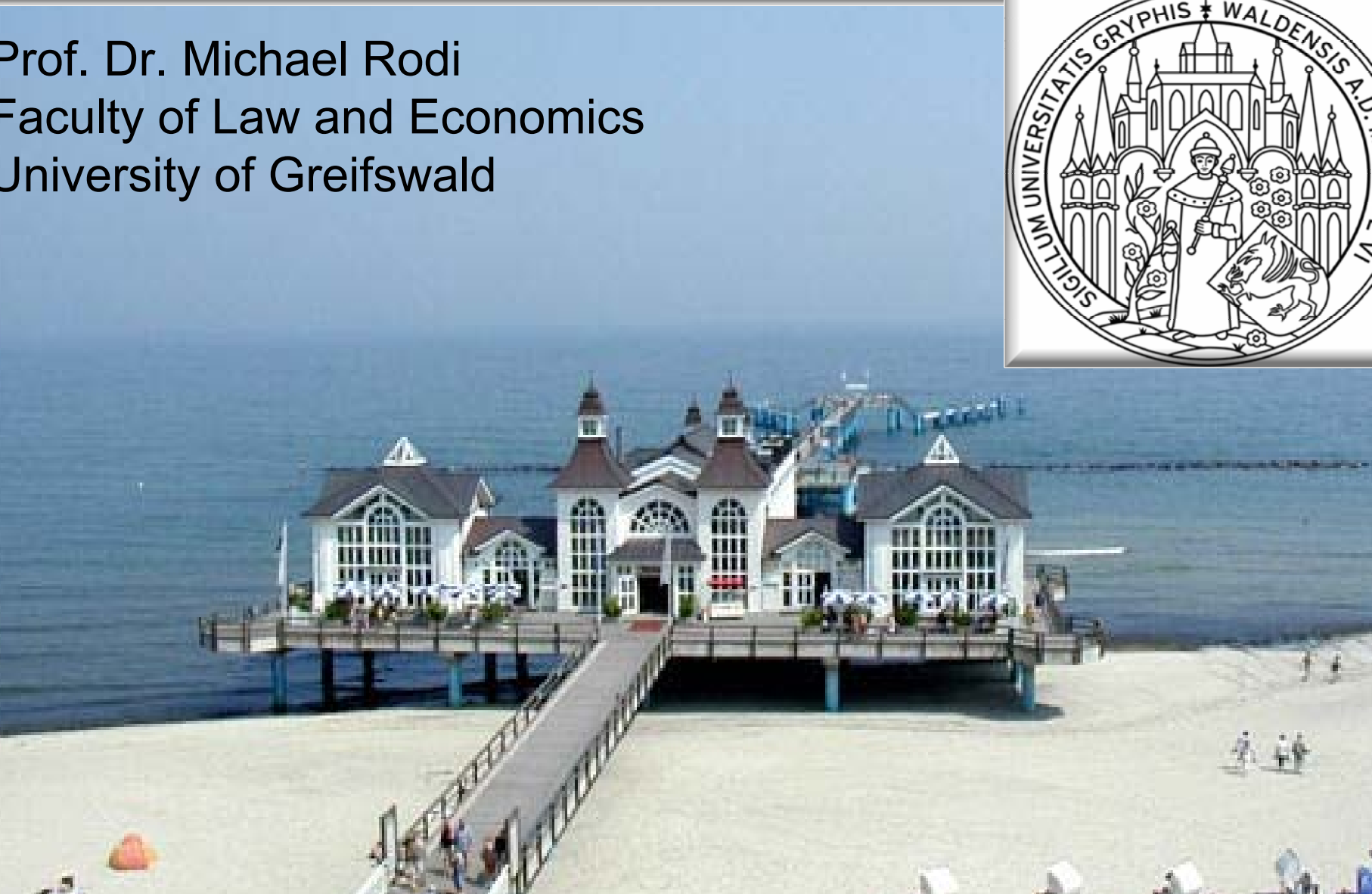


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# 1. Background

## 1.1 Sustainable Development and Energy Revolution

**Four Central Themes:**
***Innovation - Technology - Employment - Energy***

**Innovation and Technology** – traditional themes of economics

**Employment** – a key concern of social policy

**Energy** – a key concern of environmental policy, especially: climate change

🗀this results in the 3 pillars of sustainable development

# 1. Background

## 1.1 Sustainable Development and Energy Revolution

### Different Aspects of the Energy Revolution:

Paradigmatic shift towards sustainable energy sources, e.g.: renewable sources (such as wind or solar power) or new and experimental sources (such as nuclear fusion)

Dramatic improvement of energy efficiency in all sectors, e.g.: how far can the mileage and fuel efficiency of automobiles be improved *vis-à-vis* current levels?

Technologies targeted at mitigating environmental impacts, e.g.: carbon sequestration, reflection of sun rays

# 1. Background

## 1.2 Energy Revolution and Innovation

**Successful climate policies call for an "Energy Revolution" geared towards a fundamental technological innovation**

Innovation progress is a complex and dynamic process involving:
(1.) Invention
(2.) Innovation
(3.) Diffusion

Regulatory control is *particularly difficult* on the first and second levels

## 1. Background

### 1.3 State Responsibility for Innovation

ver since *Joseph Schumpeter* promulgated his innovation theory it has been recognized that market economies are characterized by a constant process of innovation

rice-induced innovation needs to be complemented with policy-induced innovation. Unlike conventional innovation policy, it may not be limited to securing price-induced innovation (copyright – trademarks)

# 1. Background

## 1.3 State Responsibility for Innovation

**nnovation policy bears opportunities and challenges:**

**1) Innovation can contribute to risk management, but can also give rise to new risks**

tate responsibility for innovation is accompanied by state responsibility for risk

"Positive" innovation regulation is geared towards stimulation of innovation, while "negative" innovation regulation limits innovations in the interest of risk control

## 1.3 State Responsibility for Innovation

**nnovation policy bears opportunities and challenges:**

**2) "Lock-in-Effect" of technological incentives**

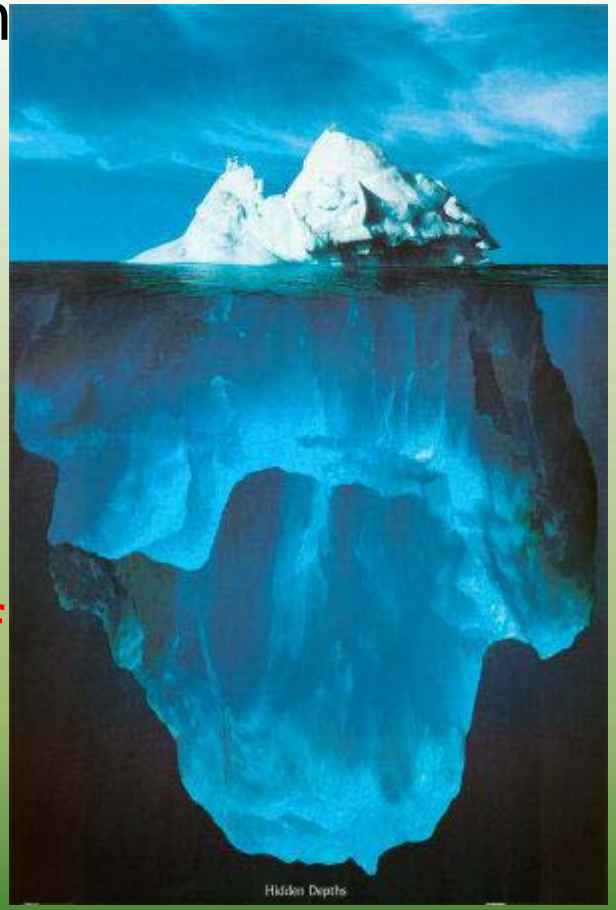
Past innovation determines technology pathways which may rule out other (potentially more beneficial) technologies

State promotion of innovation needs to be constantly subjected to evaluation mechanisms

# 1. Background

## 1.3 State Responsibility for Innovation

A core challenge of state innovation in the area of sustainable energy policy: the desired "energy revolution" resembles an iceberg – we can see a small part, presume some more, but are unable to even imagine most of it




**Problem**: how can states meet their innovation responsibility in the face of such uncertainty?

# 1. Background

## 1.4 Foundations of Interdisciplinary Innovation Research

**Governance studies and systems theory analysis in the social sciences**

**Innovation studies and institutional economy in economics**

Interesting starting point: pollution control and innovation policy are two independent, but connected aspects of market failure - pollution is a negative externality and new technologies generate positive externalities

**Traditional legal sciences must develop towards a truely "steering science" ("Steuerungswissenschaft")**

# 2. Elements of Public Innovation Regulation

## 2.1 Framework of Innovation Promotion

**Assumption:** the ability of regulation to promote innovation not only depends on the instruments used, but also on the entire regulatory framework (including the specific conditions of innovation)

**Important:** credibility of environmental regimes – "Design environmental policy so as to be constant, predictable and credible"
- planning uncertainty impedes innovation!
- a sustainable, long-term innovation strategy presupposes that the state react time after time to innovation changes (agency response) and adopt any necessary changes

# 2. Elements of Public Innovation Regulation
## 2.2 Instrument Design
### 2.2.1 Cost-effectiveness and Innovation Promotion

**Assumption**: generalized statements on the innovation potential of individual instruments are problematic. What matters is the concrete design of instruments *in casu* ("design matters").

For instance, command-and-control regulation can be designed so as to exert a strong innovation push (cf. e.g. the "Top-Runner"-model of Japanese environmental policy), whereas badly designed economic incentives can have only limited innovation effects.

Innovation regulation can operate both on the demand side ("demand pull") and on the supply-side ("supply push").

## 1.) Command-and-Control v. Economic Incentives

On average, one might observe that command-and-control regulation has fewer innovation effects than economic incentives. Still, command-and-control regulation can be designed so as to exert a strong innovation push, provided it has focused goals and refrains from describing additional processes and procedures.

Problem 1: In practice, standards are rarely updated as a result of innovative new technologies.

Problem 2: Corporations have a virtual information monopoly giving rise to the proverb of the "silent cartel of chief engineers".

## 2.) Economic Instruments vs. Informal Instruments

Informal instruments, such as voluntary agreements and pledges, have generally proven to have a lower innovation potential. Lack of transparency and accountability, but also the simple fact that measures are voluntary rather than mandatory, result in low levels of compliance towards the desired outcome.

Another category of informal instruments, including information and education measures, have had better results

## 2.2 Instrument Design

### 2.2.1 Cost-effectiveness and Innovation

**3) Comparison of Economic Instruments**

a) Emissions Trading

b) Fiscal approaches

c) Subsidies

d) Demand-management approaches

e) Innovation-friendly public procurement

## 2.2 Instrument Design

### 2.2.2 Employment Effects

**Assumption**: generalized statements on the employment effects of market-based environmental policy instruments (such as emissions trading and energy taxation) are only possible to a limited extent, unless the revenues are earmarked for measures promoting employment (such as ecological tax-reforms in many countries and the allocation o proceeds from emissions trading allowance auctioning).

## 2.2 Instrument Design

### 2.2.2 Employment Effects

Employment effects of specific technology subsidies: decentral energy suppliers, for instance, are more employment-intensive than large-scale technologies (e.g. nuclear fusion).

At the international level, in particular, large-scale technologies have effectively resulted in a centralized accumulation of capital, followed by centralized occupation effects (from a development perspective, it would be undesirable to strengthen the tendency to sell farmland and flee towards the large cities).

# 2.3. Promoting Innovation through a Policy Mix

**Assumption**: environmental policy objectives (including necessary innovation) can only be achieved through a suitable mix of policy instruments.

traditional command-and-control: safeguard an environmental minimum

great significance of information programmes for the stimulation of a "demand push" (see, notably, the newer tendencies in the European Union re. demand-side regulation)

economic incentives play a central role in the policy mix (fron emissions trading schemes via fiscal approaches to a targete sponsorship through public subsidies)

# II. Consequences for the Legal System

**Assumption**: Environmental policy and in particular climate change policy each reflect the growing functions required from state regulation. Together with other tasks of state regulation (e.g. the law of technological consequences), this approach marks and promotes a significant transition within our legal world.

1) From conditional to final regulation; from an orientation towards the measures taken to an orientation towards the outcomes achieved: for a new form and openness of administrative action and new challenges to legitimacy (legislative control) as well as rule-of-law-based control.

## II. Consequences for the Legal System

2) Modern states based on fundamental guarantees result in new reflexive control options: indirect control of networked structures (with various types o feedback); multipolar cooperation structures consisting of private and government actors; creation of relatively independent, thematically related "agencies";

3) Flexibility and revisability of the law: "learning law"; significance of monitoring and revision duties; accompanying programme for the creation of knowledge to yield new insights into the nature of environmental challenges, but also into potential side-effects of policy solutions;

4) Increased significance of organization and procedures – trend towards proceduralization of the law

# V. How Can Law Meet the Challenges of an „Energy Revolution"?

1) Generation of knowledge through reflexive control mechanisms

2) „Design Matters" – we have to realize the innovation potential of a variety of instruments

3) We have to design a suitable instrument mix for environmental policies in an interdisciplinary effort

4) Environmental Innovation goes hand in hand with a fundamental innovation of the legal order – an ongoing challenge

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