



University of Piraeus
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Renewable Energy Sources (RES) in Global Politics

Regulatory Frameworks for Renewable Energy Sources

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Piraeus 2022



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The Development of Renewable Energy Sources and its Significance for the Environment

Main objective of the presentation

To conduct a comprehensive review of the literature on regulation frameworks that are employed around the world and are related to the use of renewable energy sources.

Presentation Outline



- Introduction
- Support Policy
- Market Regulation
- Technology Transfer
- Barriers
- National and International Environmental Policies

Introduction

What about regulation?

Regulation refers to the process of making, monitoring, and enforcing **rules** that are established by a state.

These **rules** are mandated by a state to produce appropriate and desirable outcomes.

What should be considered in effective policymaking?

The interaction between players and organizations (either state or nonstate) in markets and their mutual influence.

Introduction

Regulatory instruments

- Command regulation
- Control regulation
- Market creation
- Education instruments
- Information instruments
- Economic instruments
- Self-regulation
- Voluntarism
- Property rights
- Fiscal instruments and charge systems
- Financial instruments
- Liability instruments
- Performance bonds
- Deposit refund systems
- Removal of perverse incentives

Introduction

Environmental regulation is necessary and is one of several tools to improve environmental quality.

It should be used effectively with other approaches such as motivations.

It can prevent the worst excesses, and the existence of regulation and enforcement is itself an important deterrent.

It sometimes does impose what could be perceived as excessive costs on businesses.

The costs and benefits of regulation relative to other approaches should be considered when contemplating how best to manage a particular environmental issue.

McManus, 2009

Introduction

Scientific evidence indicates that numerous environmental problems are worse now.

New issues arise as a result of technological advancements in areas such as biotechnology, nuclear energy, and wind power, which necessitate some form of regulation.

To leave each of these sectors uncommitted may encourage competition and profits within the sector but at great expense to the rest of society and the environment.

The environmental costs of irreversible environmental damage to the planet's life systems are significantly lower than the economic costs of effective environmental regulation.

McManus, 2009

Introduction

Presentation's objective

Conduct a comprehensive review of the literature on regulation frameworks that are employed around the world and are related to the use of renewable energy sources.

An attempt is made to categorize regulatory frameworks and identify their strengths and weaknesses.

Based on the book's findings, a set of optimal frameworks is proposed, along with procedures to facilitate their effective implementation.

Introduction

The regulatory frameworks are related to different dimensions of renewable energy sources.

These dimensions include:

- ✓ environmental policy
- ✓ public policy
- ✓ commercial policy
- ✓ economic policy

These regulations are required to overcome market failures and produce desirable outcomes.

Such regulatory interventions could be classified into three main groups:

- ✓ economic regulation
- ✓ regulation of anti-competitive behavior
- ✓ social regulation

Introduction

A broader classification, which we will follow in this class, includes:

- support policy
- market regulation
- technology transfer
- Barriers
- international and national regulatory policies

Attention!

Regional and international regulatory frameworks influence national environmental regulation.

Examples of this case are the different scenarios defined by the IEA for OECD countries and by the Kyoto Protocol.

Support Policy

Fossil fuels supported by subsidies remain dominant as primary global energy sources.

Support policies have also played a key role in enhancing renewable energy consumption.

These policies could direct a society's use of energy for power generation, transportation, heating, and so on.

The rapid growth of renewable energy has been driven mainly by supporting policies.

Support Policy

Renewable energy could not be economical without government support.

Some sources of energy such as natural gas and coal are available in the market at lower prices.

Different drivers of support policies based on government priorities include:

- ✓ Energy security
- ✓ Economic effects
- ✓ Carbon dioxide reduction

IEA, 2012

Support Policy

Policies of support could be implemented from the research stage to commercialization for both the:

- ✓ Supply side (i.e., academia, research centers, and firms)
- ✓ Demand side (i.e., consumers, public and private sectors, imports, and exports)

IEA, 2012

Support Policy

Organization for Economic Co-operation and Development (OECD) countries have implemented **national strategies** to support sustainable development through environmentally friendly technological advances.

These **strategies** deal with different objectives and cover a wide range of policies including:

- ✓ Environment
- ✓ Science and technology
- ✓ Transport
- ✓ Competition
- ✓ Energy

Support Policy

Different kinds of technology are used to overcome difficulties caused by **climate change**.

Concern about the effects of **climate change** and the **depletion of fossil fuel reserves** has urged many governments to design and implement policies to support the spillover of renewable energy technologies to different areas of use.

Support Policy

From binding national targets for 2020 to an EU wide target for 2030

With the adoption of the Renewable Energy Directive (2009/28/EC) for the first time binding renewable energy targets for all EU MS have become effective for 2020.

The overall EU target is a 20% share of energy from renewable energy sources in the final energy consumption in 2020, as set in the 2008 decided package of energy and climate change legislation of the EU.

The 20% EU-wide target is allocated among the MS, with national targets ranging from 10% for Malta to 49% for Sweden.

A target of 10% renewable energy in the transport sector was set, which must be achieved by each MS.

Support Policy

From binding national targets for 2020 to an EU wide target for 2030

October 2014: European Council adopted the EU's 2030 Energy and Climate framework

Foresees a RES target of 27% at EU level by 2030

The EU goal is meant to be fulfilled through Member States contributions guided by the need to deliver collectively the 27%

(without preventing Member States from setting their own more ambitious national targets)

What impacts this change in the target architecture will have on the respective implementing policies is yet to be seen.

Support Policy

Overview of policy instruments implemented

Each MS implements a mix of different **policy instruments** to support the development and deployment of RES in order to meet its individual RES target.

Most **policy instruments are** implemented to focus on the power sector.

Also, targets for specific RES shares in heating and cooling as well as for the transport sector have been introduced.

Types of policy instruments implemented include regulatory policies, fiscal incentives as well as public financing.

Support Policy

Overview of policy instruments implemented

Key mechanisms that have been introduced by various EU MS to increase RES within the power sector are:

- ✓ **Feed-in tariffs (FIT)**

- ✓ **Feed-in premiums (FIP s)**

FIT guarantees continuous retail prices for RES plant operators for a given period.

The cost for **FIT** can be funded through tax revenues or be placed on market participants.

FIT provides predictability and stability, both for the overall renewable energy landscape from a policy perspective and for the individual producers and investors regarding their revenue.

Support Policy

Overview of policy instruments implemented

In a **FIP**, plant operators have to market the electricity generated directly at the electricity market and receive an additional payment on top of the electricity market price.

Either as a fixed payment or adapted to changing market prices in order to limit both the price risks for plant operators and the risks of providing windfall profits at the same time.

Conclusion: The revenue risk is increased in a **FIP** compared to a **FIT**.

Support Policy

Overview of policy instruments implemented

Several EU MS have also introduced **quota obligations**.

In comparison to **FIT** / **FIP** this means that governments fix quantities and the market decides the price.

A minimum share of the electricity supply has to be from RES, and this share is increasing over time.

The main advantages of the **quota obligation** with tradable green certificate (TGC) markets are the high compatibility with market principles and the competitive price determination.

Quota obligations are not only used for supporting the development of RES electricity but also for increasing renewable energy in the transport sector, thus via biofuel support policies such as blending obligations.

Support Policy

Overview of policy instruments implemented

Another option for RES support is to use **tender or auction schemes** to:

- ✓ Allocate financial support to different renewable technologies.
- ✓ Determine the support level of other types of support schemes, such as feed-in systems, in a competitive bidding procedure.

There are different ways to design an auction, but the static sealed bid and the dynamic descending clock auction or a combination of the two have been used the most to support new renewable energy plants.

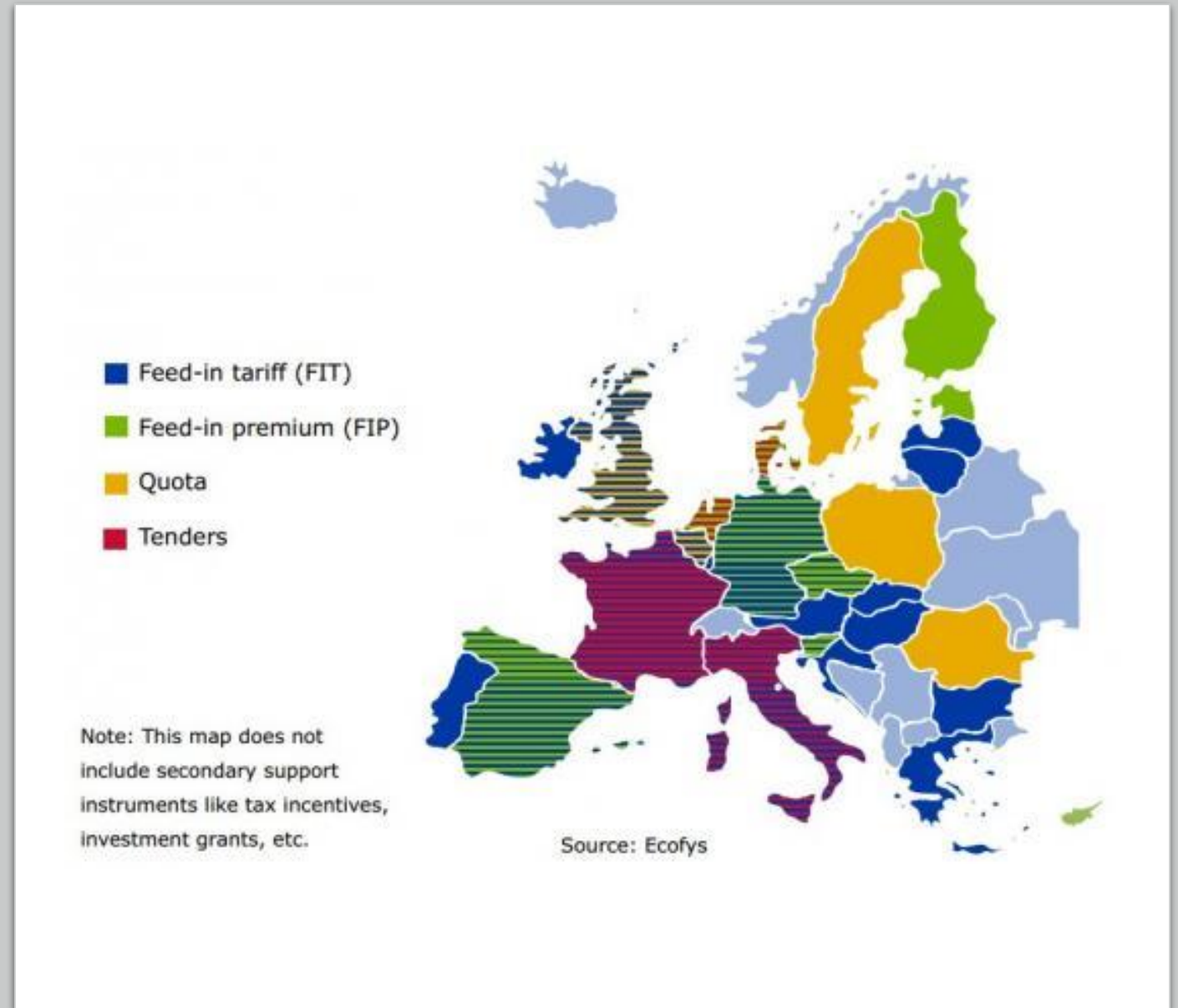
Tendering is used e.g., in Denmark, the Netherlands, and France.

Support Policy

There are numerous policy instruments available to support the deployment of renewable energy.

Within the EU, Member States are subject to renewable energy targets until 2020, but national governments can decide individually on which support policies to implement.

This has led to a wide range of different policies.



Support Policy

Literature review (Sawin, 2004)

Governments can utilize several options to enhance renewable energy deployment.

Three options of instruments in the support policy mechanism:

1. Supporting voluntarism through education and information
2. Supporting environmental standards and energy taxes
3. Supporting renewable energy technologies directly

Education is a crucial component in using renewable energy technologies.

The effectiveness of government policies depends on the design and enforcement of policies.

There is no guarantee that a particular policy will be successful → Support policies should focus on the end to promote renewable energy technologies on a small-scale and distributed basis.

Support Policy

Literature review (Gunningham et al., 1998)

Five major categories of education and information instruments:

- 1. Education and training**
- 2. Corporate environmental reporting**
- 3. Community right-to-know and pollution inventories**
- 4. Product certification**
- 5. Award schemes**

Support Policy

Literature review (Gunningham et al., 1998)

Five major categories of education and information instruments:

1. Education and training

Crucial part of the mechanism to develop renewable energy technologies in the industry and residential sectors.

They are essential in changing mindsets and facilitating customer acceptance.

2. Corporate environmental reporting

Corporate environmental reporting is considered a useful practice (i.e., prepared as part of an annual report or a separate report) in enhancing the environmental protection activities performed by firms.

Support Policy

Literature review (Gunningham et al., 1998)

3. Community right-to-know and pollution inventories

Community right-to-know (CRTK) is used as a policy to inform communities about the environmental impacts of pollution caused by a firm's activities.

4. Product certification

Providing customers who care about energy consumption with information is facilitated by product certification.

5. Award schemes

Evidence shows that eco-labeling as a form of sustainability measurement enables customers to consider environmental concerns in combination with education and information strategies as a mixed policy of a regulatory regime.

Support Policy

Literature review (Dinica, 2006)

Discussion on support systems for the diffusion of renewable energy technology from the point of view of investors.

Analysis of the investor's perspective in order to examine the potential of support policies for the spillover effects of renewable energy.

Including the investor's perspective in examining **government policies** enables support to the diffusion of renewable energy technologies for the generation of electricity generation.

Such **policies** could be more effective if they were based on risk and profitability for investors.

Conclusion: The importance of the investor's perspective in achieving successful outcomes.

Support Policy

Literature review (Fouquet & Johansson, 2008)

Many policymakers favor a support policy regardless of the result and relationship between the policy and the policy takers.

Examination of European renewable energy policy, with a focus on electricity **support mechanisms**.

Some **support mechanisms** should be considered for expanding the use of renewable energy to enhance:

- ✓ Energy security
- ✓ Reduce greenhouse gases
- ✓ Improve economies

Results: The feed-in tariff policy is more effective than tradable green certificates are.

Support Policy

Literature review (Verbruggen, 2009)

Evaluation of the performance of a support system for renewable energy sources to generate electricity.

Comparison of the results of the Flemish system with simulations applied in Germany.

The findings showed that the tradable certificate system in Flanders had not been developed properly.

Three crucial objectives should be clarified before designing a support policy:

1. Target setting
2. Qualification of RES-E (electricity produced from renewable energy)
3. Sources and technologies, and the robustness of achieved levels of effectiveness

Support Policy

Literature review (Steinbach et al.,2013)

Quantitative analysis to assess the costs and benefits of various scenarios in six member states.

(Austria, Greece, the Netherlands, Lithuania, Poland, and the UK)

The quantitative evaluation was based on the following criteria:

- Cost-optimal resource allocation
- Enforced target compliance
- Minimization of transaction cost and total policy cost
- Avoidance of market distortion in order to support the idea of a harmonized European internal market

Results: The intended target could be achieved by harmonized obligations and decreased generation costs, which were facilitated by better resource allocation.

Market Regulation

The regulatory mechanism has a central role in developing the generation of power using renewable energy sources.

Governmental support is required to facilitate new technology applied to developing renewable energy.

The lack of a regulatory framework and market environment to support new technology and investment increases the probability of market failure.

Efforts to improve energy efficiency and adapt current policy, regulatory frameworks, and market environments, in addition to grid modernization, are critical to facilitating investment in new technology.

This will be a major challenge for stakeholders in the electricity sector.

Market Regulation

Literature review (Wang, 2006)

Evaluation of the development of renewable energy policymaking in Sweden.

The Swedish government faced a dilemma in supporting renewable energy development and phasing out nuclear power:

1. There was a political decision to replace nuclear power with renewable energy
2. They were concerned about the negative effects of this policy on industrial competitiveness.

Lack of government commitment because of this uncertainty was an essential factor and was apparent in policies.

Future renewable energy policies would strongly depend on nuclear policies.

Market Regulation

Literature review (Costantini and Crespi, 2008)

Estimation of an empirical model.

Severe environmental regulations could be a positive signal for increasing investment in new technology by providing a source of comparative advantage.

Countries with a) strong environmental regulation and b) higher innovation capability:

- ✓ Had greater export capacity
- ✓ Could be exporters of environmental technology

Market Regulation

Literature review (Zhao et al., 2011)

Analysis of the policy frameworks to examine the influence of renewable energy regulations on the structure of power generation in China.

The results showed a strong positive relationship between the diffusion of energy regulations and the growth rate of renewable energy deployment.

National laws, regulations, policies, and strategic plans are essential to promote the structure and penetration of renewable energy projects.

Considering China's plan to achieve a share of 15 % of no fossil fuel in primary energy consumption by 2020, the authors stated that the elasticity of policies to note sustainable growth rates of renewable energy in power generation should be considered.

Market Regulation

Literature review (Nykamp et al., 2012)

Data envelopment analysis (DEA) and stochastic frontier analysis (SFA) were applied to examine the effects of incentive regulations on the investment decisions of power network operators to integrate renewable energy sources.

The results showed that grid operators tended to avoid new investments.

Current regulations do not provide enough incentive for operators to invest in smart solutions.

Therefore, changes in regulations are required to provide incentives for grid operators.

Technology Transfer

“A technology transfer typically includes the transfer of the technology design as well as the transfer of the property rights necessary to reproduce the technology in a particular domestic context”.

Lewis & Wiser, 2007

In order to promote renewable energy consumption, advanced technology and investment in new technology are required.

The unit cost for power generation through RES is more than for conventional resources such as fossil fuels.

This cost could be reduced by advanced technology and economies of scale.

It is crucial to develop appropriate regulations to promote technological innovation.

Technology Transfer

It is necessary for governments (who set targets for emission reduction within a certain period) to facilitate investment in low-carbon technologies from the demonstration to the commercial stage.

There should be a proper link between actors in order to take advantage of interactive learning and new ideas.

An appropriate capability is required to learn rapidly and effectively.

It is not possible to transfer and apply new technology.

Technology Transfer

Imperfections in the system pose a serious problem in **applying, transferring, learning, or adapting** to new technological developments, making it nearly impossible to meet deadlines.

According to IEA, the process of technological change in some cases takes decades and there are limits to the rate of deploying new energy technology.

In contrast, the possibility of acceleration in information technology depends on government policy.

IEA, 2012

Technology Transfer

Literature review (Jaffe et al., 2005)

Investigation of the interaction of

market failures associated with environmental pollution and

market failures associated with the innovation and diffusion of new technologies

Technological advances are affected by market and regulatory incentives.

The government should focus on the commercialization of technologies that lead to increased public benefits.

Technology spillover and the achievement of associated benefits could be stimulated by proper incentive instruments (e.g., tax credits for new equipment in order to make them cost-effective).

Technology Transfer

Literature review (Lewis and Wiser, 2007)

Analysis of the strategies of local industry in wind turbine manufacturing, technology acquisition, and incentives for technology transfer.

Cross-country comparison of support policy mechanisms applied in 12 countries: Denmark, Germany, Spain, the USA, the Netherlands, the UK, Australia, Canada, Japan, India, Brazil, and China.

A technology policy is influenced by short-term and long-term goals.

The application of appropriate policies is essential in stimulating incentives for technology localization.

Governments may turn to foreign direct investment for turbine manufacturing, use local transferred technology for the components, and use local manufactures for the turbines.

The annual size and stability of the market is crucial parameter that influences policy mechanisms.

Technology Transfer

Literature review (Loock, 2012)

Investigation of a database of 249 renewable energy investment managers including:

banks, funds, investment advisors, private equity, and venture capitalists

Three generic business models calculated the share of preference for investors found that *investors prefer to be supported by better services than lower prices or better technology.*

Suggestions: Policymakers focus on policies that support service-driven business models instead of price or technology.

Technology Transfer

Literature review (Lema and Lema, 2013)

Analysis of technology transfer in the Clean Development Mechanism (CDM), which is focused on wind power.

Exploration of how quantity flows in CDM are affected by technological capability in the host country.

Evidence from China and India:

CDM wind projects tend to take advantage of existing transfer mechanisms instead of creating new mechanisms to support low carbon technology.

An important relationship between international law regarding technology transfer mechanisms and domestic technological infrastructure should be considered by policymakers.

Technology Transfer

Literature review (El Fadel et al., 2013)

Knowledge management mapping in renewable energy to design a framework for defining activities in different time spans.

Renewable energy development in developing countries relies on financial and technological aid provided by developed countries as well as international and regional organizations.

It is crucial for developing countries to facilitate appropriate capabilities (e.g., knowledge exchange, technical capability, and financial mechanism) in order to take advantage of supportive instruments.

Barriers

The intermittent nature of some renewable energy sources, such as wind and solar energy, is the most significant challenge in deploying renewable energy.

This intermittency causes uncertainty in using electricity on demand.

When power generation is faced with a shortage of demand, a solution should be available.

e.g., Denmark is the forerunner in the generation of electricity through offshore wind turbines.



Barriers

Norway and Sweden: Water is stored behind dams for later use when excess electricity is transmitted by Denmark.

Although hydro energy is considered a stable RES, the building of dams across rivers impacts environmental conditions (for instance, landscape).



Barriers

Wind turbines and economic factors such as other RES are considered in environmental issues because of their impacts on flora and fauna and the noise impacts on neighborhood residents.

Barriers

The **unit cost** of power generated by RES is generally higher compared to that of conventional sources of energy such as fossil fuels and nuclear power plants.

This **cost** has decreased during the last decade because of technological advancements, which were achieved by supportive government policies.

Challenge in taking advantage of RES: Lack of knowledge and education of consumers

Social acceptance and buyer readiness are among the most important factors for market implementation.

Renewable energy development policies will not be successful if they cannot influence customer acceptance at the stage of buyer readiness.

Barriers

Literature review (Foxon et al., 2005)

Examination of the UK innovation system for renewable energy technologies in order to enhance the efficiency of the system.

wind, marine, solar PV, biomass, hydrogen, and micro-CHP (combined heat and power)

Results:

Sustainable investment is required for these technologies in order to take advantage of their potential.

A stable policy framework is necessary to make it possible.

Barriers

Literature review (Owen, 2006)

Investigation of the effects of market failure constraints on the adoption of Renewable Energy Technologies (RETs) by:

- Estimating the damage costs incurred by fossil fuels

- Analyzing the externalities of power generation in financial terms

Results: If external effects of fossil fuel combustion were internalized into electricity generated by conventional energy sources, several RETs would be competitive from the economic point of view.

Note! The Middle East region has great potential for generating electricity by using renewable energy sources.

Barriers

Literature review (Sovacool, 2009)

Renewable energy from the perspective of social and cultural barriers to energy efficiency technology in the USA.

Conventional systems of power generation vs RES

Social concerns regarding welfare, profits, consumption, control, and trust instead of a disagreement over technology.

Where the US government should concentrate its efforts:

Enhance the social understanding of energy systems instead of allocating supportive incentives to promote the efficiency and technical capacity of RETs.

National and International Environmental Policies

Environmental policy refers to:

The commitment of an entity at the level of an organization, government, or group of countries (regional or international) to regulations regarding environmental issues.

- United Nations Environmental Program (UNEP)
- World Environment Organization (WEO)
- Intergovernmental Panel on Climate Change (IPCC)

Bilateral and regional agreements and international organizations deal with environmental issues.

Resource-rich and resource-poor countries have tried to apply degrees of environmental protection to overcome climate change issues.

National and International Environmental Policies

The possibility of using energy transition and new technology has created challenges in terms of energy security and environmental management.

Bhattacharyya, 2011

International Maritime Organization (IMO) has the power to enforce the performance of regulations made by IMO regarding the control and prevention of marine pollution.

Most policies made by organizations are performed by members based on their commitments.

Because of the state-centric nature of the international role in making international environmental regulations.

Axelrod et al., 2011

National and International Environmental Policies

Denmark

Front-runner in renewable energy deployment:

33 % of its power supply is generated by RES (20 % wind and 13 % biofuels)

it exports excess electricity generated by offshore wind turbines to neighboring countries (i.e., Norway and Sweden).

Danish government (2005) released **Energy Strategy 2025**, which focused on initiatives for energy saving, renewable energy, climate change, energy markets, and technology.

It set the long-term target of 100 % independence from fossil fuels

National and International Environmental Policies

Germany

RES comprise 22 % of electricity generation.

Progress in reducing CO₂ emissions and the energy intensity of its economy.

Has formulated its energy policy to make it a world leader in the field of energy efficiency and environmental protection.

Its targets include ambitious environment protection indices as an essential part of energy policy including 40 % reduction in GHGs by 2020, 55 % by 2030, 70 % by 2040, and 80–95 % by 2050 compared to 1990 levels.

National and International Environmental Policies

The elements of the integrated energy and climate program and GHG emission reduction target areas are as follows:

- reducing electricity consumption
- modernizing fossil-fired power stations
- promoting electricity generation from renewable energies
- promoting CHP generation
- modernizing building and heating systems
- using renewable energies in heat production
- implementing energy-saving measures in the transport sector

National and International Environmental Policies

The Earth's population would have increased to more than 9 billion people by 2050.

The global GDP will quadruple, and the energy consumption is projected to grow by more than 80 % without new policies and with increasing emissions caused by the combustion of fossil fuels.

Because no single policy is considered a solution to climate change, a mix of policy instruments is applied to reduce GHG emissions.

National and International Environmental Policies

The essential parts of this policy mix according to the OECD are the following:

- ✓ National climate change strategies
- ✓ Price-based instruments (cap and trade)
- ✓ Carbon taxes and removing fossil fuel subsidies
- ✓ Command and control instruments and regulations
- ✓ Technology support policies including R&D
- ✓ Voluntary approaches; public awareness campaigns
- ✓ Information tools

OECD, 2012

National and International Environmental Policies

The coverage and scope of work for each instrument vary among countries:

Carbon pricing is the main policy in Australia, the EU, Korea, and the UK.

Canada, China, France, Germany, India, Italy, Japan, Russia, Portugal focus on policies regarding energy efficiency.

Policy tools for climate change mitigation that could be used as price-based instruments:

- taxes on CO2 emissions
- taxes on inputs or outputs of the process
- removal of environmentally harmful subsidies
- subsidies for emission-reducing activities
- emission trading systems

Thank you for your attention