

Economics of Renewable Energy & Externalities

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NHH Summer Course 2016

Natural Resource Management and Policy: The Norwegian Model

Energy Sources on the market

Table 2

Key data used in economic analysis (US\$2008).

Technology		Overnight construction cost (US\$/kW)	Plant economic life (years)	Capacity factor (%)	Source
Wind (onshore)	Min	1283	20	41	Lazard
	Max	3716	25	23	NEA/IEA
Wind (offshore)	Min	3953	25	43	NEA/IEA
	Max	6083	25	37	NEA/IEA
Solar PV	Min	2878	20	27	Lazard
	Max	6592	25	16	NEA/IEA
Solar CSP	Min	5527	20	43	Lazard
	Max	6416	20	26	Lazard
Gas CC	Min	538	30	85	NEA/IEA
	Max	1549	30	85	NEA/IEA
Hydro	Min	896	80	57	NEA/IEA
	Max	3414	80	40	NEA/IEA
IGCC w CCS ^a	Min	4194	40	85	NEA/IEA
	Max	5182	40	75	Lazard
Supercritical coal ^b	Min	602	40	85	NEA/IEA
	Max	8290	40	93	Lazard
Nuclear	Min	1556	60	85	NEA/IEA
	Max	5863	60	85	NEA/IEA

^a IGCC with carbon capture and storage.

^b Supercritical coal.

Non-renewables:

Crude Oil, Coal, Natural gas, Uranium (nuclear)

Renewables:

Solar, Hydro, Wind, Geo-thermal, Wave

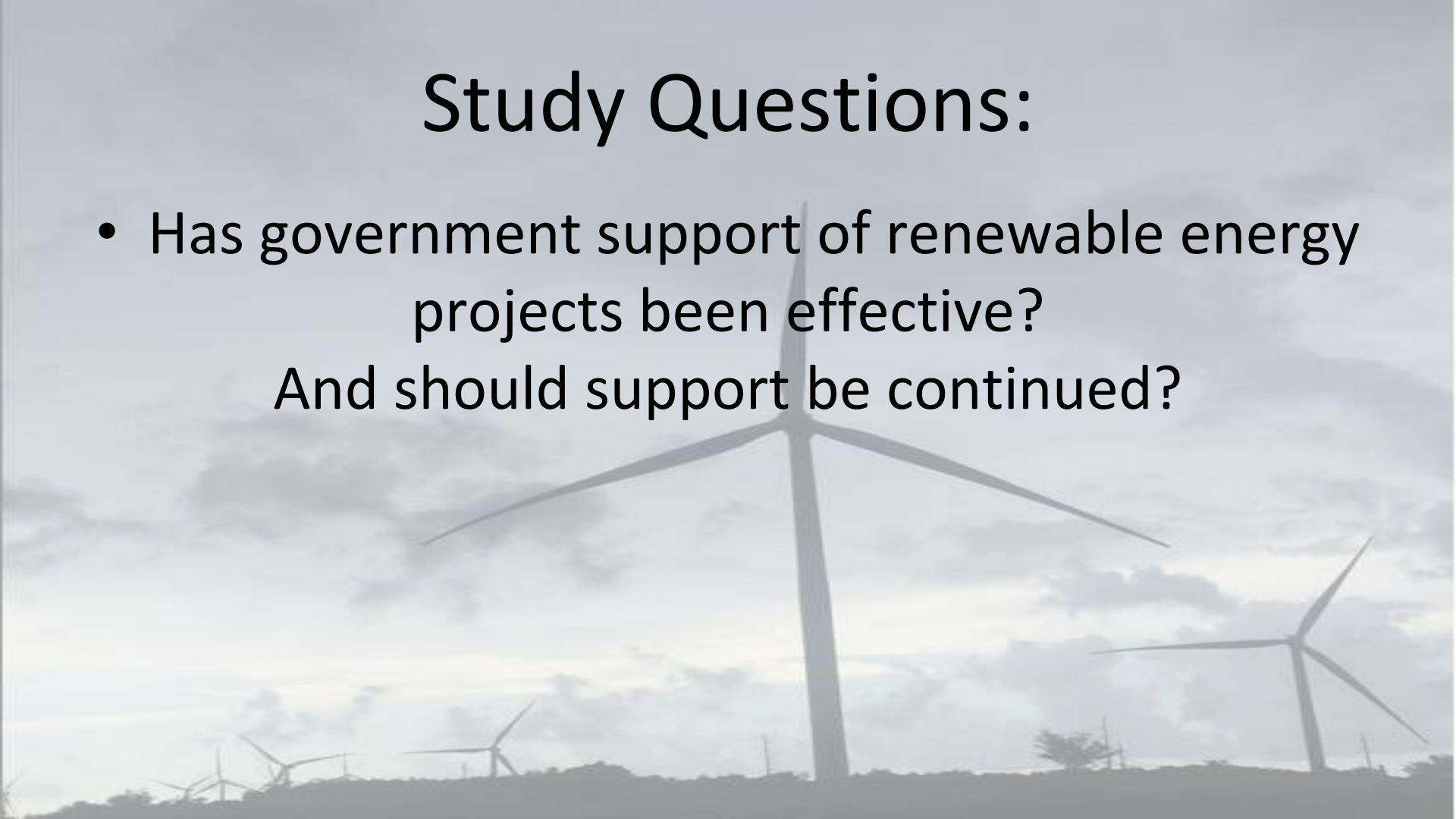
Costs and benefits of each

Topic

Discuss arguments for and against public policy support to renewable energy, derived from the economic theory of externalities.

Study Questions:

- Has government support of renewable energy projects been effective?
And should support be continued?



Introduction

Why is this important?

Discussing the issue of what's happening on planet Earth in regards to energy, the environment, emissions, fossil fuels

Energy sources on the market

What are the important questions?

We are...

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Why a reliance on fossil fuels are bad for society

Health Care

US library of Medicine estimates \$361-886 Billion on Health Care

SO₂, NO_x

Destruction of the land, and water

Acid Rain

Effects corp lands

Smog

Tapped in the City

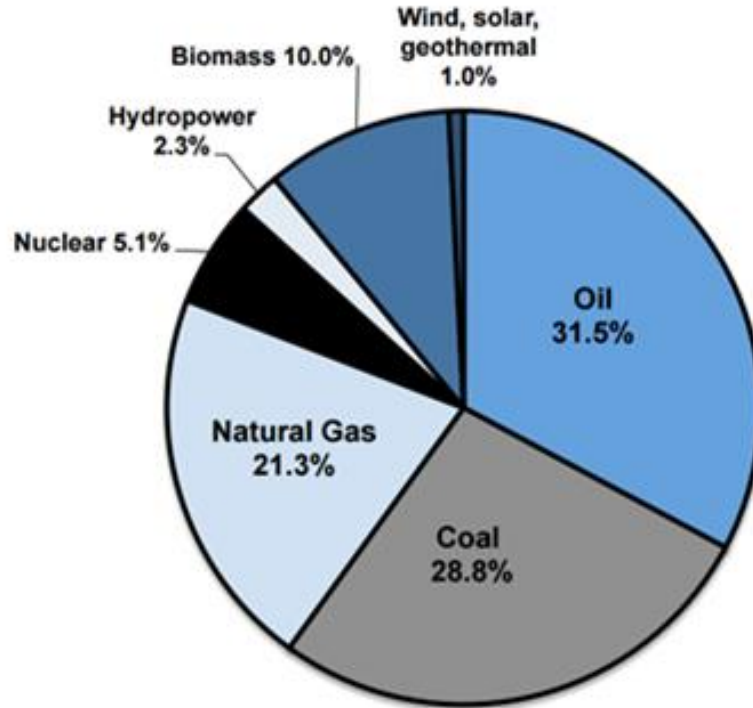
Economic theory of externalities

An externality is a cost generated by one agent that affects the actions of another agent in the economy

Fossil fuel use tends to generate negative, rather than positive, externalities

Fossil fuel subsidies that encourage wasteful consumption are slowly being decreased as time goes by

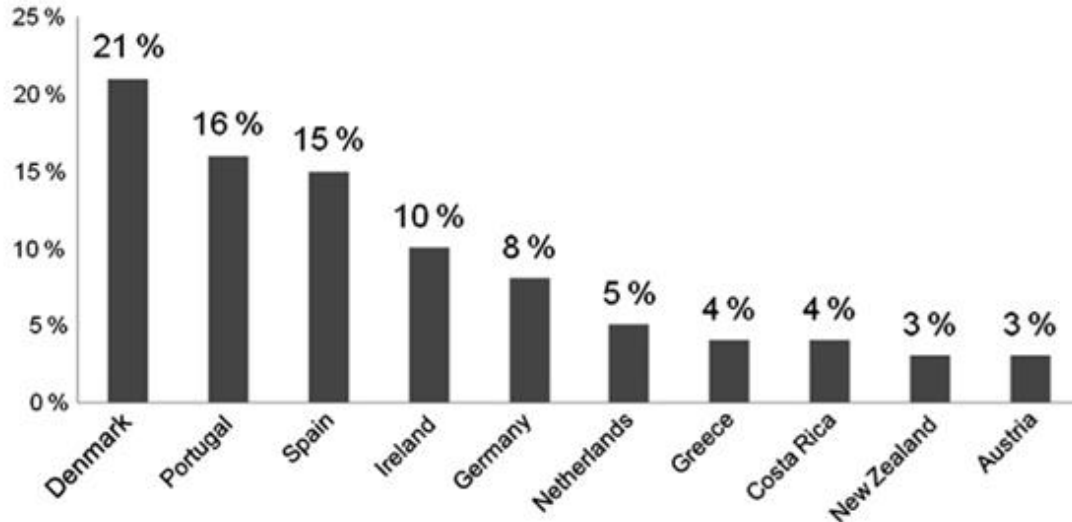
Global energy consumption by source, 2011



International growth of renewables

P.A. Narbel / Energy for Sustainable Development 17 (2013) 386–390

2009 electricity shares from new renewables



- Such technologies can contribute to energy security if their utilization reduces the need for fossil fuels
- However, few renewable energy programs are competitive without public policy support
- Specific policy instruments such as carbon tax, feed in tariffs and feed in premium are heavily relied upon

Fig. 1. Top-10 countries of the dataset with respect to their share of new renewables for electricity in 2009.

Norway.

Public policy support

Research

Wind and Hydropower



Public policy support in Norway

The transition away from fossil fuels depends on public perception of new technologies

Most individuals are reluctant to pay more for energy generated from renewable resources

Voters' political preferences and their attitudes towards renewable energy

Hydro: history of waterfalls, industrial plants



Why it matters in Bergen

Smog during the winter

Norway ranked 32th in CO₂ emissions per capita in 2009

Wind power

Table 1

Cumulative installed wind power capacity (MW), 1980–2012.

Source: EPI (2008), GWEC (2013).

Year	Germany	U.S.	Spain	India	China	Denmark	Other	Global
1980	0	8	0	0	0	2	n.a.	10
1990	62	1,484	0	0	0	343	41	1,930
2000	6,104	2,578	2,235	1,220	346	2,300	2,617	17,400
2012	31,332	60,007	22,796	18,421	75,564	4,162	70,200	282,482

Wind power in Denmark

Wind energy is expected to contribute the highest share of renewable energy, among all sources

Less negative environmental impact

wind farms pose



challenges

Issues with the Denmark wind energy

Spatial clustering

Plants are running at a loss

Decay of fossil fuel plants

California Renewable Energy Policy

- California has committed to cutting emissions by 40% of 1990 levels by 2050
- A cap and trade program allow a within industry trading system
- Realized many successes in reduction to GHG's
- Faces financial, legal and political troubles

Solar Energy in Germany

Successful integration of renewable energy, especially Solar

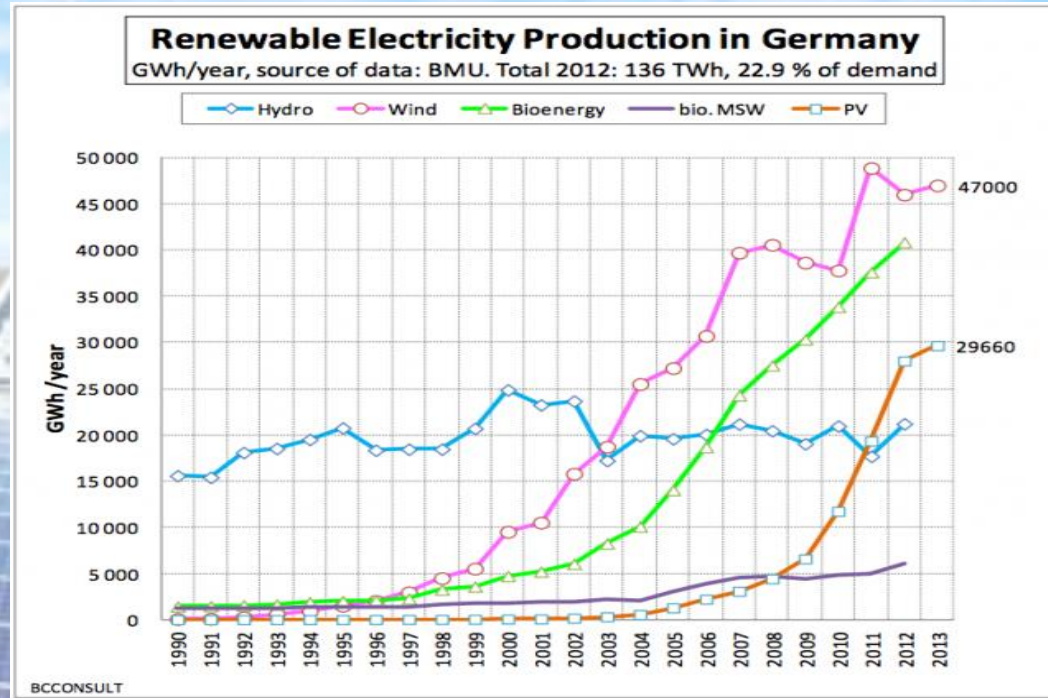
1.5 million Photovoltaic systems all over the country

Germany utilizes the policy mechanism of feed-in- tariffs

Goal to cut costs radically

International growth of renewable

- Marginal cost to produce is zero for an extra KWH
- Creation of a new market and new industry
- Benefits come by increased trust and utilization
- Proof policy matters





Successes...

Job market in the US

75,000 wind energy jobs were created

250,000 hydroelectric

Estimated 3-1 renewable jobs vs fossil fuel jobs

Helps develop rural communities

Land rent

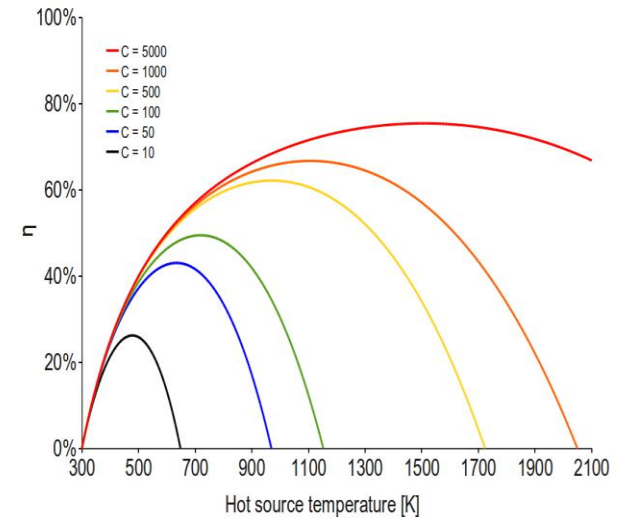
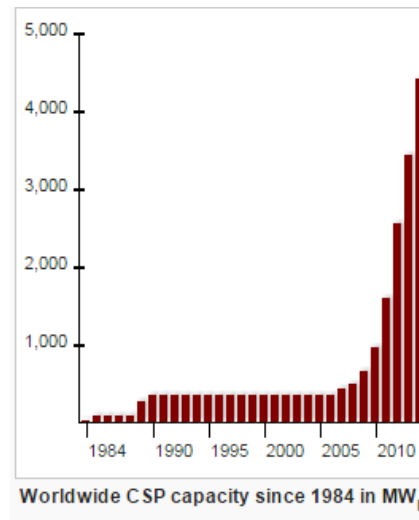
Initial land subsidies

Future Ventures

Concentrated Solar Power

Vast improvements in capacity

Israel



Wave Energy

Portugal built the first 2008

UK, USA, Australia

Their own challenges

Converting UV rays into energy

...and Challenges

Solar Energy

Labs vs reality

Wind Energy

Start up cost vs that of a coal plant

Thinking Globally

What now?

- Policy Matters
- Look at what you have
- Benefit in keep going with renewable technologies
- Canada

Looking forward

- Do the research
- Potential for unforeseen negative externalities with renewable technologies
- In what other ways we combat the inevitable devastations associated with climate change?

Conclusion - Resources & thank-yous

Owen, Anthony D. “*Renewable energy: Externality costs as market barriers.*”

School of Economics, The University of New South Wales

<http://www.ceem.unsw.edu.au/sites/> (22 June 2016).

NHH...

All of you!

Questions?
