

# **The economic effects from electricity systems created by increased and intermittent supply from renewable sources**

*Presented by Dr. Marian Krzaklewski*

*on the basis of EESC opinion and  
PPT presentation made by*

**Prof. Gerd Wolf the rapporteur of  
the opinion**



The **European Economic and Social Committee (EESC)** is a **consultative** body that gives representatives of Europe's socio-occupational interest groups, and others, a formal platform to express their points of views on EU issues. Its opinions are forwarded to the larger institutions - the Council, the Commission and the European Parliament. It thus has a key role to play in the Union's decision-making process.

- The EESC has 353 Members (also called Councillors).

They are drawn from

economic and social interest groups in Europe. Members are nominated by national governments and appointed by the Council of the European Union for a renewable 5-years term of office.

- The opinion „***The economic effects from electricity systems created by increased and intermittent supply from renewable sources***“ had been



**Point of reference:**

## **Goals of the EU low-carbon roadmap 2050**

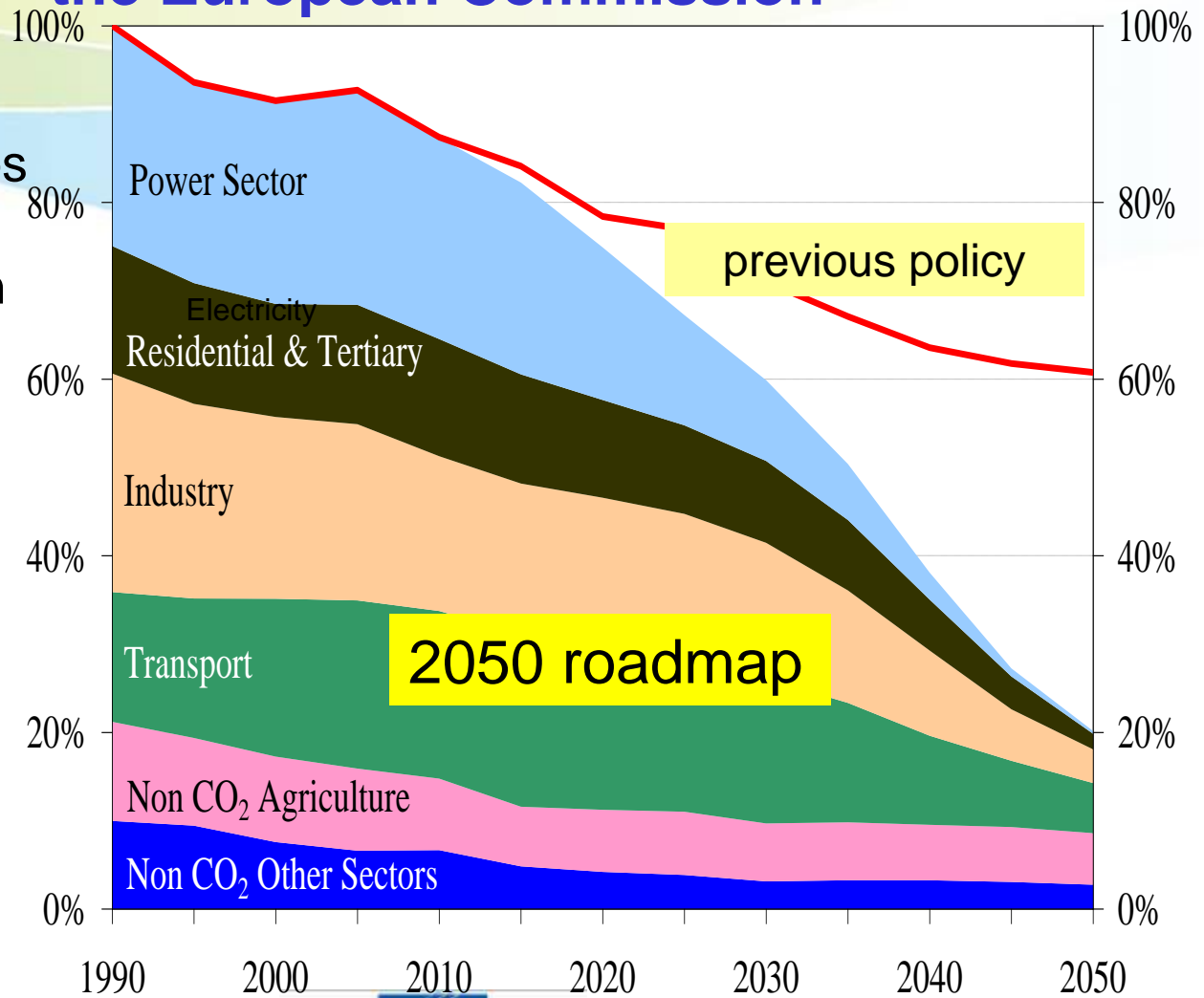
- **Reduce** overall energy-related CO<sub>2</sub> emissions until 2050 to **80% of the 1990 value.**
- **Reduce** electrical energy-related CO<sub>2</sub> emissions until 2050 to **95% of the 1990 value!**
- **Assumption:** A sustainable energy system (largely renewables) is the only long-term solution.



# Low-Carbon Economy Roadmap 2050 (March 2011) of the European Commission

Basis of scenarios  
80% domestic  
GHG reduction in  
2050

**Efficient  
pathway:**  
-25% in 2020  
-40% in 2030  
-60% in 2040



# Goals of the EU roadmap 2050

**This is an enormous task  
Why ?**



# Performance of RES (Germany)

from Deutsches Bundesministerium für Wirtschaft und Technologie Energiedaten Tabelle 20 vom 7/08/2013

installed capacities (GW) and annual energy yield (TWh) in Germany

year		2010	2011	2012
Wind-Power	GW	27,2	29,1	31,3
Wind-Energy	TWh	37,8	48,9	50,7 (7,6%)
Photovoltaik-Power	GW	17,6	25,0	32,7
Photovoltaik-Energy	TWh	11,7	19,6	26,4 (4,6%)

figures in brackets: contribution to the total annual electricity consumption in %



# Performance of RES (Germany)

Annual energy yield from installed capacity (power) in Germany

Year	2011	2012
<b>Wind</b>	<b>~19.8 %</b>	<b>~19.2%</b>
<b>Solar</b>	<b>~10.3%</b>	<b>~10.4%</b>

see also later „firm capacities“



# Need for excess capacities

*To replace the energy yield of base-load power stations by wind or solar, production capacities will have to be increased by a significant factor, well in excess of the annual peak load*

The level of excess capacity will depend on:

- Regional weather conditions
- The availability and **efficiency of long-term storage and reuse**
- The demand management potential
- The compensation possibilities between solar and wind and the long-distance compensation possibilities (depending on grid extent and capacity)





# Leading to excess supply - 1

Whenever electricity generated from wind or solar power exceeds grid capacity and demand from consumers, three things can happen:

- **production partially shuts down** (with some potential energy output being unused)
- **grids become overloaded**, security of supply is endangered and the spot price breaks down (negative prices!)
- **surplus electrical energy could be stored** and subsequently supplied to consumers when wind or solar output becomes insufficient, in case large-scale storage capacity is available



## Leading to excess supply - 2

- The presently installed capacities are far from what is needed for the goal of the 2050 Roadmap
- However, **lacking the required storage capacity, excess supply regularly disturbs the grid systems, the energy market and the whole energy economy**
- Risk of significantly exceeding tolerance and seriously endangering of supply

***WARNING !!! Energy produced from German wind and/or solar power stations from time to time already now overloads existing transmission grids in neighbouring countries (especially Poland, the Czech Republic, Slovakia and Hungary), a source of irritation entailing a threat to grid operation and also additional costs due to the need to invest into protective systems (such as phase-shifting transformers).***



**A detailed analysis of these features including also cross-correlations etc. is given by**

**Friedrich Wagner, IPP-Report 18. 1. 2012,  
*„Features of an electricity supply system based  
on variable input”***



Consequences: Excess Supply **and** Excess Demand

However, this leads to both, situations/problems of (i) excess supply and of (ii) excess demand

- when the sun is shining and/or the wind is blowing everywhere: excess supply
- in case of no sun and no wind over larger areas: excess demand



# Leading to excess demand

- RES can only make a very limited contribution to "firm capacity": i.e. to secure coverage of peak annual consumption (example Germany):
  - 5% -10% for wind energy
  - 1% for solar energy
  - In comparison, 92% for lignite-fuelled power stations
- **Backup power stations** will still be needed to compensate for insufficient RES output and provide reliable capacity and security of supply
- Backup power stations are used less intensively and operate with lower efficiency levels and higher variable costs, entailing higher life cycle costs than normal power stations
- **Storage systems** – if available - are some kind of backup power stations
- The economic incentives needed to ensure the requisite backup capacity are now under discussion



# Coping with excess supply and demand

## **Need for the complete RES system to have the following features:**

- Considerable installed overcapacities
- Backup power stations
- Sufficient (energy-efficient) storage capacities
- Massive grid extensions
- Promoting flexible and demand-response use



# Coping with excess demand and supply

## Consequences

- >>> (1) severalfold increase in electricity prices
- >>> (2) need for innovative solutions (storage!)

*Reflection of prof. Wolf* : „If the backup power stations use fossil fuels (as opposed to hydrogen and derivatives generated by electricity from CO<sub>2</sub>-free energy sources), they will make it impossible to achieve the Energy Roadmap 2050 target ” .



# Effects of significant cost increase

- damage to the competitiveness of European industry
- greater burden on socially disadvantaged groups (energy poverty!)
- manufacturing relocated to non-EU countries where energy is cheaper (e.g. USA shale gas, Brazil oil)

*Personal opinion of Wolf:*

*Which fraction of GNP for providing energy is tolerable?*

- *In a closed economic system, perhaps Europe could shoulder these costs*
- *However, we are not in a closed system – need for global solutions!*





# What should be done?

## install the complete RES system:

- considerable installed overcapacities
- reserve power stations
- sufficient (!) storage capacities
- massive grid extensions
- efforts towards flexible use

**>>> need for innovative solutions (storage!)**

**>>> need for cost saving measures**



## Efficiency (electricity to electricity) of the LOHC storage system: example NEC/H12-NEC



- Temperature level and efficiency of the energetic hydrogen utilization is most relevant;
- Main losses are in the electrolysis and in the conversion of hydrogen to electricity (fuel cell, engine) – efficiency is very high compared to other methods of chemical energy storage.

	H2 combustion engine	PEM-FC	SOFC
Electrolysis	70 %	70 %	70 %
Hydrogenation	98 %	98 %	98 %
Dehydrogenation	100 %	80 %	100 %
H2 to electricity	42 %	55 %	55 %
<b>Total efficiency</b>	<b>29 %</b>	<b>30 %</b>	<b>38 %</b>

Teichmann, Stark, Müller, Zöttl, PW, Art, Energy & Environmental Sci. 2012, 5(10), 9044

Received from Peter Wasserscheid



# What should be done?

- development and installation of sufficient overall storage capacity an absolute necessity
- should these components not yet be available: redefine feed-in rules
- cost increase only estimated >>> the Commission should order a quantitative economic study on these issues



# What should be done? - R&D

- Develop innovative energy technologies
- Transfer and further develop the European Strategic Energy Technology Plan (SET-plan) in the 2014-2020 funding period.
- Avoid bureaucratic inflexibility, risk aversion and market distortions, i.e. any kind of barrier to innovation.
- Promote the driving forces behind new ideas and concepts.



# **A level playing field for global competition!**

- **Countries in other parts of the world must urgently make similar efforts and agree on realistic joint targets, to ensure fair and comparable conditions for competition at global level.**
- **Despite the disappointments to date, the European Economic and Social Committee supports continued efforts by the EU to achieve this.**



# Europe going it alone ?

If these efforts fail:

- How long can the EU afford to continue going it alone and working towards radical targets ?
- How can the EU avoid undermining its own economic strength, thus depriving itself of the very resources it needs to prepare for climate change?

Since in that case climate change would probably be inevitable – together with all its economic and political repercussions.



# Conclusions

- We need a common European energy policy and an internal energy market → European Energy Community!
- We have to avoid further costs from inappropriate subsidies and incentives varying from one European country to another
- We need an effective and more market-oriented support instrument covering the whole EU to enable renewable energy technologies to compete on free markets.
- Appropriate carbon pricing could be used to this end (e.g. a tax).
- We have to unlock the potential of Member-States and private Industry for more R&D and innovation.
- We have to analyse: how long can Europe act alone?

