Problems, Consequences and Necessities of a growing Installation of intermittent Renewables

3rd European Energy Conference

October 2013

Gerd H. Wolf

Based on the „OPINIONs“ of the European Economic and Social Committee on

“The economic effects from electricity systems created by increased and intermittent supply from renewable sources”

and

“Energy technologies and innovation”

European Economic and Social Committee

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-year term of office.

The opinion „*The economic effects from electricity systems created by increased and intermittent supply from renewable sources*“ had been requested by the then Irish EU Presidency; it has been presented and discussed at the informal council of EU energy ministers in Dublin April 2013.

European Economic and Social Committee

Point of reference:

Goals of the EU low-carbon roadmap 2050

- **Reduce** overall energy-related CO2 emissions until 2050 to **80% of the 1990 value**.
- **Reduce** electrical energy-related CO2 emissions until 2050 to **95% of the 1990 value!**
- **Assumption**: A sustainable energy system (largely renewables) is the only long-term solution.

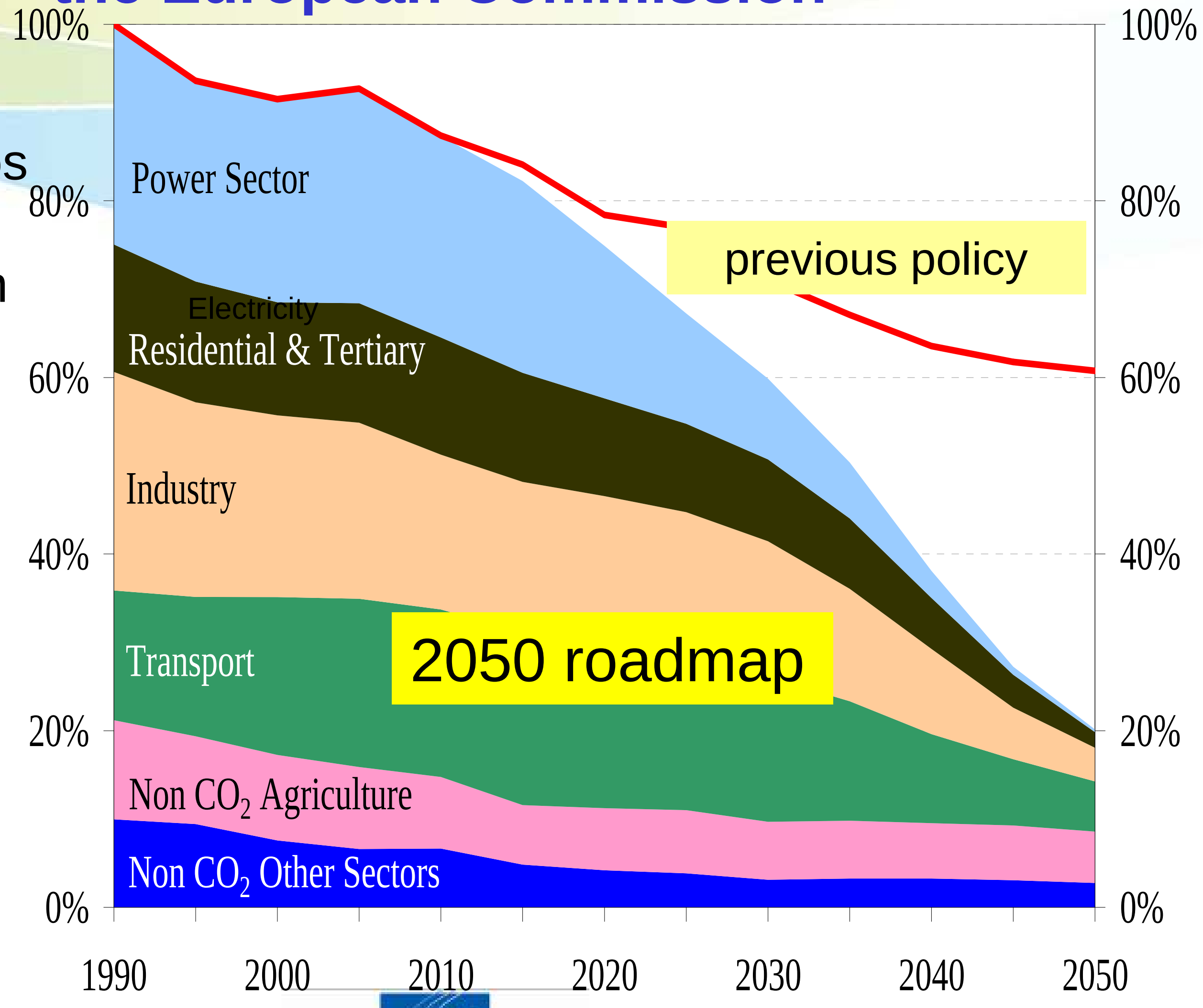
European Economic and Social Committee

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



European Economic and Social Committee

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 %

European Economic and Social Committee

Performance of RES (Germany)

Annual energy yield from installed capacity (power) in Germany

Year	2011	2012
Wind	**~19.8 %**	**~19.2%**
Solar	**~10.3%**	**~10.4%**

see also later „firm capacities“

European Economic and Social Committee

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)

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 electricty (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 electricty	42 %	55 %	55 %
Total efficiency	**29 %**	**30 %**	**38 %**

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

FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG

The (excess-)capacities will have to be multiplied by 2.5 – 3 !

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 the security of supply

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"*

Consequence: 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!)

If the backup power stations use fossil fuels (as opposed to hydrogen and derivatives generated by electricity from CO2-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 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 electricty (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 electricty	42 %	55 %	55 %
Total efficiency	**29 %**	**30 %**	**38 %**

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

FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG

Received from Peter Wasserscheid

European Economic and Social Committee

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

European Economic and Social Committee

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.

What should be done? - R&D and Politics

- Use the scarce R&D resources under Horizon 2020 such that they act as leverage and incentive for Member States and the private sector to their increase investment in R&D.
- Acquire further sources of financing, i.e. EU Structural Funds, the European Investment Fund and the revenues from the EU Emissions Trading System
- Unlock the investment potential of the market economy and its industries and gear it to addressing this huge challenge.

How to unlock the investment potential of the market economy and its industries and gear it to addressing this huge challenge?

- **Cut** the confusion of nationally-oriented anti-competitive market interventions and create valid and reliable Europe-wide rules, in order to give investors planning certainty and the necessary incentives.
- **Create** a European Energy Community with a common European energy policy and an internal energy market.
- **Reform** the so-called feed-in laws of some Member States which involve excessive subsidisation of intermittent energy sources. *(They constitute one particularly extreme example of regulation which hampers innovation.)*

Make use of market forces, allow competition

If CO_2-emission is the culprit

- penalize CO_2-emission to an extent which gives renewables (and their complete system) the chance to become competitive
- but delete all other subsidies for renewables.

A proper carbon tax might do the job.

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.

European Economic and Social Committee

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.

European Economic and Social Committee

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?

European Economic and Social Committee