



AALBORG UNIVERSITY  
DENMARK

# Denmark's success in wind power and sustainable energy: Is replication possible?

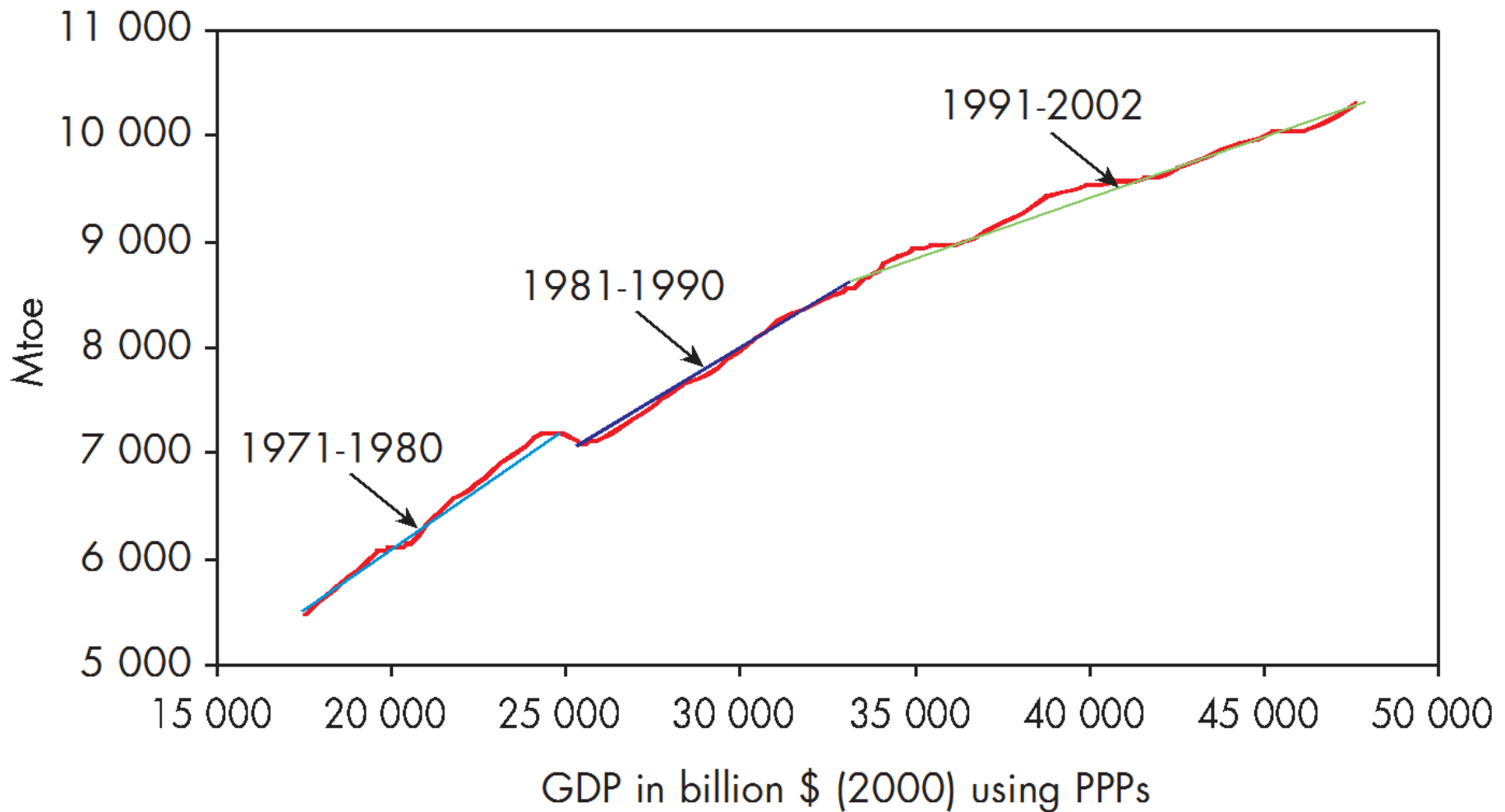
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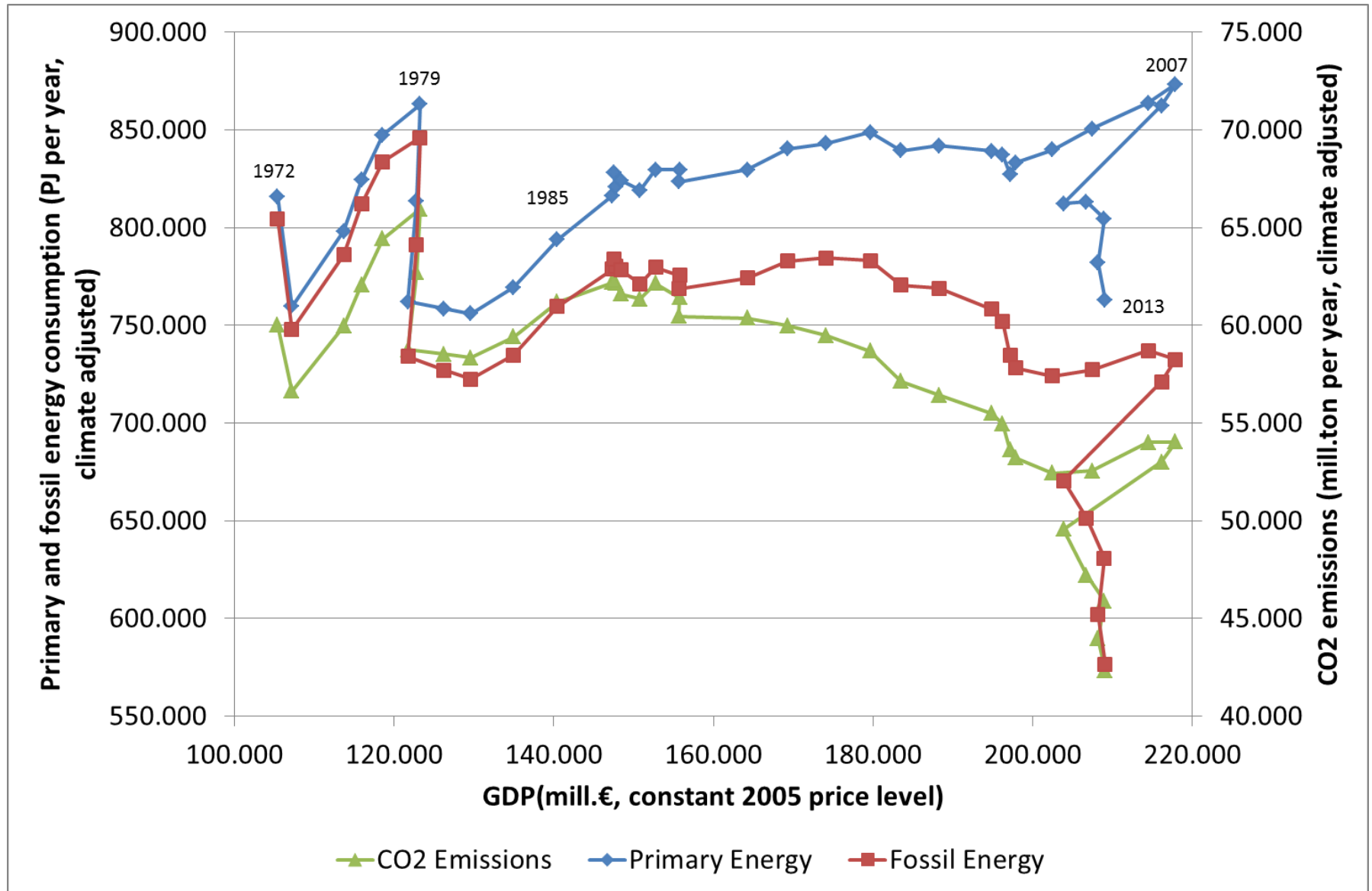




## Global GDP and energy consumption



## Another way



# 1960s: Johannes Juul and the Gedser Wind Turbine



Pariserlampen, 1925



PH Glaspandel, 1926



PH Kogle, 1958



PH 5, 1958



PH 4/3, 1966



[tinyurl.com/kulturkanon](https://tinyurl.com/kulturkanon)

108 artifacts in 8 categories



# 1890s: Poul La Cour and Askov Folk High School



## 1940s and 1950s: F.L. Smith's Aero Generator on Bogø



## 1960s: Fighting a losing battle against the Carbon Rush



## 1969: Juul and the Gedser Turbine dies

... haven taken "... one small step for man, one giant leap for mankind".  
But the world could not care less



## 1973 and 1979: The Oil Crises



**1974 – 1984: Authorities wants nuclear to replace fossil fuels –  
but grassroots had other ideas**



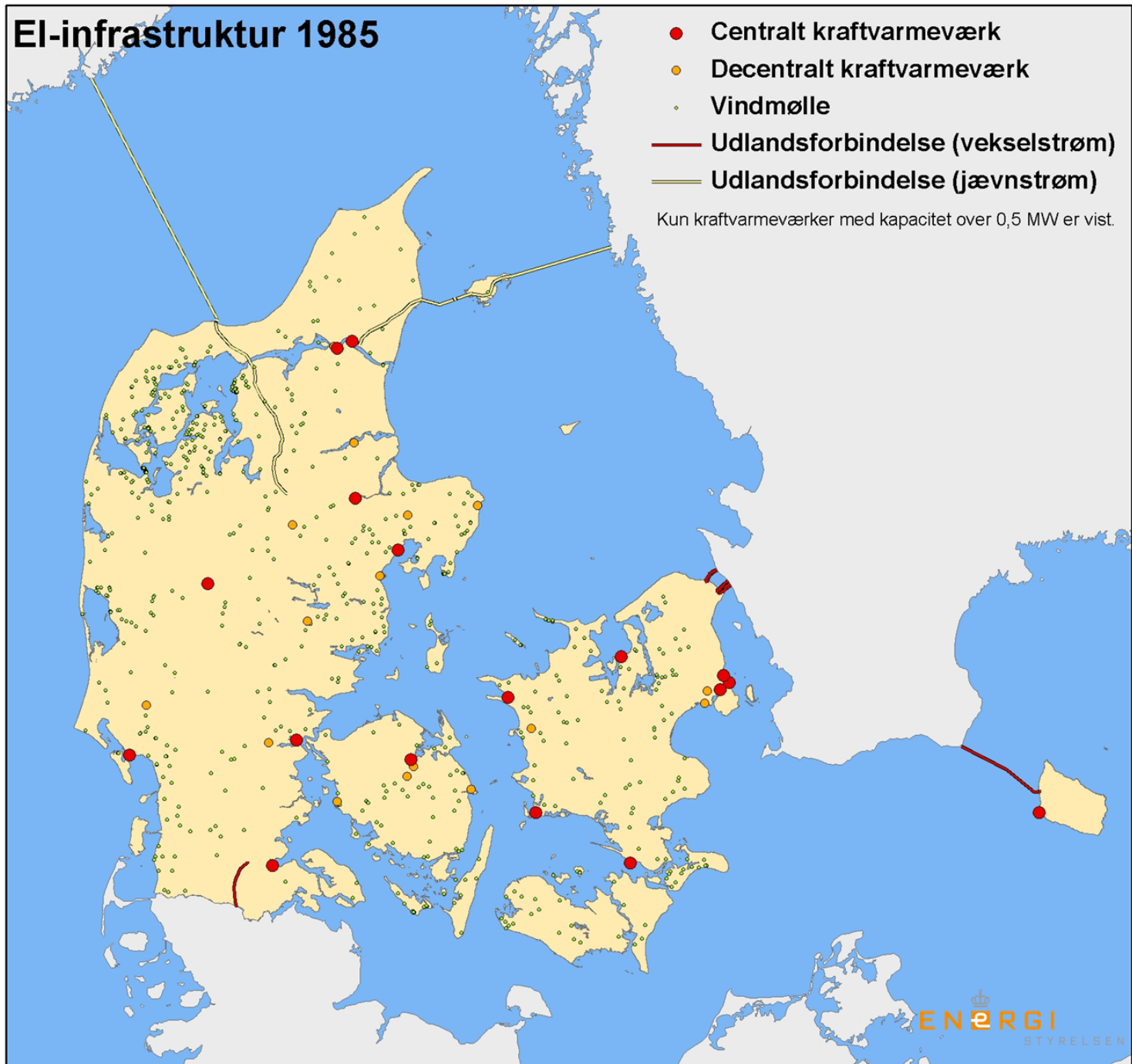
# Experimental innovation and Juul's patents re-surface



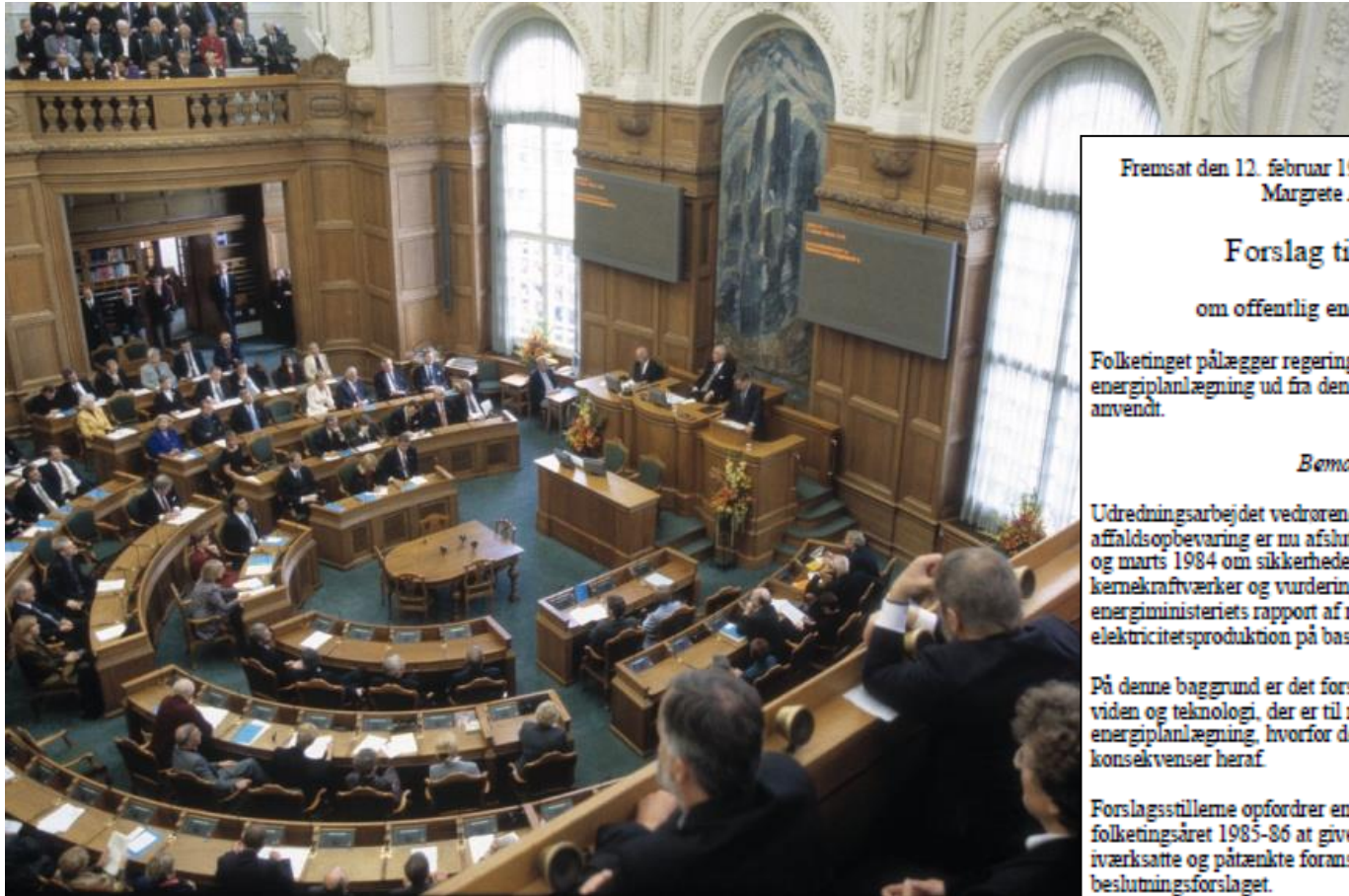
# El-infrastruktur 1985

- Centralt kraftvarmeværk
- Decentralt kraftvarmeværk
- Vindmølle
- Udlandsforbindelse (vekselstrøm)
- Udlandsforbindelse (jævnstrøm)

Kun kraftvarmeværker med kapacitet over 0,5 MW er vist.



# Nuclear banned from public energy planning



Fremsat den 12. februar 1985 af Lone Dybkjær (RV), Jytte Hilden (S),  
Margrete Auken (SF) og Tinning (VS)

## Forslag til folketingsbeslutning

om offentlig energiplanlægning uden atomkraft

Folketinget pålægger regeringen at tilrettelægge den offentlige energiplanlægning ud fra den forudsætning, at atomkraft ikke vil blive anvendt.

### Bemærkninger til forslaget

Udredningsarbejdet vedrørende atomkraftens sikkerhed, økonomi og affaldsopbevaring er nu afsluttet, jfr. miljøministeriets rapporter af februar og marts 1984 om sikkerheden ved kernekraftværker, placering af kernekraftværker og vurdering af elværkernes salthorsthundersøgelser samt energiministeriets rapport af november 1984 om forhold af betydning for elektricitetsproduktion på basis af kul og uran.

På denne baggrund er det forslagsstillernes opfattelse, at atomkraft med den viden og teknologi, der er til rådighed i dag, skal udgå af den danske energiplanlægning, hvorfor det pålægges regeringen at drage de nødvendige konsekvenser heraf.

Forslagsstillerne opfordrer energiministeren til straks ved begyndelsen af folketingsåret 1985-86 at give det energipolitiske udvalg en redegørelse for iværksatte og påtænkte foranstaltninger til efterlevelse af beslutningsforslaget.

Folketingsbeslutningen blev vedtaget ved 2. (sidste) behandlingen den 29. marts 1985, med 79 stemmer (S, SF, RV og VS), mod 67 (KF, V, CD, KrF og FP).

# April 25-26, 1986: Chernobyl



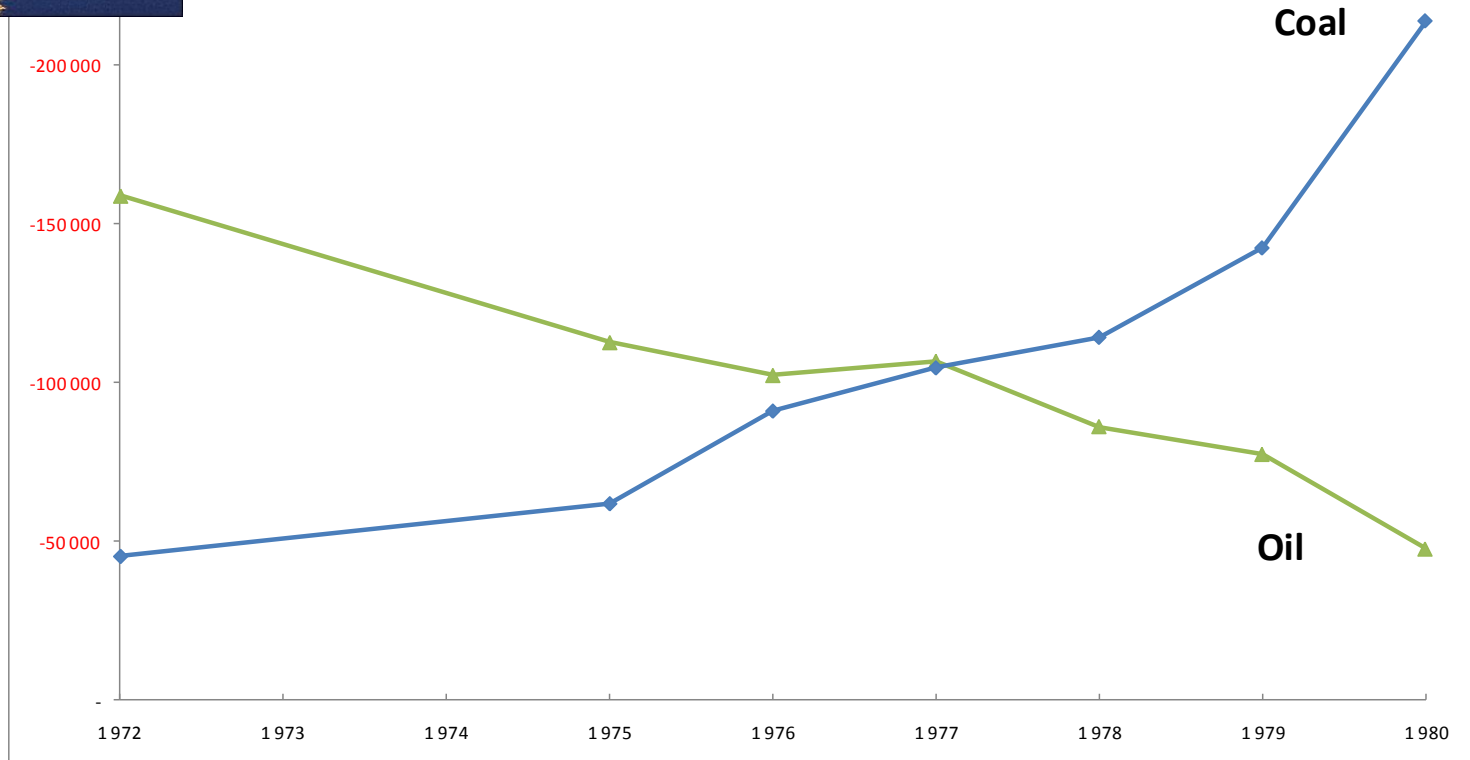
# Chernobyl today: Sarcophagus 10000 yrs maintenance



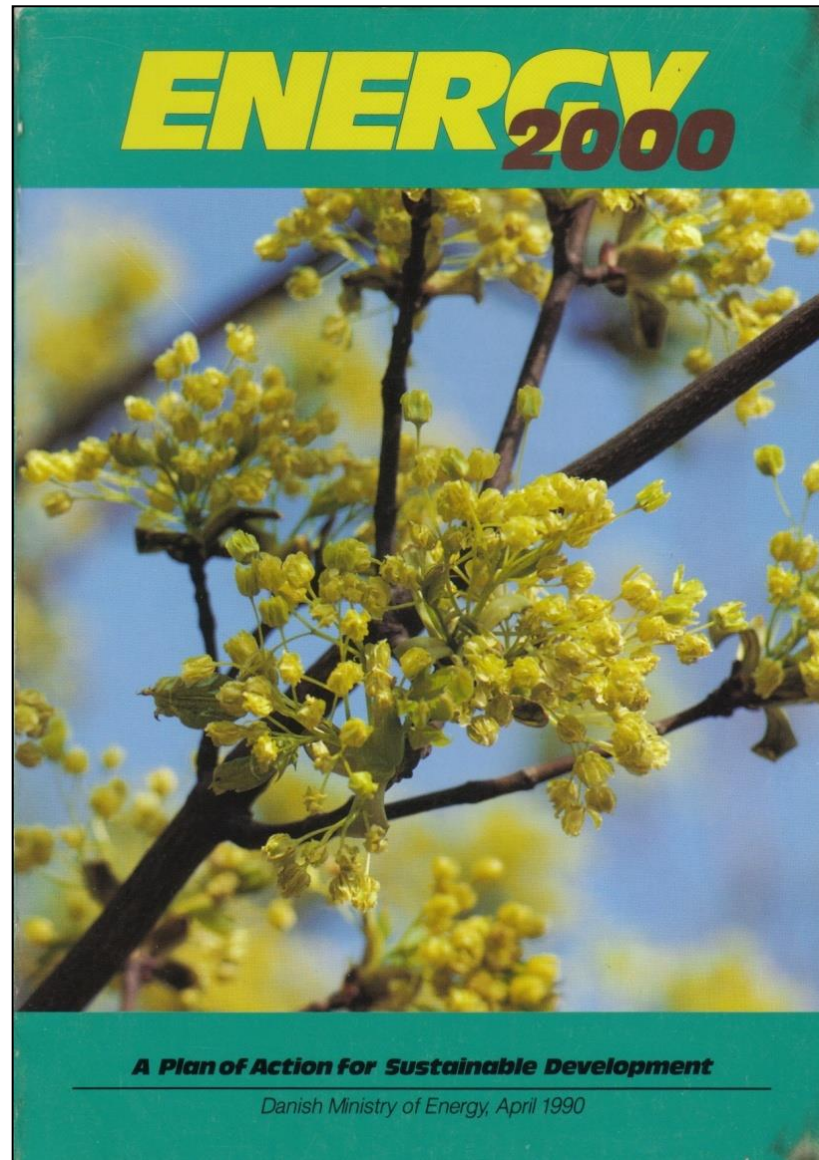
# Important ingredients: Transition success for coal + finding gas



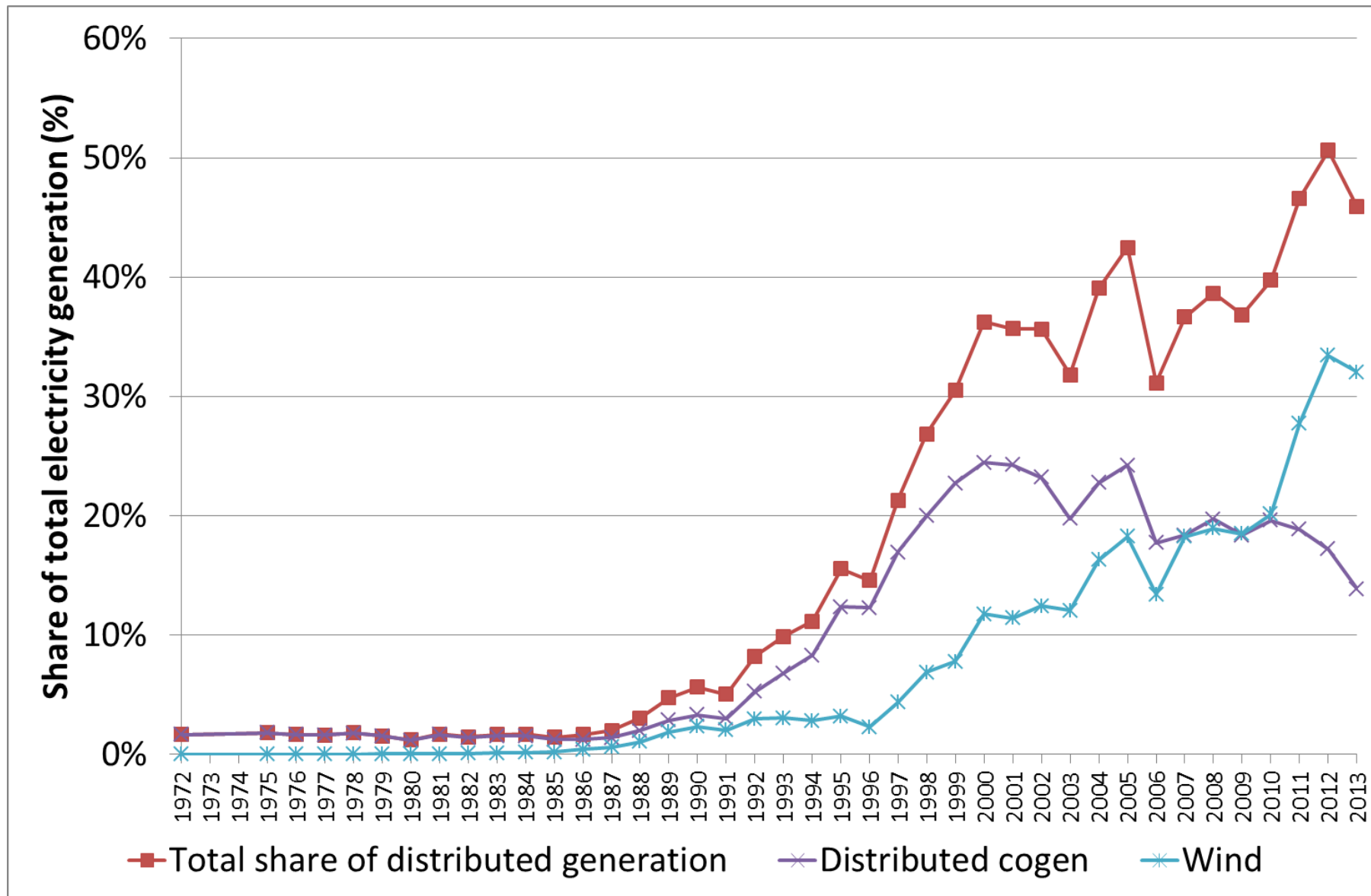
**Fuel consumption in electricity production 1972-1980**



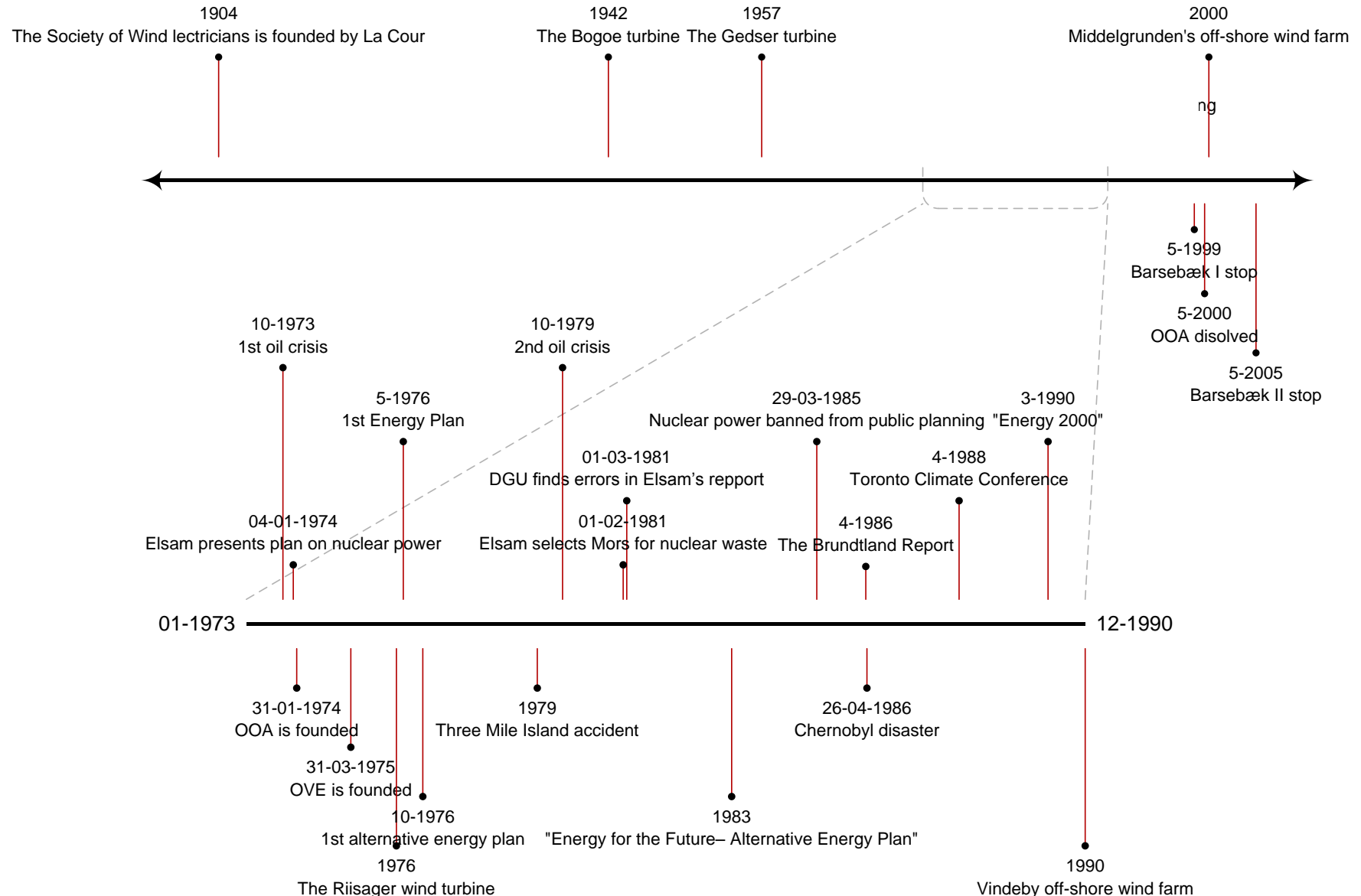
# 1990: World's First Official Sustainable Energy Plan



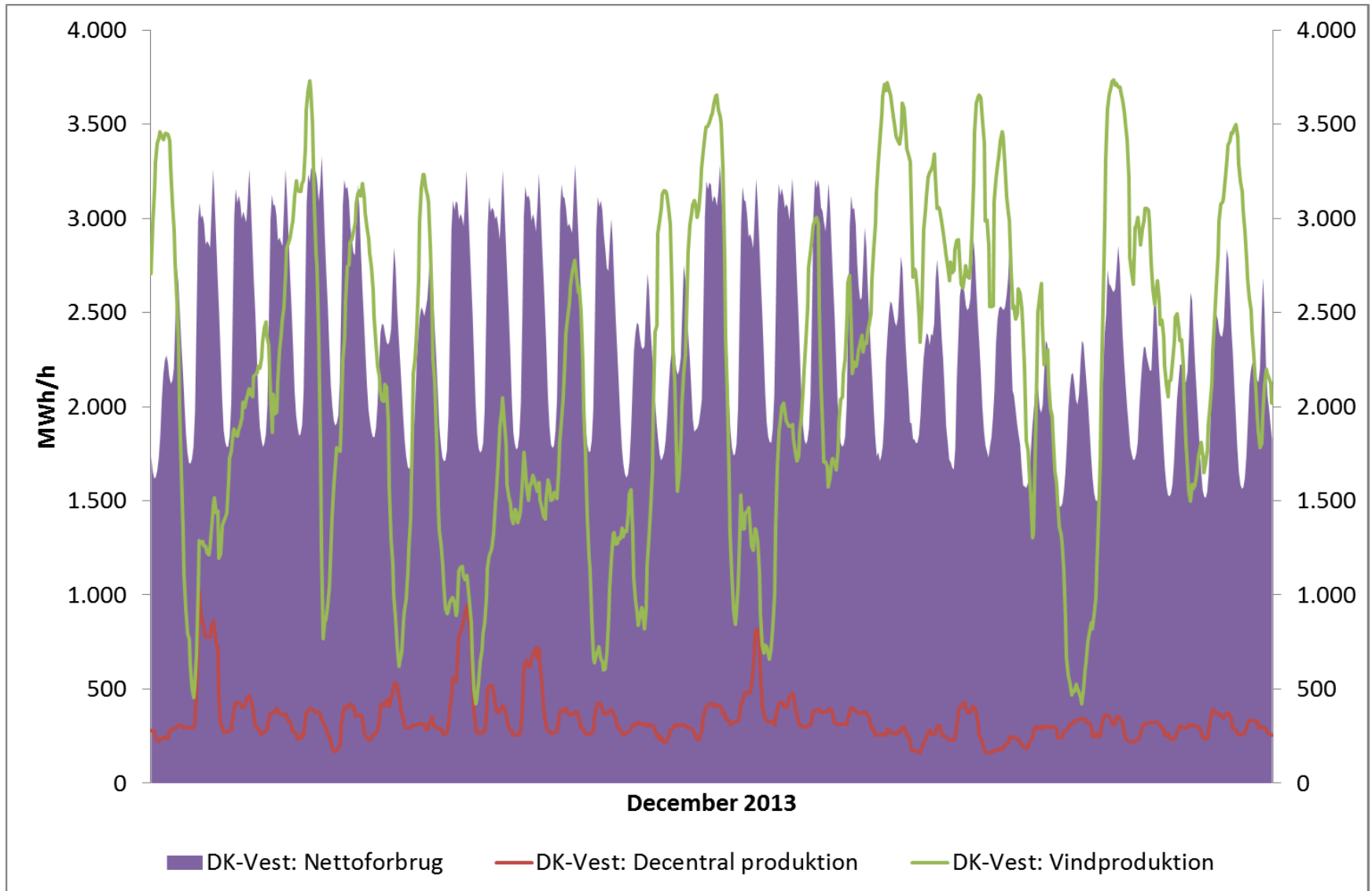
## Strong penetration of gas-fired distributed cogeneration + wind power

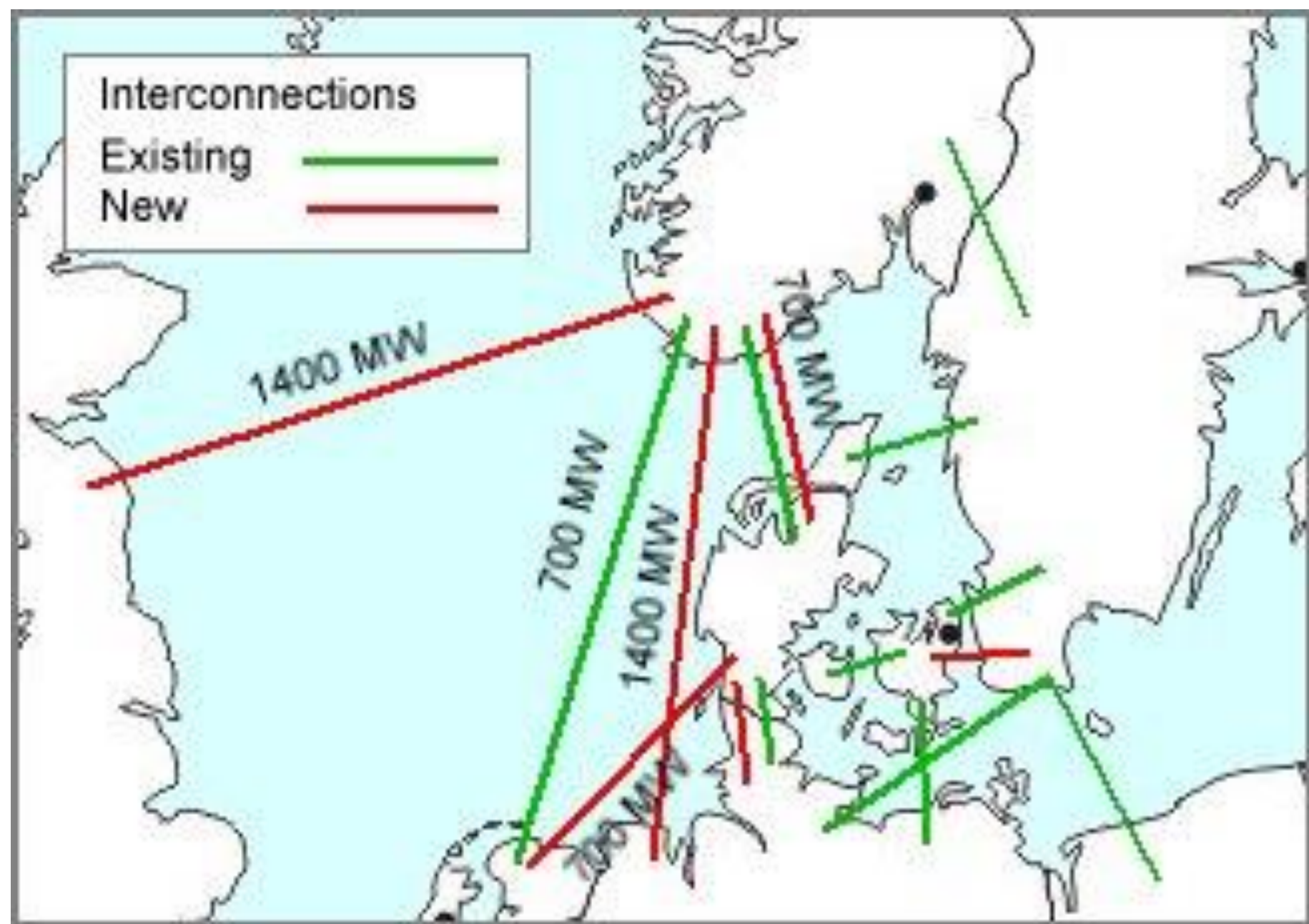


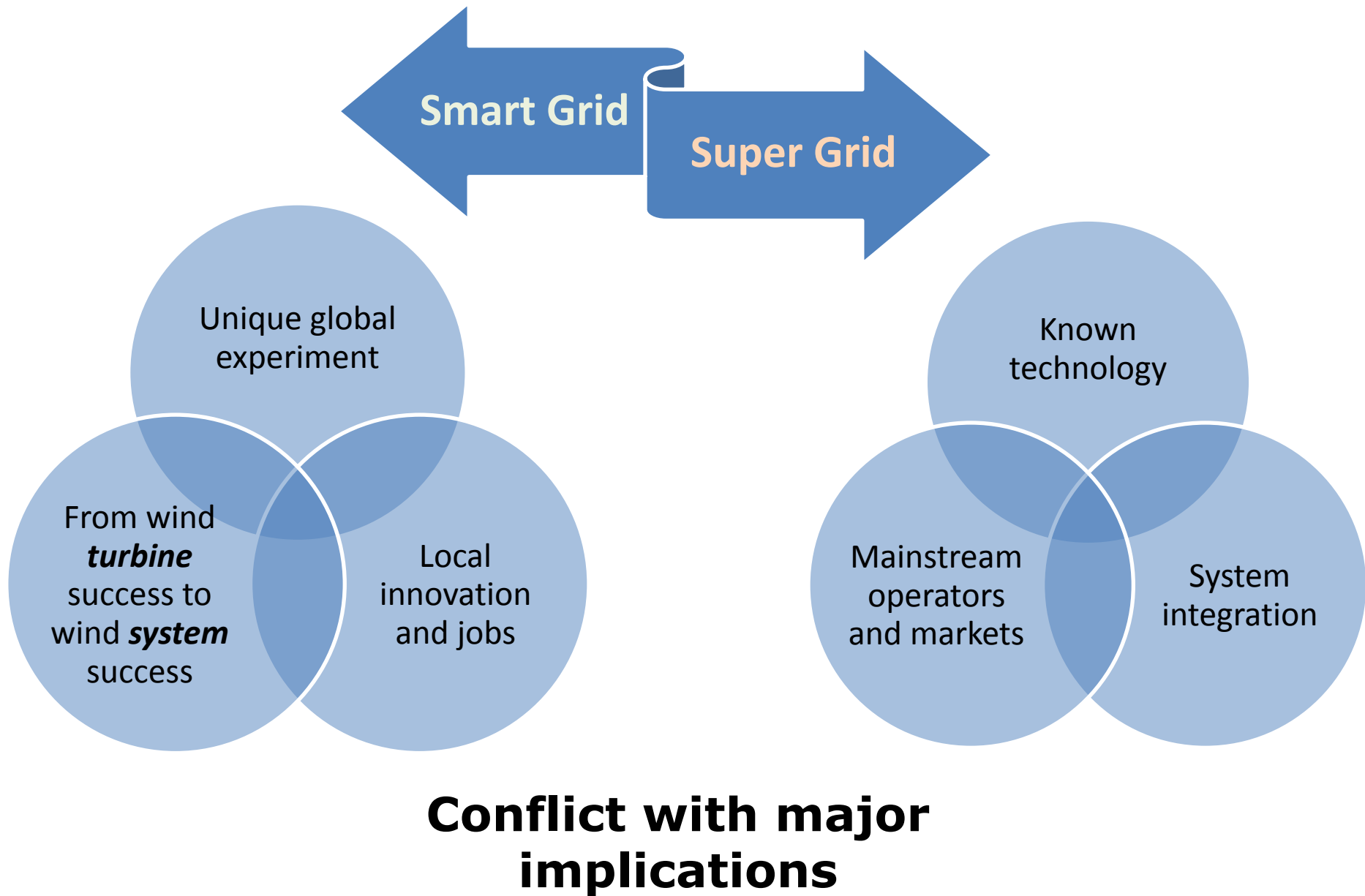
# What explains this development? And what happens next?



# Wind power, Distributed cogeneration, Power demand



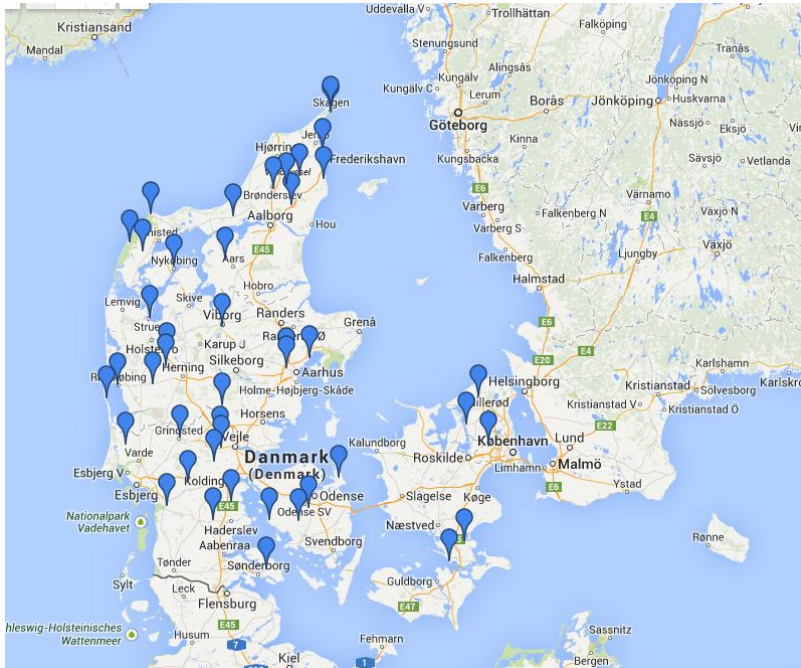




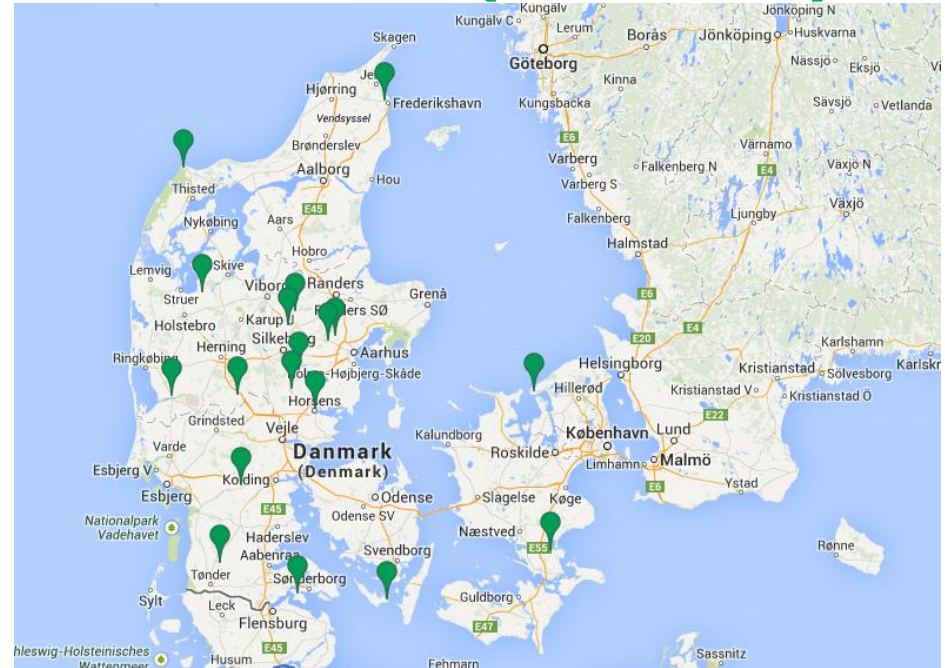
Blarke MB, Jenkins B, SuperGrid or SmartGrid: Competing strategies for large-scale integration of intermittent renewables? Energy Policy, Volume 58, Pages 381–390, July 2013.

# The first wave of SmartGrid technologies in district heating: Electric boilers and compression heat pumps

405 MWe



37 MW-varme (ca. 9 MWe)



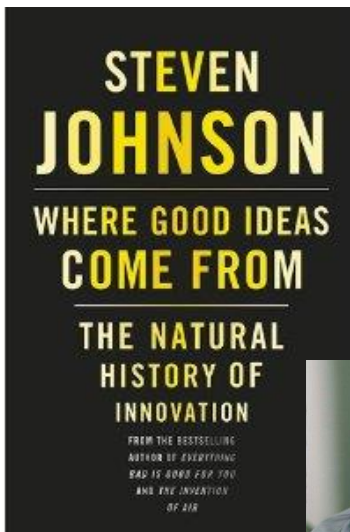
Electric  
boilers

Compression  
heat pumps

# Understanding change: Open versus Closed Systems

“The lone genius entrepreneur is a rarity, far more innovation is coming out of open, nonmarket networks”

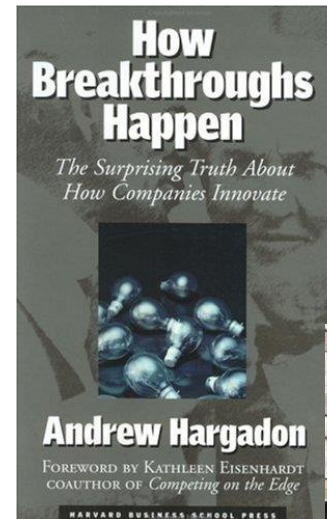
“Divided we innovate”



**Studied  
history and  
artifacts**



Steven Johnson  
Science Author and Theorist



**Studied  
organizations  
and  
processes**



Andrew Hargadon  
Professor, University of California Davis

## Evolving planning theory

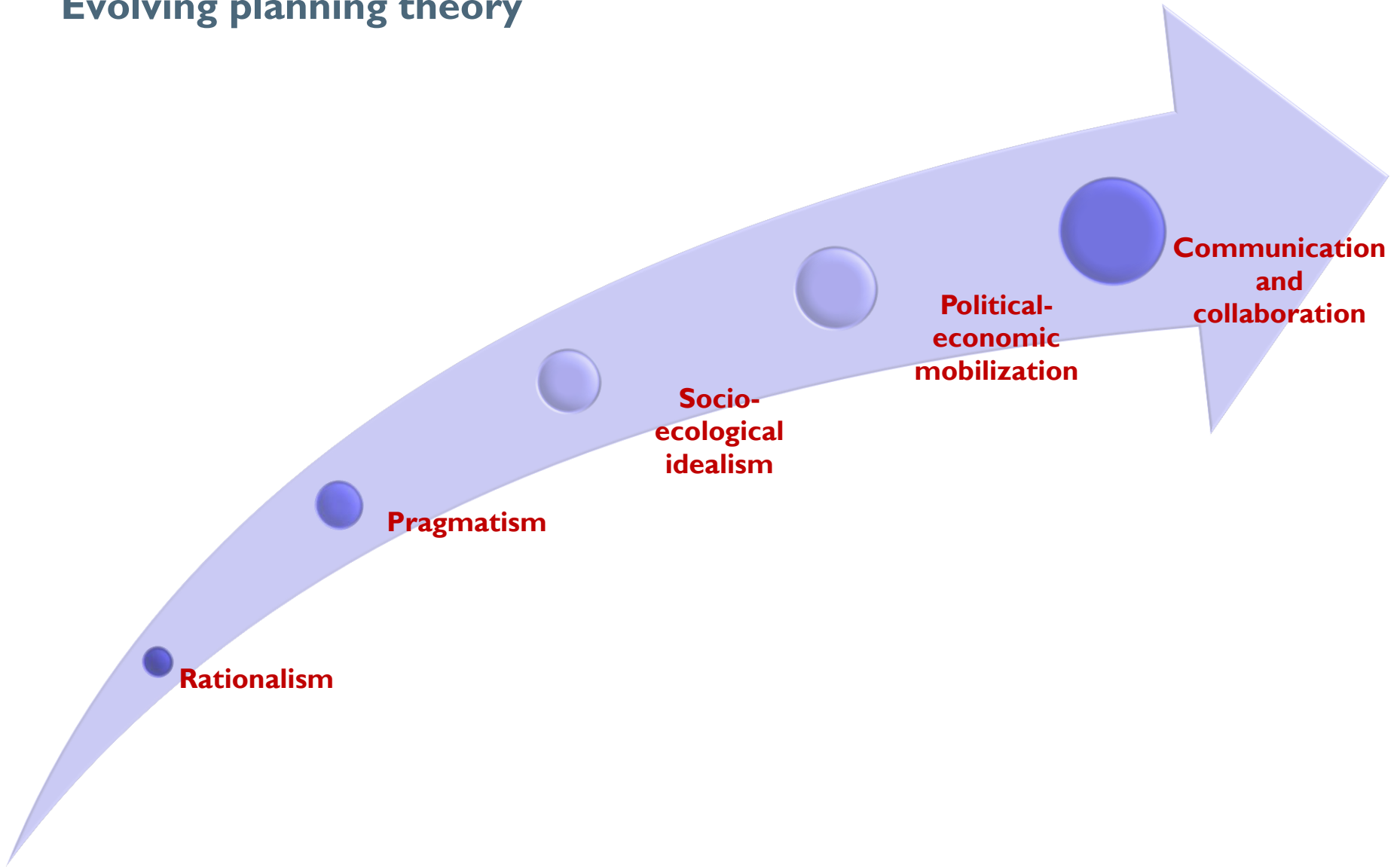
**Rationalism**

**Pragmatism**

**Socio-  
ecological  
idealism**

**Political-  
economic  
mobilization**

**Communication  
and  
collaboration**



# Evolving innovation theory

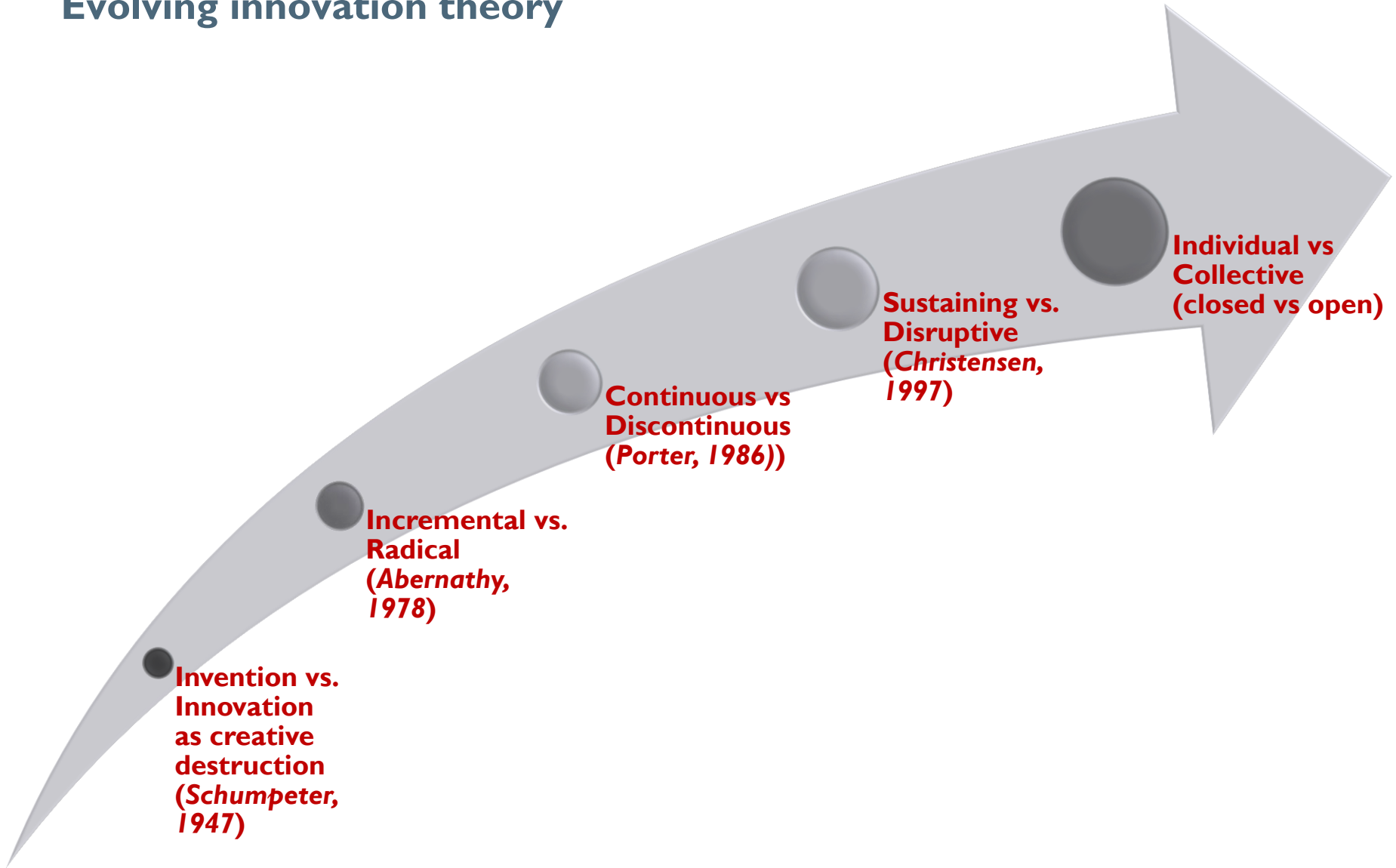
**Invention vs.  
Innovation  
as creative  
destruction  
(Schumpeter,  
1947)**

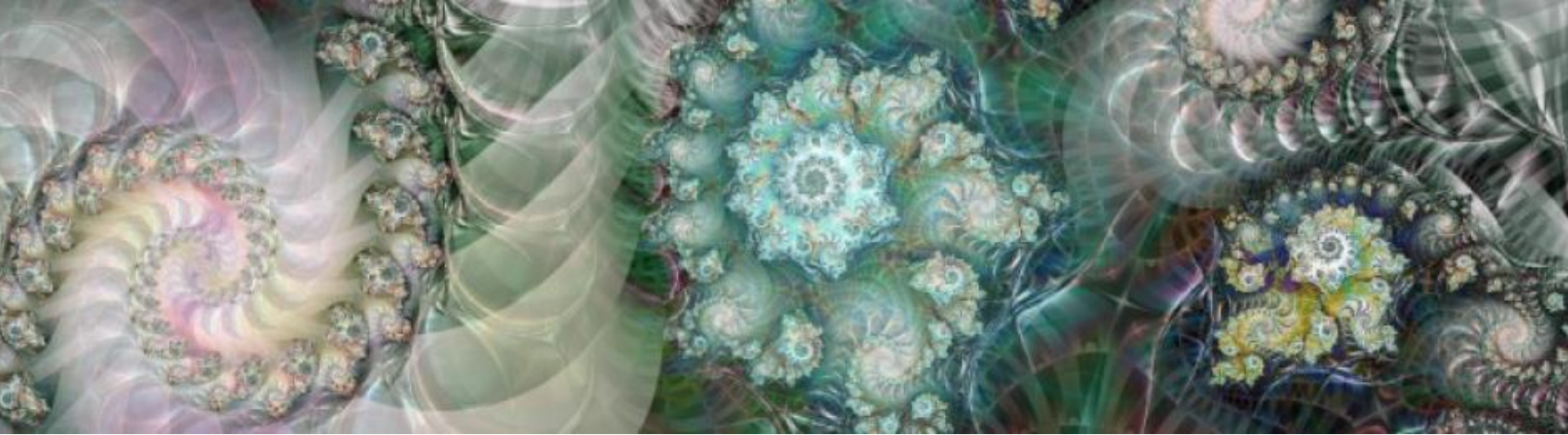
**Incremental vs.  
Radical  
(Abernathy,  
1978)**

**Continuous vs  
Discontinuous  
(Porter, 1986))**

**Sustaining vs.  
Disruptive  
(Christensen,  
1997)**

**Individual vs  
Collective  
(closed vs open)**



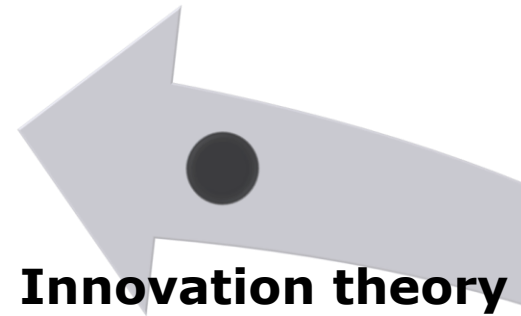


**Planning theory**

Creating environments where  
ideas **connect**

**Social scenes with or  
without boundaries**

The greatest need:  
Tools for constructive **conflict**  
management



**Innovation theory**



**There is no key  
without a lock**

Conflict -> change

Big conflict -> large  
change potential

Ideas are products of  
collective networks

If you want  
change/success,  
engage a conflict,  
connect with allies!

**Slides download: [tinyurl.com/iscan2015](http://tinyurl.com/iscan2015)**