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Institutions and industrial policy in energy disruption: The illustrative case of Denmark

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SMART ENERGY TRANSITION

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Introduction

1. Intro to Smart Energy Transition Project – Work Package 3

2. Concepts and methods

3. Preliminary findings from empirical case of Denmark.

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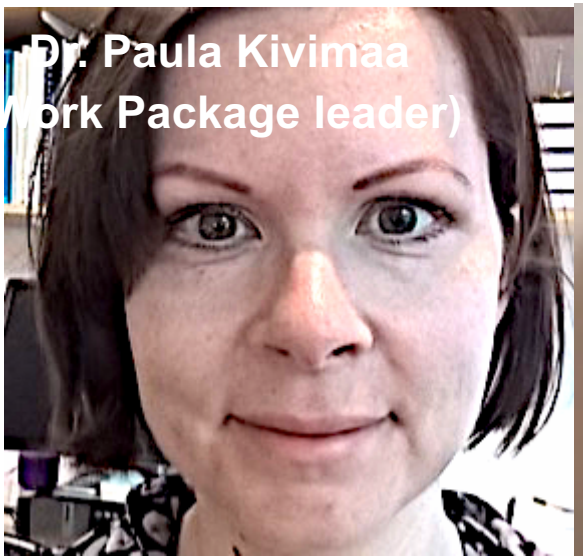
WP3 RESEARCHERS



Aim and Research Questions

AIM: the development of a conceptual framework to understand the role played by institutional factors and industrial policy in energy disruption

1. How can disruption be characterised in energy transition processes?

2. What is the role of institutions for energy disruption – both as enablers and barriers – and how have any changes in institutional factors been influenced by, or influenced disruptive processes in the energy system?

3. What is the role of industrial policy for energy disruption – both as enabler and barrier – and which new industrial policies have emerged to handle energy disruption?

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Research Design

1. Literature review on the theoretical fields of ”disruptive innovation”, “institutional analysis” and “industrial policy”

2. Development of an analytical framework for the comparative case study to test existing theories of energy disruption and the role of institutions and industrial policy for disruptive innovation

3. Comparative analysis of three case studies: Denmark, UK and Germany
   - Semi structured interviews with key actors (state, knowledge institutions, businesses, grassroots)
   - Primary and secondary literature review on the cases in relation to the theoretical fields

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Disruptive innovation

- Inspired by the Shumpetarian “creative destruction”
- Building on the fundamental debate on “breakthroughs” or “punctuated” periods of technological development
  - trying to respond to the incapability of incumbent actors to ”catching the wave” of technological development
  - examining the institutional environment of “radical” or “discontinuous” innovations
- Contributing to the field of energy transitions:
  - Systemic perspective - regime based approaches to market reconfigurations
  - Focusing on context - the structures, agents, and processes that support or prevent disruption
  - Characterization of disruptive innovations: “added values”, “business models”, “ownership models”, “system architecture”
- Respond to the ambiguity of definitions by asking:
  - When and how does innovation become disruptive?
  - How is disruption viewed/understood by a diversity of stakeholders?

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Institutional theory

- The institutional context in which disruptive innovation evolve differ markedly with context (geographical, historicall, cultural, etc)
- Sociological institutionalism:
  - understanding environmental conditions influencing organizational structures and dynamics (legitimacy, isomorphism, organizational fields/regimes, logics)
  - Formal and informal institutions(routines, rules, practices, etc): Cognitive, Normative, Regulative
  - How to understand directionality and divergence?
- Historical Institutionalism:
  - understanding how specific institutional contexts are formed over time
  - understanding how institutions structure and shape political behaviour and outcomes
  - Attention on the power asymmetries of organizational fields/regimes
  - Politics of sustainability transition: “path dependency”, “critical junctures”, “variety of capitalism”, “qualities of democracy”
  - How do institutions change? E.g. displacement, layering, drift and conversion
  - How institutional change affect socio-technical transitions?

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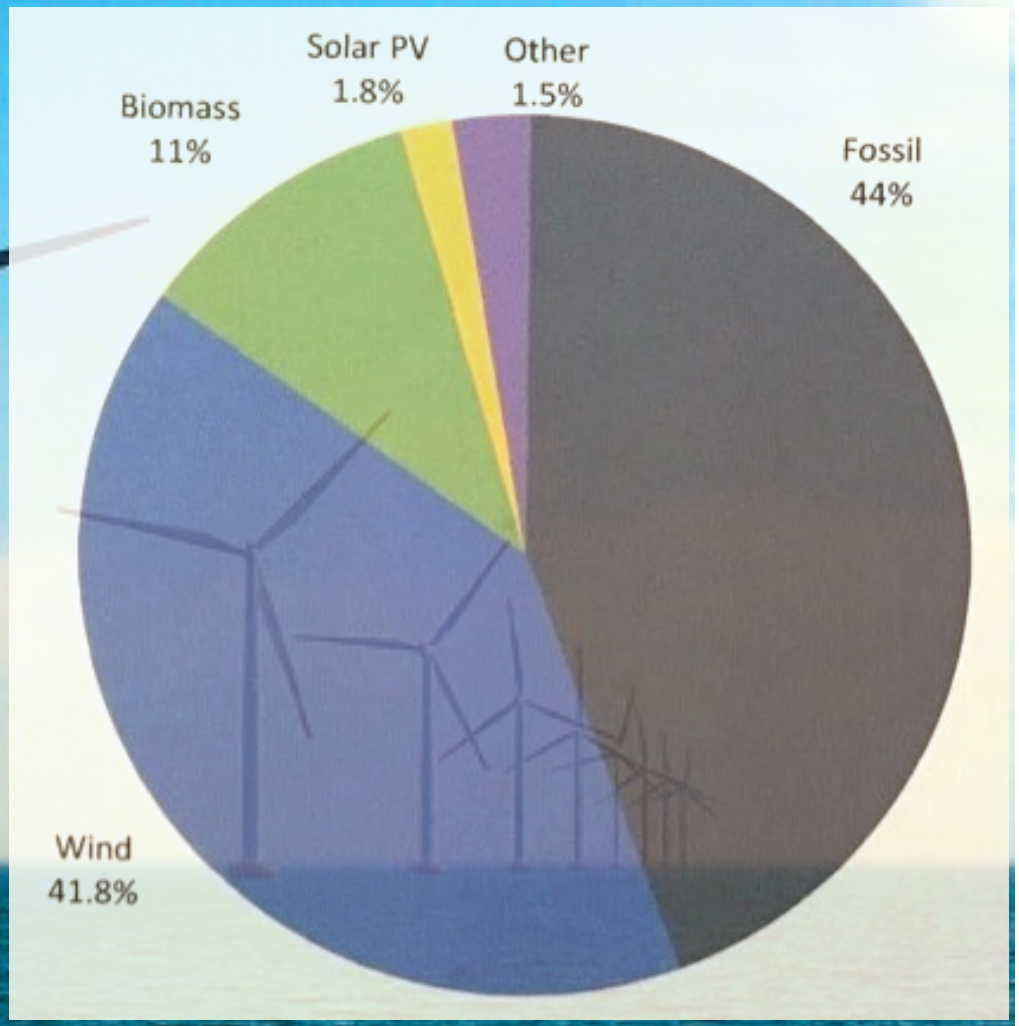
industrial policy

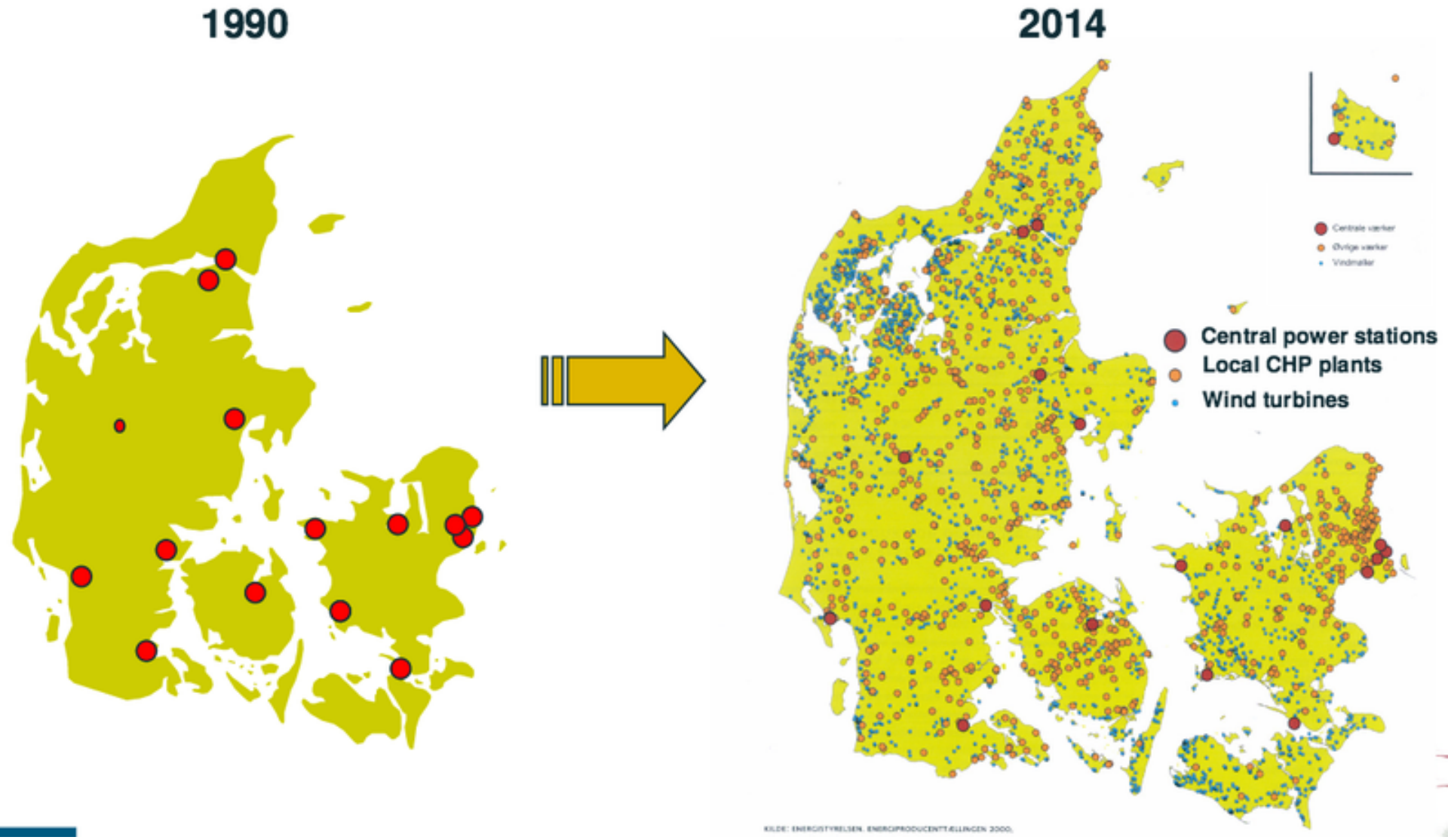
- Industrial policy: a set of instruments promoting industrial restructuring and crucially supporting the emergence of new industries and innovations as part of strategic economic policy (Bianchi & Labory, 2006: 3)
- Recognizing that some level of state intervention is necessary to produce 'competitive economies' (Stiglitz et al. 2013)
- Different approaches: vertical ("picking winners") and horizontal (embeddednesses by coordinated support)
- 'Green industrial policy' as "government intervention to hasten the restructuring of the economy towards environmental sustainability" (Pegels et al, 2014)
- Examples: 1) subsidies in their many forms—from production subsidy to lower interest rates; protection from imports; (2) direct public participation; (3) public procurement rules (e.g., "domestic sourcing" requirements); (4) targeted public investments, for example in infrastructure; and (5) cluster policies and other forms of innovation policies
- Industrial policy has not been a focal point of enquiry for sustainability transitions

Danish Power Mix (2015) and present goals

- **2020 goal:** 50% electricity production by wind
- **2035 goal:** CO2 neutrality of electricity and heat
- **2050 goal:** CO2 neutrality of the whole energy system



The Danish Energy "Disruption" Map



The Danish Green Energy Disruption

Disruptive technological transformations:

- Energy Saving Regulations
- District Heating by CHP
- Wind technologies

Historical Phases

1. Thriving for Energy Security (1970s)
2. Facing out Nuclear (1980s)
3. Off-shore Wind (1990s)
4. COP15 and Climate policies (2000s)
5. Electricity prices and fluctuating production (Today)

Phase 1 - Thriving for Energy Security

Institutional Context

- 1970 oil crises and embargo by Saudi Arabia
- Users and municipally owned companies
- District heating largely developed in urban areas
- Organized social capital/Entrepreneurial civil society

The First National Energy Plan (1976)

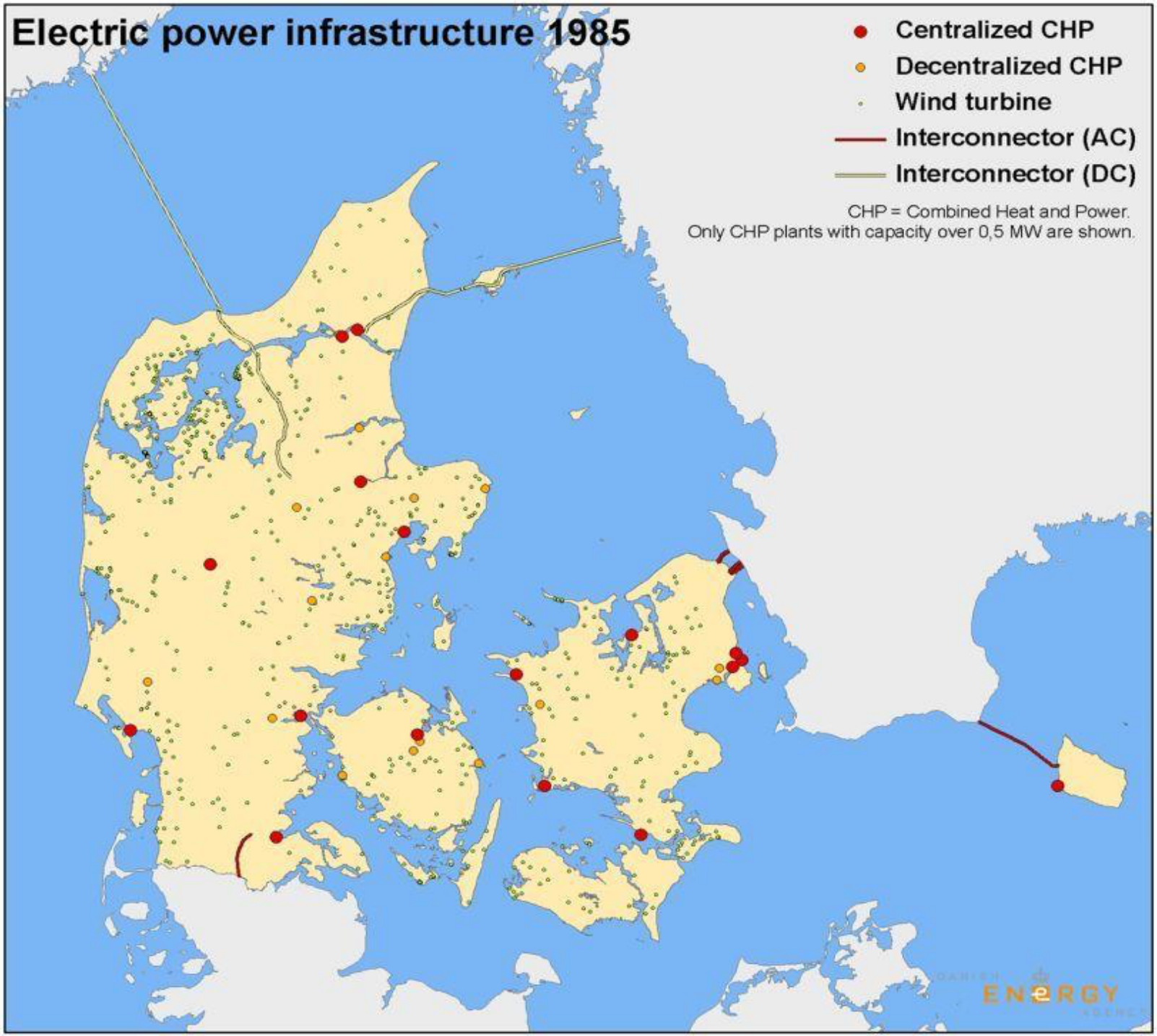
- Reducing oil dependency to improve supply security (coal and nuclear)
- Supporting domestic energy sources
- Promoting energy savings (building regulations, cogeneration)
- Establishing a national heat plan by district

Institutional dynamics

- Gas in the North Sea (DONG legacy)
- Oil power plants translated into coal
- Emerging Wind entrepreneurship
- Informed and informative Anti-nuclear movement – with a vision!
- The Alternative Energy Plan (NGOs, civil society, scientists)

Industrial policies

- Energy saving policies creating a platform for R&D on energy efficiency technologies (windows, isolating material, pumps etc.)
- Large investments on district heating through co-generation
- Raising taxes on fossil fuels


Electric power infrastructure 1985
Centralized CHP
Decentralized CHP
Wind turbine
Interconnector (AC)
Interconnector (DC)
CHP = Combined Heat and Power.
Only CHP plants with capacity over 0,5 MW are shown.

Phase 2 - Phasing out Nuclear

Institutional Context

- Regionalization of energy planning for district heating development
- Pro-active anti-nuclear movement supporting wind and renewables
- Danish Energy Association opposing wind and supporting nuclear

Policy context

- March 29th, 1985 Energy Act:
  - **Nuclear Energy production declared illegal!!!!!**
  - Agreement with energy utilities to build 100 MW of wind power

Institutional dynamics

- Growing local wind entrepreneurship
- Local owners investments on wind
- Owning shares of wind turbine becoming a “status symbol”

Industrial policies

- Energy Utilities “forced” to invest on wind
- Subsidies for CHP, wind, solar
- Stricter regulations on building, industries and on the use of fossil fuels
- Active coordination by government for the sustainable development of Danish industry

Phase 3 – Off-shore Wind

Institutional Context

- Increasingly decentralized power infrastructure
- Municipalities became central actors
- Green industry: source of export income and job creation
- Energy and Industrial associations to become increasingly supportive to wind

Policy context

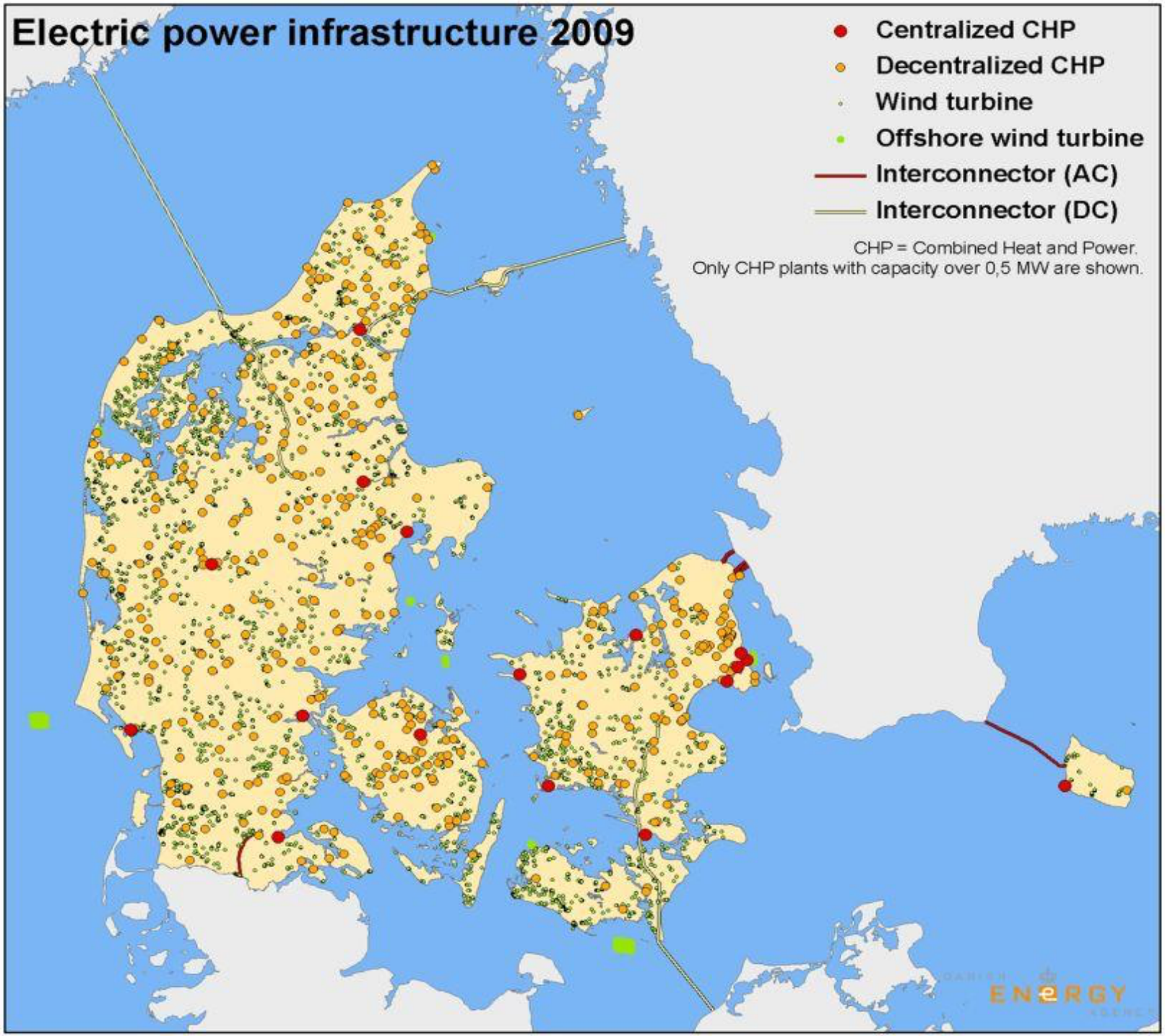
- (1993-2001) – Iconic "Super Minister" of Environment & Energy (Svend Auken)
- 1998 – EU directives for the liberalization of energy sector
- 1997 – Kyoto agreement
- Off-shore wind as the way forward: "a game for the big guys"

Institutional dynamics

- DONG acquired two large utility companies
- Separation of distribution and production
- Proactive and flexible national TSO, building interconnections with neighboring countries

Industrial policies

- 1998 - Introduction of the PSO (Public Service Obligation) Levy on electricity prices
- Wind framed as a valuable and strategic industrial cluster: R&D investments
- Re-dimensioned subsidies for on-shore wind and solar/ Off-shore wind largely subsidized
- Vattenfall invited to acquire Danish energy utilities to avoid DONG monopoly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ENERGY

Phase 4 – COP15 and climate policies

Institutional Context

- Neoliberal turn in 2000s - Dark time for wind until 2008 – Climate-sceptic PM apologies!!!
- 2009 – DONG stopped constructions of coal power plants to invest heavily on off-shore wind – the 85/15 reverse goal
- Vattenfall decided to sell all the fossil fuel based production in Denmark to invest only on wind

Policy context

- 2012 Energy Act:
  - **2020 goal**: 50% electricity production by wind
  - **2035 goal**: CO2 neutrality of electricity and heat
  - **2050 goal**: CO2 neutrality of the whole energy system
  - On-shore wind farms developers to offer 20% to locals inhabitants

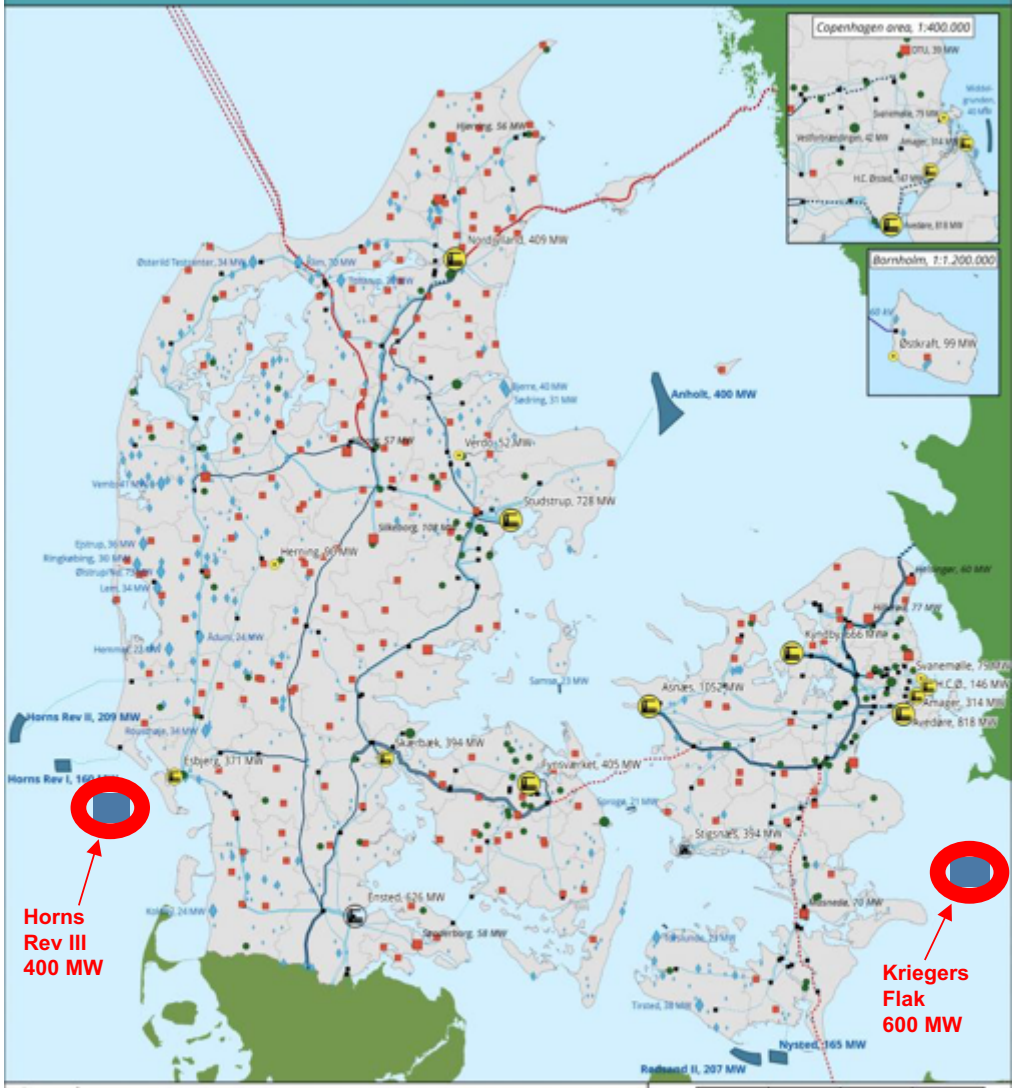
Institutional dynamics

- Coal based power plants sold to local utilities and partly translated into biomass or gas plants
- Municipalities setting ambitious goals for CO2 neutrality and freedom from fossil fuels
- Increasing resistance to on-shore wind

Industrial policies

- Wind, Biomass and Biogas as picked winners
- Coal/oil employees were transitioned to new roles - the DONG case: 1/3)staying; 1/3)transferred to off-shore wind; 1/3)sold to companies operating coal power plants outside Denmark

Power Production and Transmission in Denmark



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2016

Phase 5- Electricity prices and fluctuating production

Institutional Context

- Decreasing electricity prices
- Off-shore wind farms project bid for 1/3 of the traditional price
- 35% of thermal plants stopped operating
- Fluctuating energy production
- Increased wind power in neighboring countries (Germany and Sweden)
- Municipalities co-creating local strategies with citizens and local businesses
- Over-capacitated waste incineration plants: “Danish people like to burn stuff”

Policy context

- Untaxed Biomass
- High electricity taxes

Debated Adaptive Measures

Institutions

- R&D on storage facilities (heat and/or batteries)
- Increasing system flexibility by interconnections with UK and other countries
- Facilitating smart energy consumption
- Developing a smart energy system: centralized or decentralized????

Policy

- Facilitating electrification of heat and transport
- Taxation on Biomass???
- Decreasing taxation on electricity???

Key institutional factors

- Entrepreneurial associative culture supporting the green transformation (wind and energy efficiency)
- Empowered local democratic authorities
- Locally owned and non-for-profit heat and power utilities
- District heating by CHP
- Flexible and proactive TSO
- Nord Pool
- Very reactive and adapting industries

Key supporting industrial policies

- Energy saving regulations and R&D benefitting green companies
- Public Service Obligation (PSO) to be reinvested in R&D for renewables and TSO flexibility
- High taxation on fossil fuels
- Diversified and dynamic subsidies for wind and other renewables
- Separation of energy distribution and production
- Involvement of workers' unions

What made the Danish energy "disruption"?

- A propositive, informed and informative anti-nuclear movement
- A vision for a fossil-fuels/nuclear free energy future
- Local ownership
- National coordinated activities to greening the Danes and the Danish Industry
- Empowered public institutions at different governance level
- Involvement of workers' unions
- A flexible and proactive TSO

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Final reflections

- Energy in Denmark has been the only system not largely affected by the Neoliberal turn of 2000s
- Green industrial policies and institutional change finished to reinforce the neo-liberal agenda
- Ownership and business model of the green energy transition has changed nature to become more centralized and less diversified
- Strong tensions with still present bottom up dynamics of change, more holistic in nature (place making vs functional perspectives)
- Difficulties for less resourceful/conservative municipalities to keep up with the transition – substantial geographical diversity
- High taxes on electricity might bring to a lock-in situation favoring biomass over wind in the heating sector
- The role of PV is still weak – but possibly growing due to lowering prices

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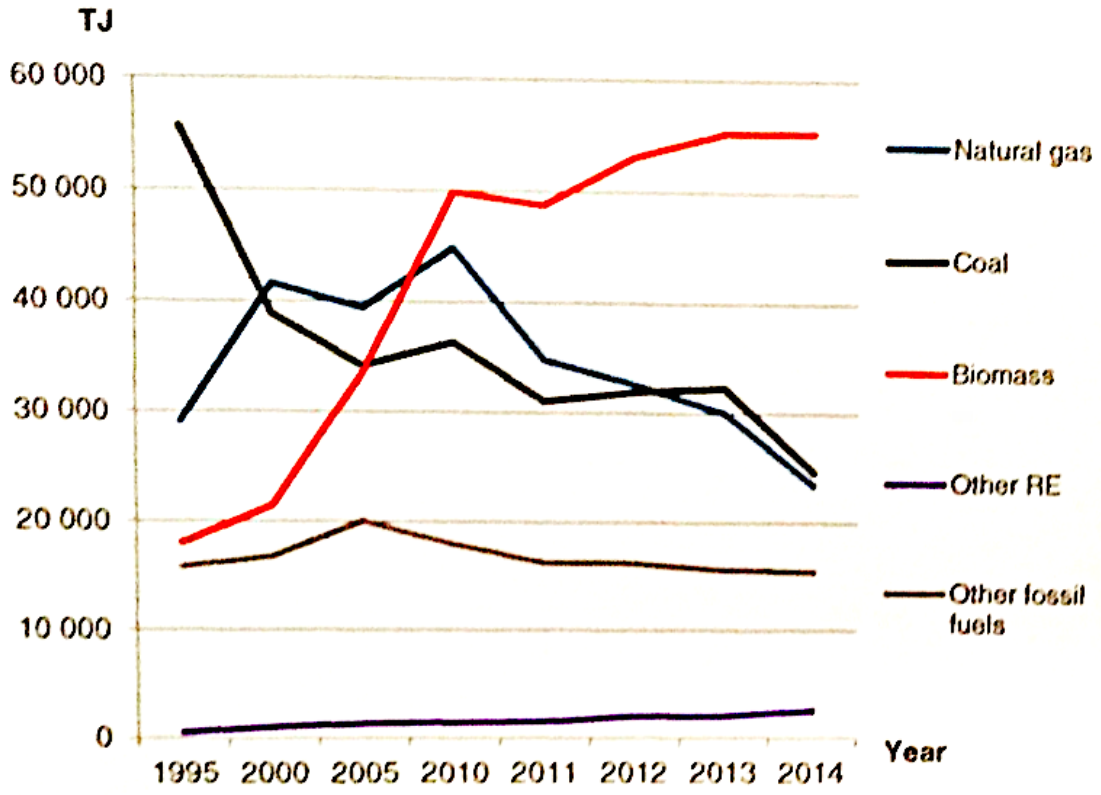
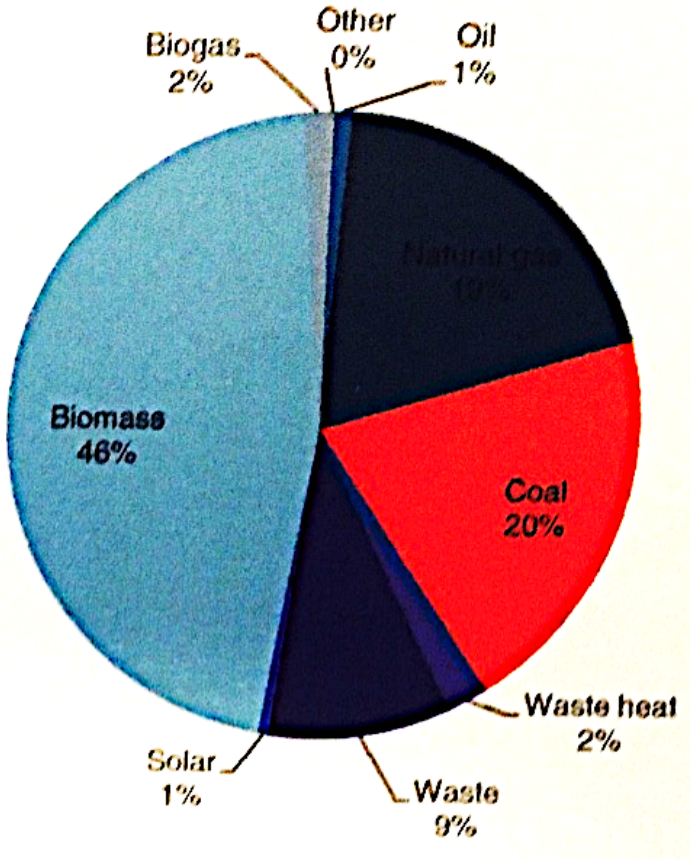
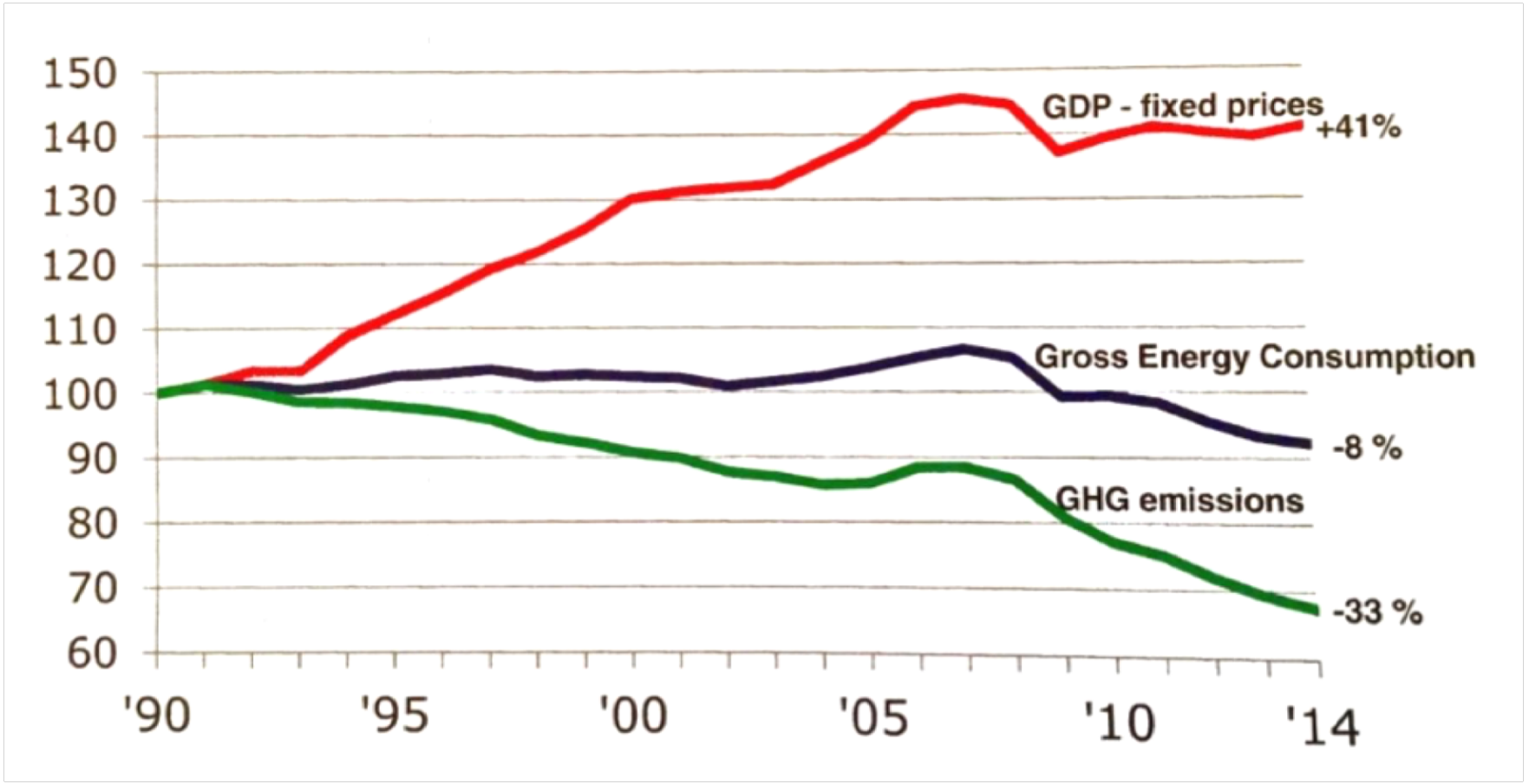
Thank you for listening!
Any questions?

The Danish District Heating Disruption





Danish Energy Disruption Track Record



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