

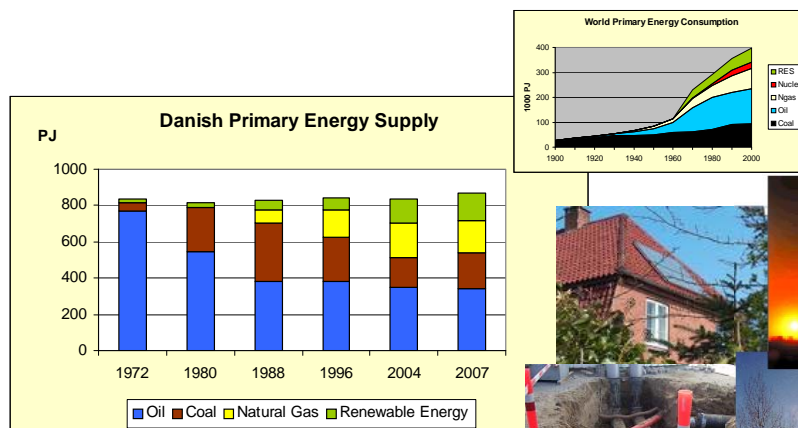


Anvendelse af biomasse i scenarier for 100% vedvarende energi

Osramhuset, København
 8. december, 2011
 Lektor Brian Vad Mathiesen
 Institut for Planlægning, Aalborg Universitet
people.plan.aau.dk/~bvm/



Fire årtier med et stabilt energiforbrug



thiese1
 bvm@plan.aau.dk




40 års aktiv energiplanlægning

- Mere end 40 års aktiv politik på energiområdet, præget af konsensus med forskellige fokusområder
- Den aktive energipolitik blev sat på stand-by i 2001
- Nyt mål i 2006: Mål om 100% vedvarende energi i Danmark
- Alternative energiplaner og offentlig debat i mere end 40 år




©Brian Vad Mathiesen
bvm@plan.aau.dk



Vi ved allerede meget

Fælles udfordringer:



- Mere vind i el-systemet
- Flere el- og varmebesparelser i husholdninger og industri
- Mere el i transporten
- Større effektivitet i konverteringen
- Større system integration



©Brian Vad Mathiesen
bvm@plan.aau.dk


Et muligt scenario ud af mange mulige:

- IDAs Klimaplan 2050 fra 2009
 - Består af
 - Hovedrapport (også på engelsk)
 - Teknisk baggrundsreport (også på engelsk)
 - 9 andre faglige notater


©Brian Vad Mathiesen
bvm@plan.aau.dk






The aim of the 100% renewable energy scenarios in CEESA

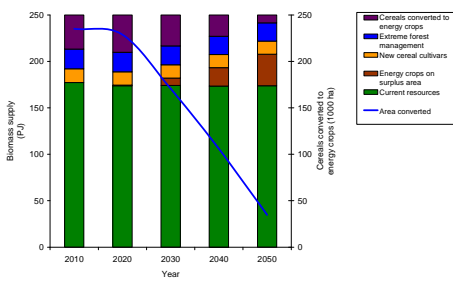
- Create a variety of 100% renewable energy system scenarios for Denmark.
- Analyse and integrate the transport sector into such systems.
- Analyse the effects of using biomass resources in 100% renewable energy systems considering the limitations in the biomass resources.
- Use energy system analysis to integrate flexibility and *smart energy systems* solutions into the electricity, heating and transport sectors as well as into the fuel supply to gas grids which utilise renewable energy.
- Analyse the effects on fuel efficiency and greenhouse gas emissions.
- Analyse the transition towards such a system from today until 2050.
- Identify the socio-economic consequences of such scenarios, incl. job effects, commercial potentials, health effects and others.



©Brian Vad Mathiesen
bvm@plan.aau.dk



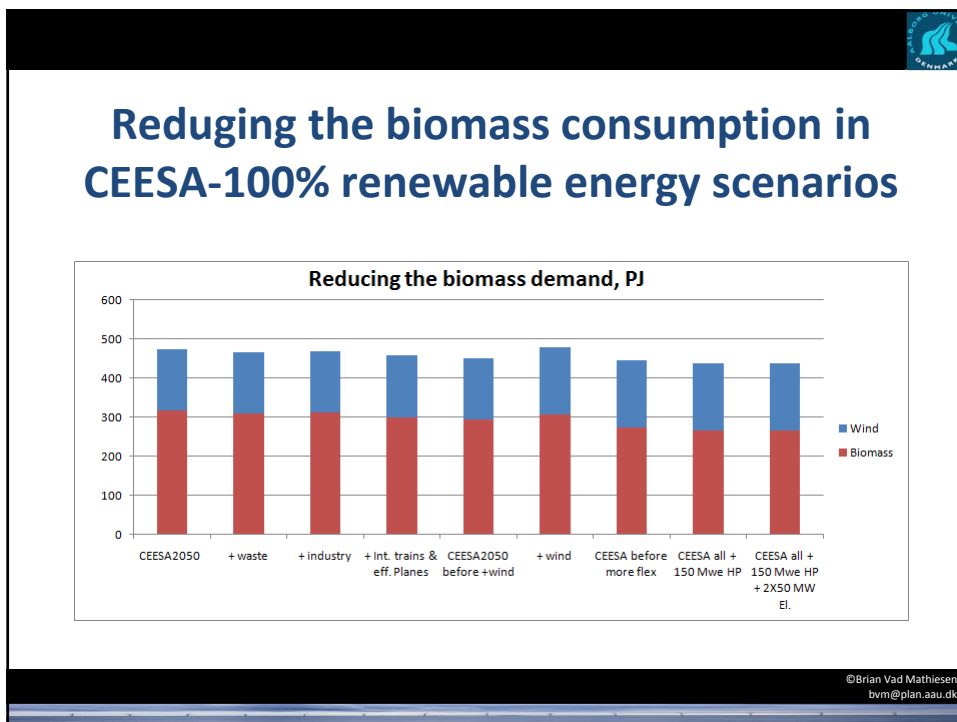
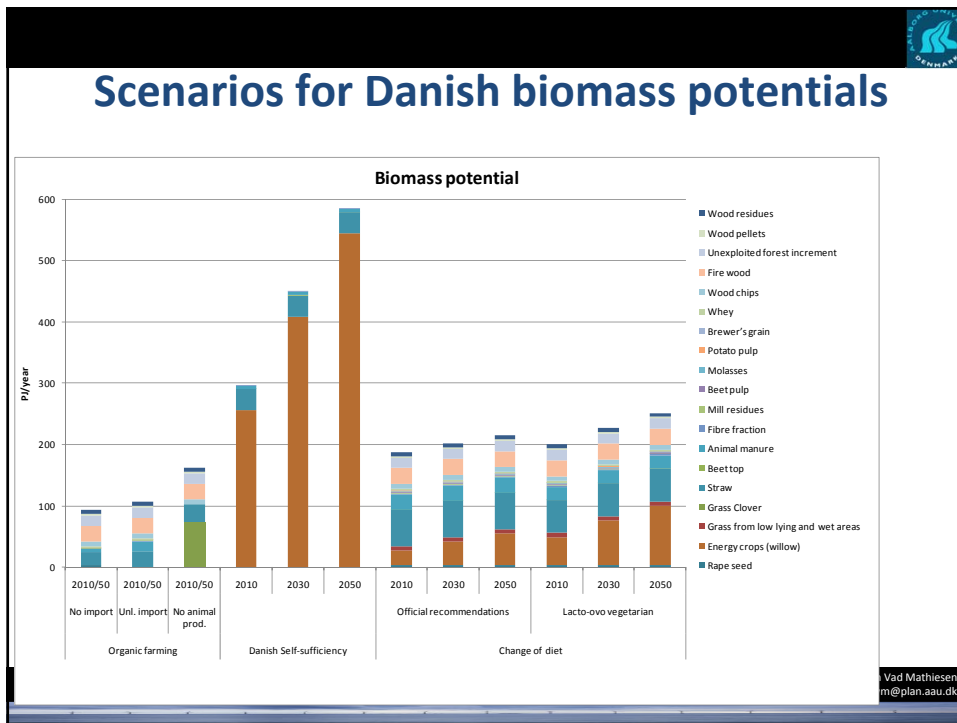
Biomass potentials identified in CEESA



Year	Current resources (PJ)	Surplus areas (PJ)	Energy crops on surplus areas (PJ)	Total Biomass Supply (PJ)	Area converted (1000 ha)
2010	175	15	10	200	20
2020	175	15	10	200	25
2030	175	15	10	200	35
2040	175	15	10	200	55
2050	175	15	50	240	100

- CEESA presents different biomass potential scenarios.
- 240 PJ is the target for the overall energy system
- 33-45 PJ of waste is additional
- 40-50 PJ for petro-chemical products has to be considered

©Brian Vad Mathiesen
bvm@plan.aau.dk



Smart energy systems are crucial for reducing biomass consumption in 100% renewable energy systems

Electricity smart grids are only one part of this system. The scenarios rely on a holistic *smart energy system* including the use of:

- **Heat storages** and district heating with CHP plants and large heat pumps.
- **New electricity demands** from large heat pumps and electric vehicles as storage options.
- **Electrolysers and liquid fuel** for the transport sector enabling storage as liquids.
- **The use of gas storage.**

Flexible integration of electricity, heat, gas and transport

©Brian Vad Mathiesen
 bvm@plan.aau.dk

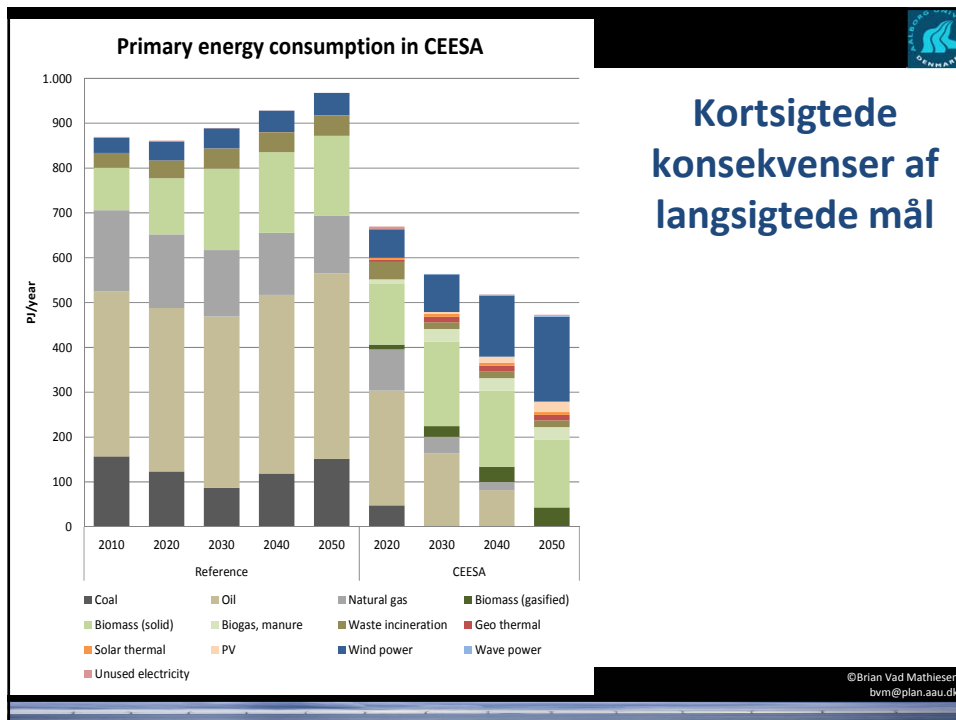
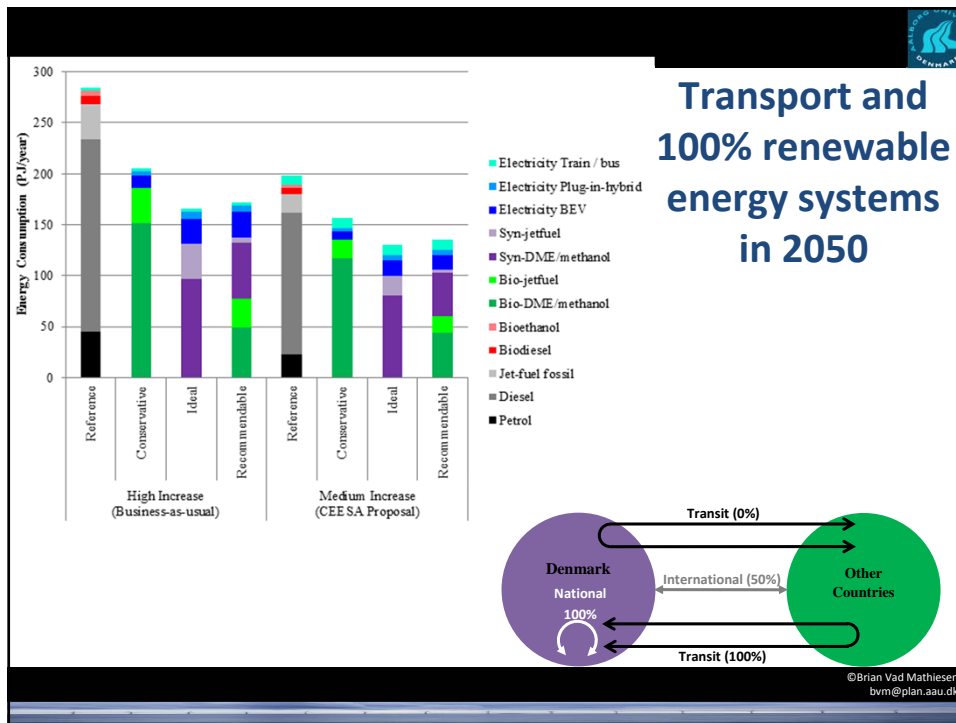
Transport modeling in CEESA

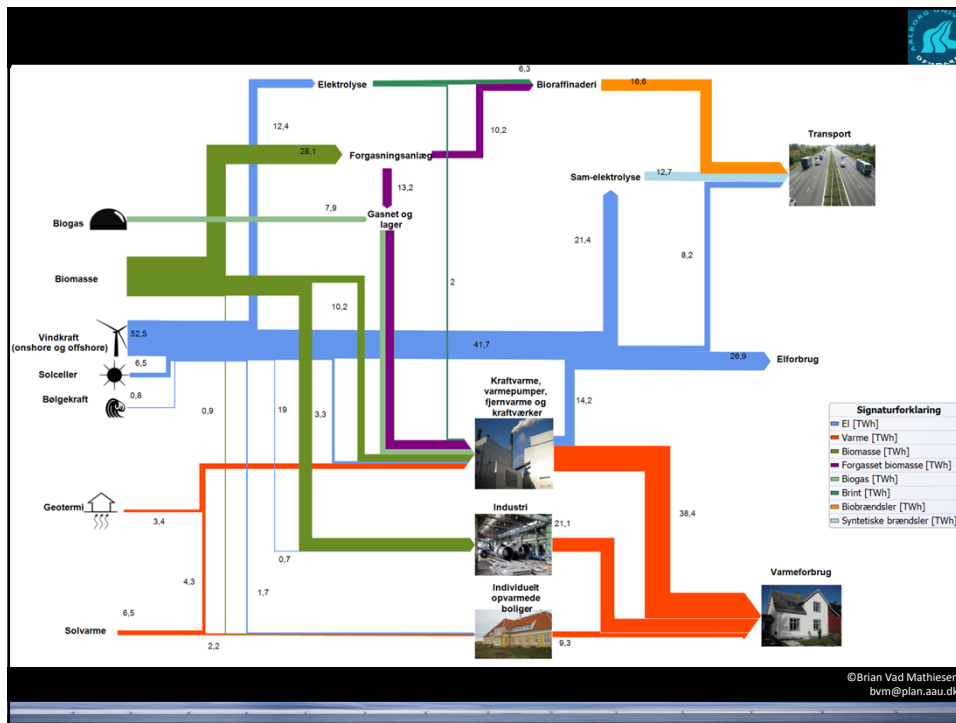
- Particular focus due to large challenges:
 - >95% reliant on oil
 - High increase historically
 - Large potential for electric cars and direct electricity but..
 - Specific challenges in bringing in electricity in sea, aviation and good transport

```

            graph TD
                subgraph TransportPLAN
                    TD[Transport Demands: Actual (pkm/tkm), Vehicle capacities, Load factors, Traffic work (km), Future demand]
                    TED[Transport-Energy Demand: Fleet efficiencies, Efficiency improvements, Modal shift]
                    Tech[Technologies: Types of vehicles, Fuels, Efficiencies, Infrastructure, Costs]
                end
                TD --> TED
                TED --> Tech
                Tech --> Out[Outputs: Fuel by technology, Fuel by mode, Vehicle costs, Infrastructure costs]
                Out --> ER[EnergyPLAN: Energy System Analysis]
                ER --> TR[Transport Results]
                ER --- ER_Assess[Assess: Energy Production Effects, Total Fuel Demands, National GHG Emissions, Total System Costs]
                TR --- TR_Assess[Assess: Future demands, Modal Shifts, Efficiency Improvements, Different Technologies]
            
```

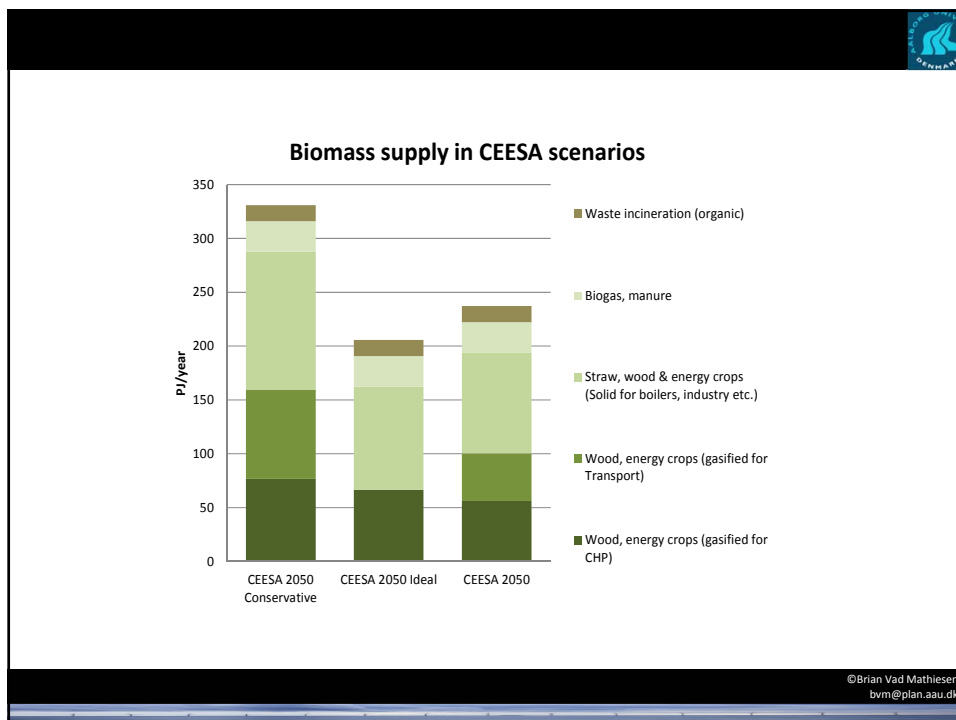
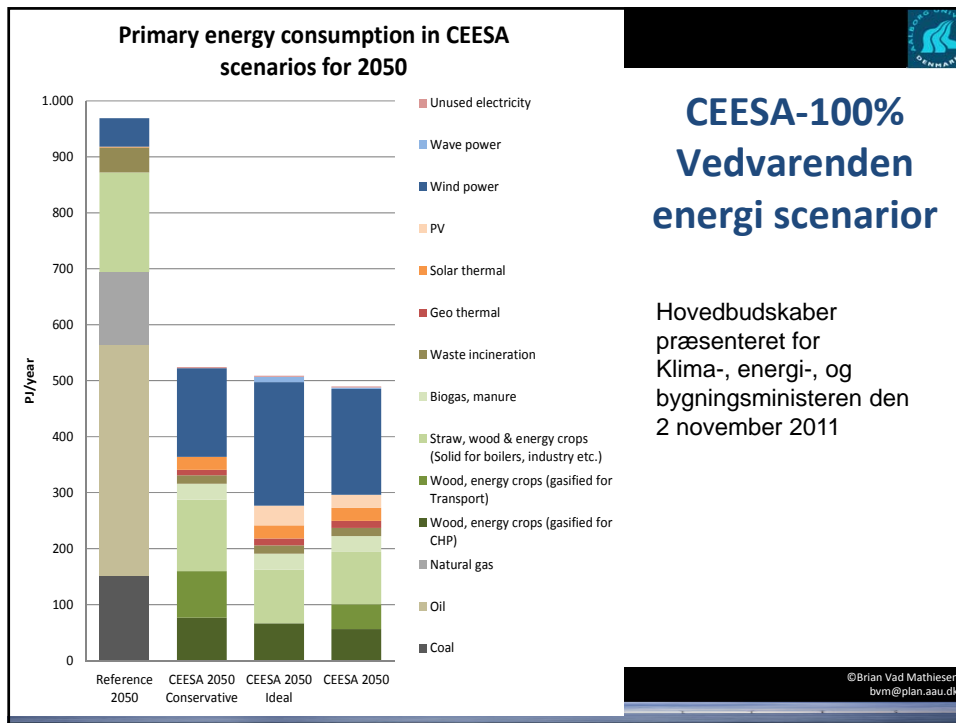
©Brian Vad Mathiesen
 bvm@plan.aau.dk

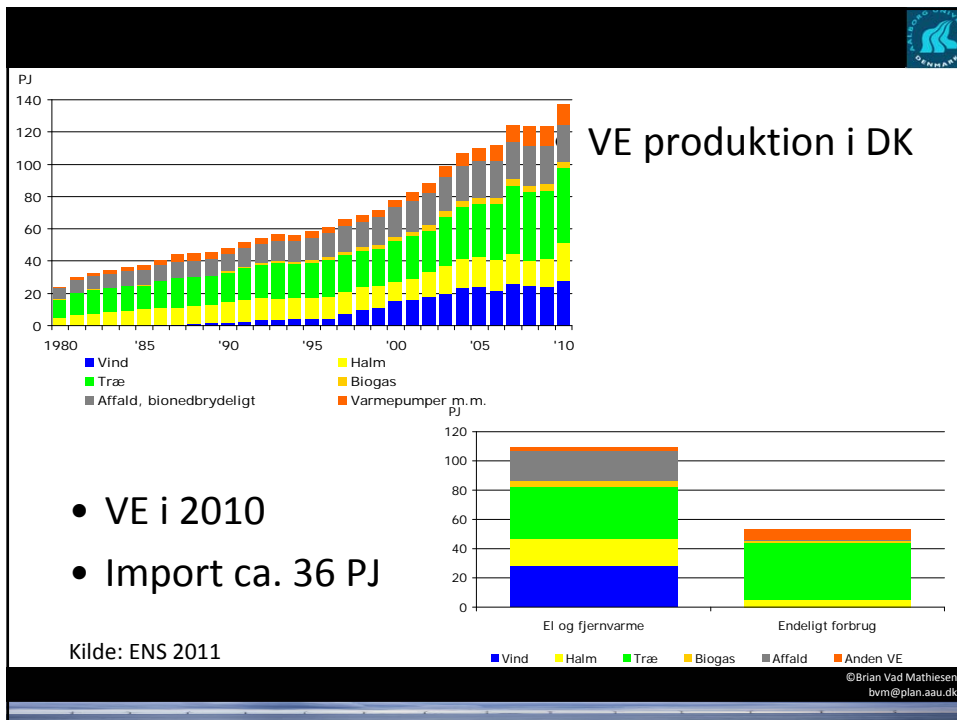
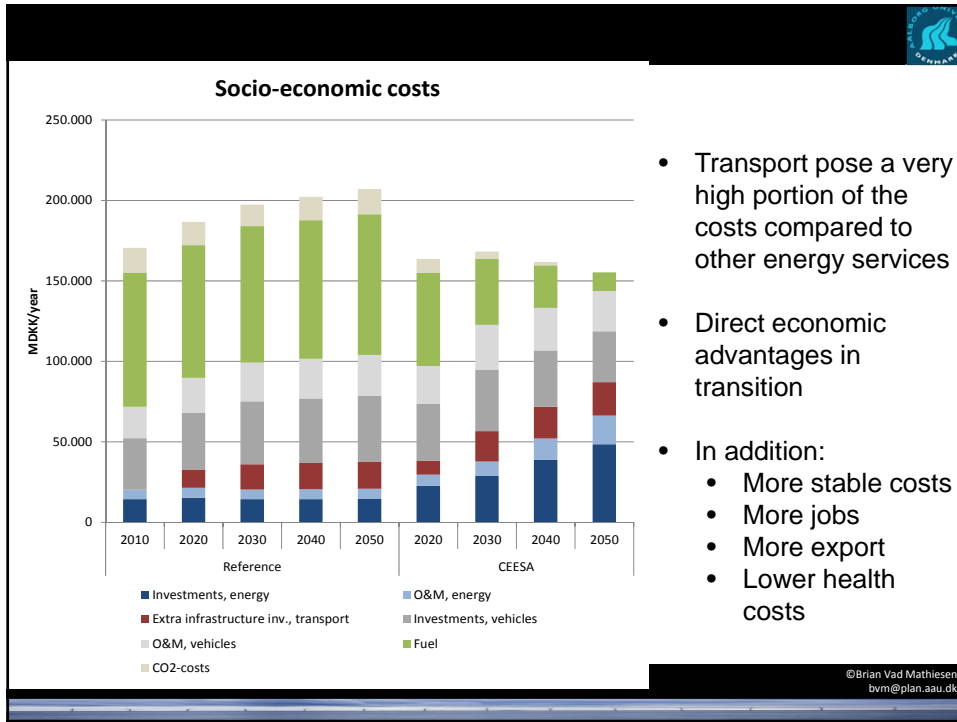


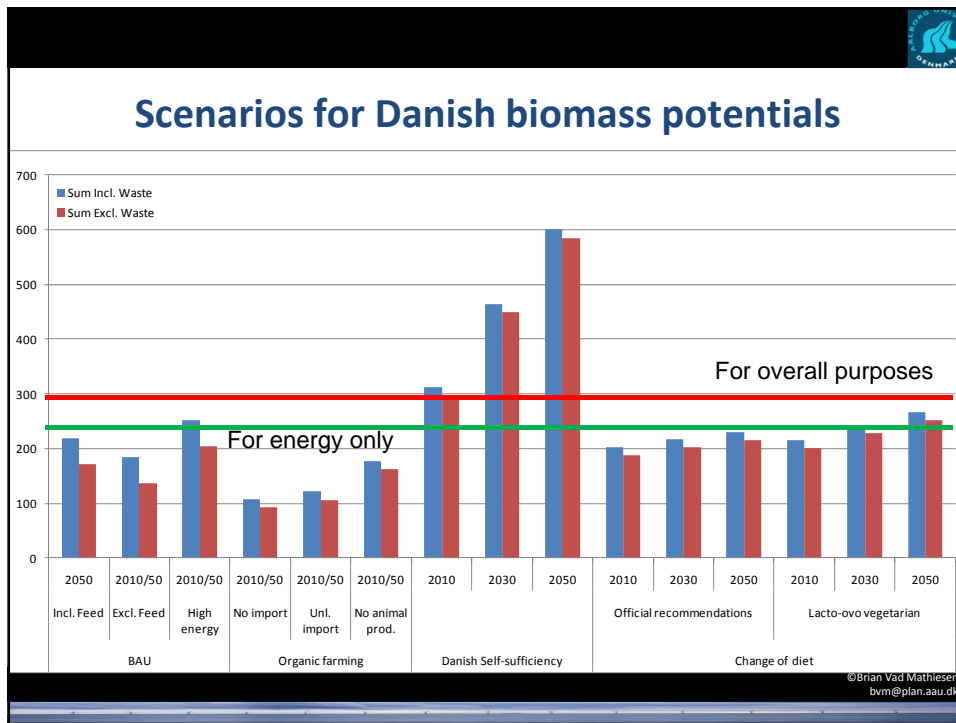


Three 100% renewable energy system scenarios in CEESA

- **CEESA-2050 Conservative:** The conservative scenario is created using mostly known technologies and technologies which are available today.
- **CEESA-2050 Ideal:** In the ideal scenario, technologies which are still in the development phase are included on a larger scale.
- **CEESA-2050:** This scenario is a “realistic and recommendable” scenario based on a balanced assessment of realistic and achievable technology improvements.










CEESA Publications

- CEESA reports (www.ceesa.dk):
 - Main report: Coherent Energy and Environmental System Analysis
 - Part 1: CEESA 100% Renewable Energy Scenarios towards 2050
 - Part 2: CEESA 100% Renewable Energy Transport Scenarios towards 2050
 - Part 3: Electric power systems for a transition to 100% Renewable Energy Systems in Denmark before 2050
 - Part 4: Policies for a Transition to 100% Renewable Energy Systems in Denmark before 2050
 - Part 5: Environmental Assessment of Renewable Energy Scenarios towards 2050
- And a number of other reports including:
 - IDAs Climate Plan 2050, background report
 - Danish Wind Power - Export and Cost
 - Technical potentials of biomass for energy services from current agriculture and forestry in selected countries in Europe
 - Energy Vision for Aalborg Municipality 2050
 - EnergyTown Frederikshavn
 - Heat Plan Denmark (2008 and 2010)
- And 5 PhD projects, 19 book chapters or journal papers, 25 conference proceedings and presentations.






©Brian Vad Mathiesen
bvm@plan.aau.dk



Hvor skal vi starte?

- **70-80 procent** af investeringer i teknologi i et IDA 2050 er kendt teknologi...
 - Lav varme- og elbesparelser
 - Lav besparelser i industrien og omstil til el
 - Udvid fjernvarmeforsyningen
 - Udbyg med land- og havvindmøller
 - Udbyg med store solvarmeanlæg
 - Udbyg med store varmepumper
 - Udbyg den kollektive transport



©Brian Vad Mathiesen
bvm@plan.aau.dk



Hvor skal vi starte?

- **70-80 procent** af investeringer i teknologi i et IDA 2050 er kendt teknologi...
 - Effekt på kort sigt: Mindre import naturgas, olie og kul og økonomiske besparelser
 - Effekt på lang sigt: mindre pres på biomasseressourcen og mindre import samt mindre udsving i omkostninger
 - Udbyg den kollektive transport



©Brian Vad Mathiesen
bvm@plan.aau.dk



Tak for opmærksomheden

Osråmhuset, København
8. december, 2011
Lektor Brian Vad Mathiesen
Institut for Planlægning, Aalborg Universitet
people.plan.aau.dk/~bvm/

