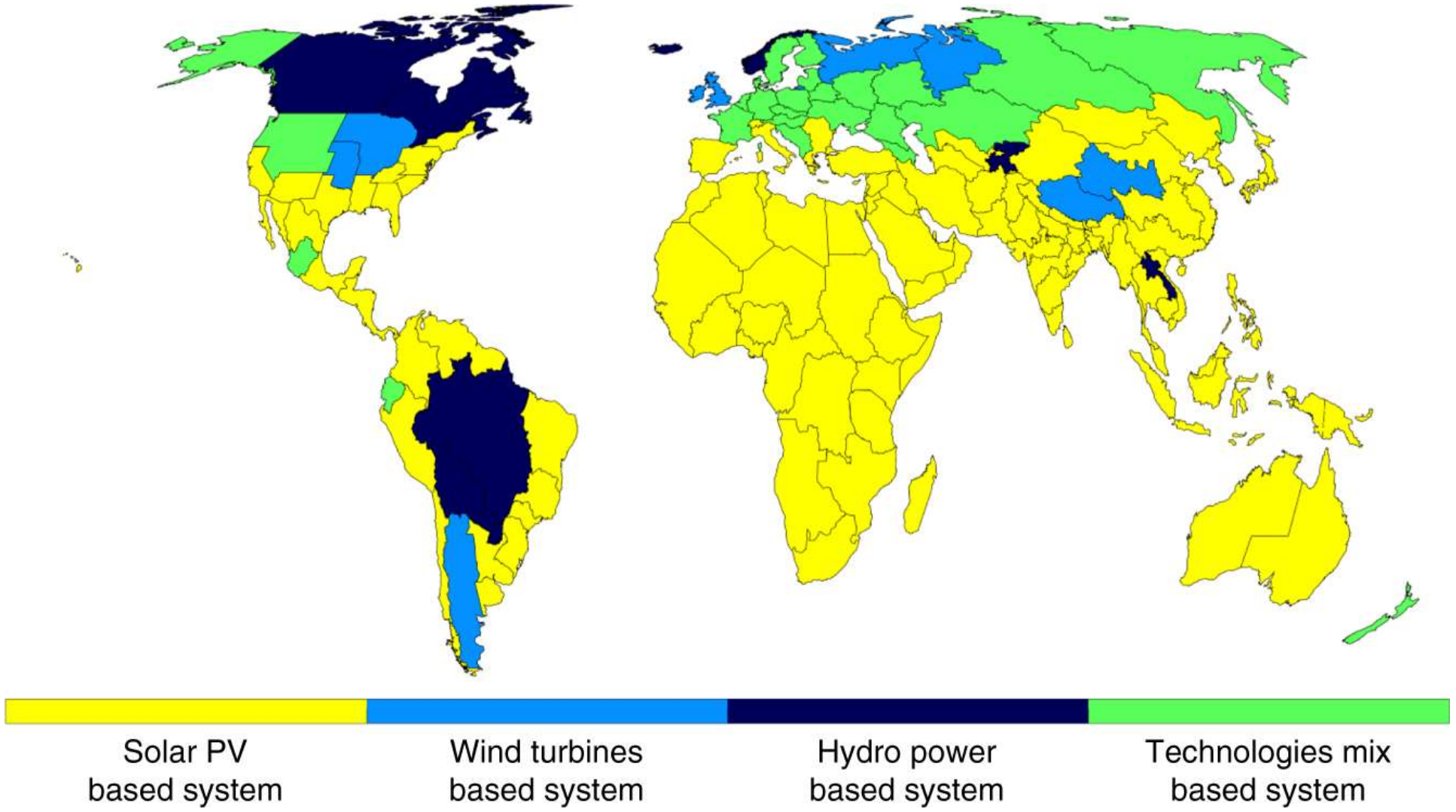
Heat demand modelling

- Useful energy demand should be modelled based on socioeconomic elasticities, and not final energy demand
- Energy efficiency measures like NZEB etc should be modelled
- Based on density of useful heat demand selection of heat networks or individual systems – GIS models necessary
- Power to heat linkages, like CHP, HP, electric boilers
- Heat storage

Heat supply modelling

- Waste heat
- CHP
- Geothermal heat -> DHC
- Solar heat -> DHC, hot water
- Biomass heat -> DHC, individual
- Heat pumps -> DHC, individual
  - Air-to-air, air-to-water, water-to-water, ground-to-water
- Resistance heating
- Fossil fuel heating (gas, coal, oil)

Breyer: optimal mix



https://www.nature.com/articles/s41467-019-08855-1

Issues on the way

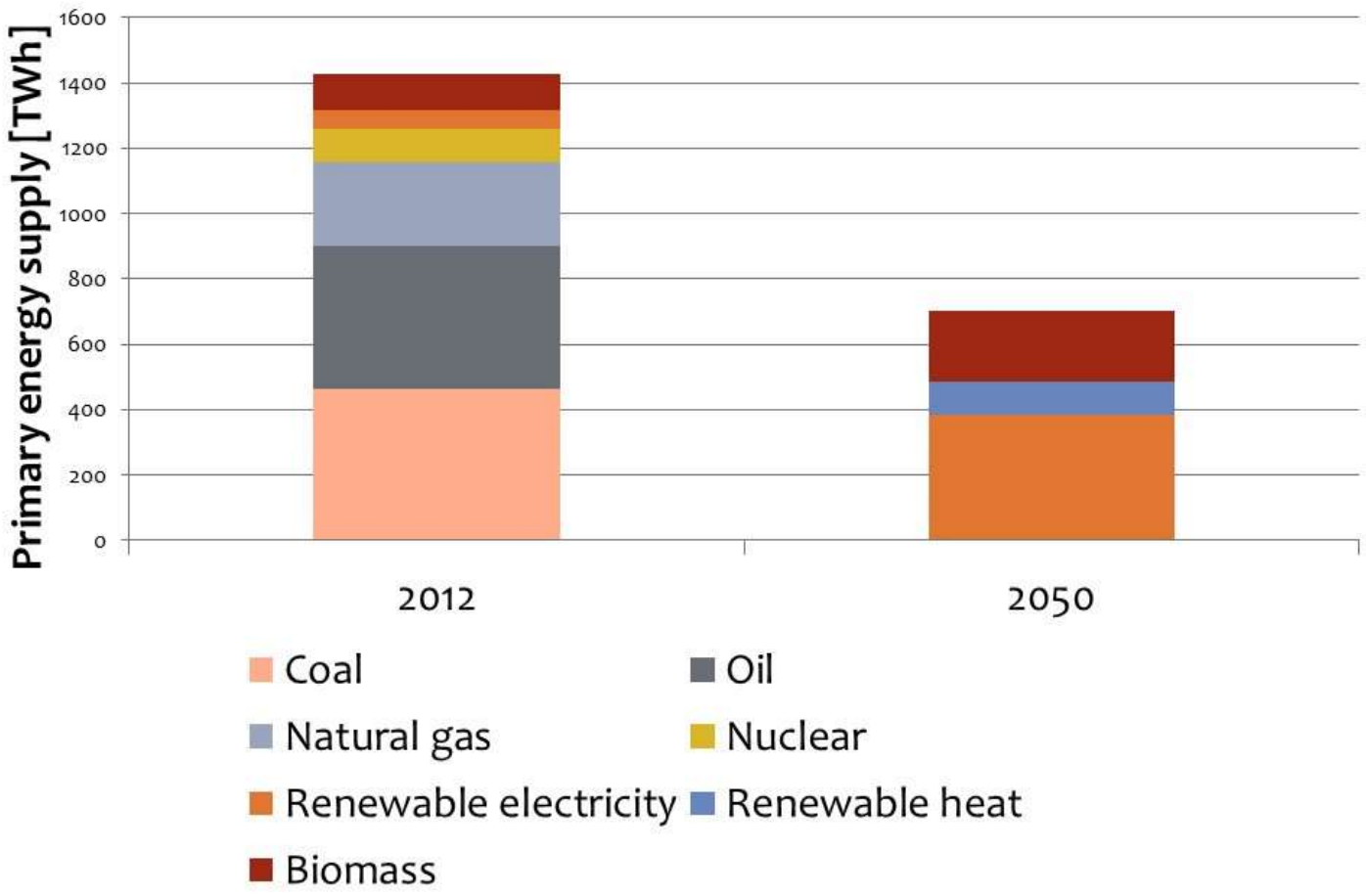
- Road freight – maybe electrified roads
- Shipping, aviation cannot yet be electrified
- High temperature processes sometimes cannot be electrified
- Winter windless weeks
- It all makes up to 20% of energy demand
- If biomass is used only for the above it could cover half of the missing demand
- And the rest? Synthetic or e-fuels including hydrogen?

100% RES Southeast Europe 2050

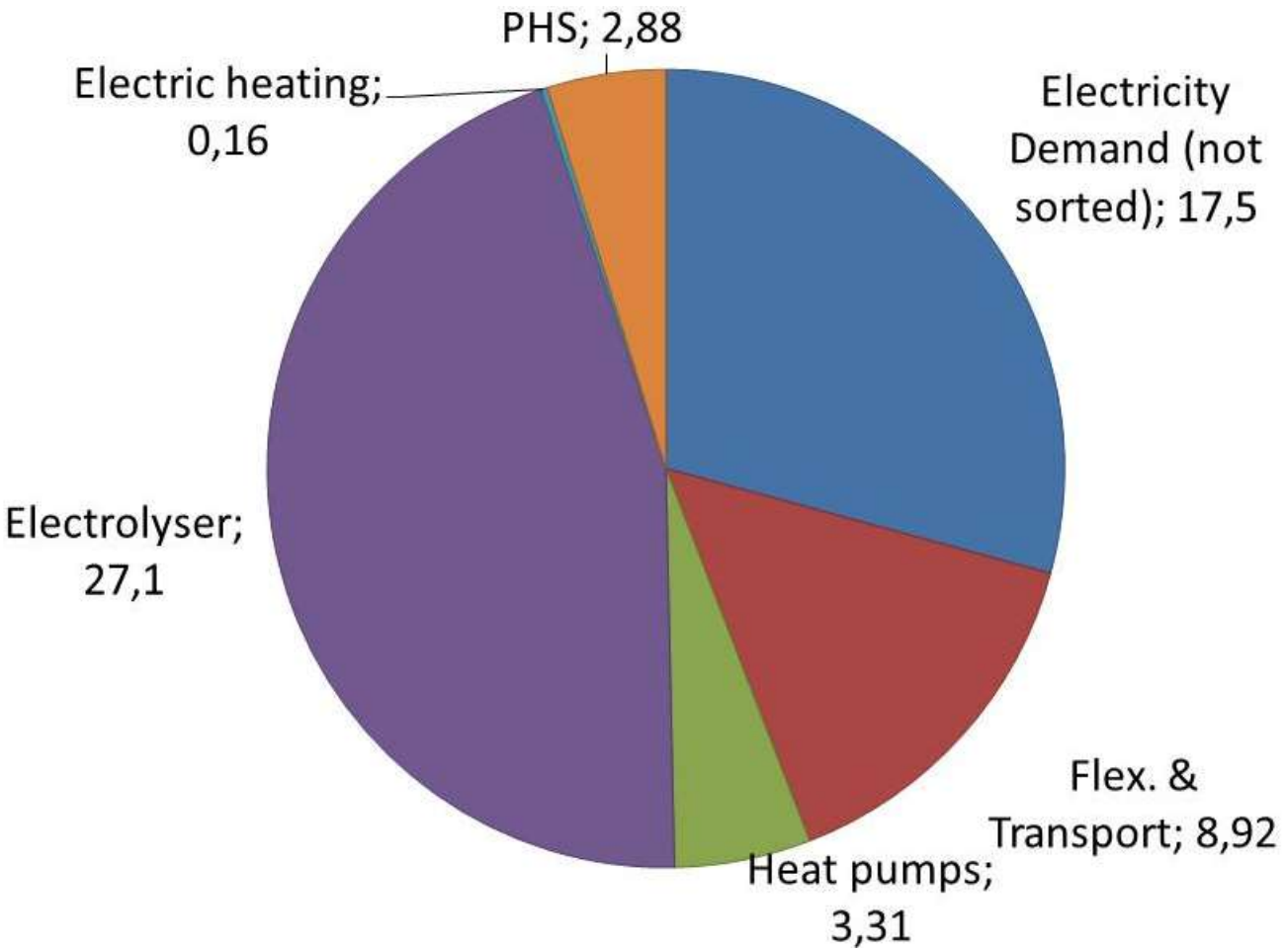
Zero carbon energy system of South East Europe in 2050, D.F. Dominković, I. Bačeković, B. Ćosić, G. Krajačić, T. Pukšec, N. Duić, N. Markovska, Applied Energy, doi:10.1016/j.apenergy.2016.03.046

- PV: 65 GW, CSP: 11 GW
- Wind: 50 GW
- Dammed hydro: from 18.8 to 23.5 GW
- DH supplies 51.5% of heating demand
- Large-scale HPs: 1.5 GW
- Solar thermal with energy storage in DH: 13.3 %
- Seasonal thermal energy storage: 230 GWh
- Waste incineration plants: 0.96 GWe
- Geothermal plants: 1.25 GWe
- Geothermal heating plants: 7.5 GW
- River hydro, pumped-hydro 2 GW, 1000 GWh
- Decommission of nuclear PPs
- Reduction in thermal power plants capacity to 24.7 GW

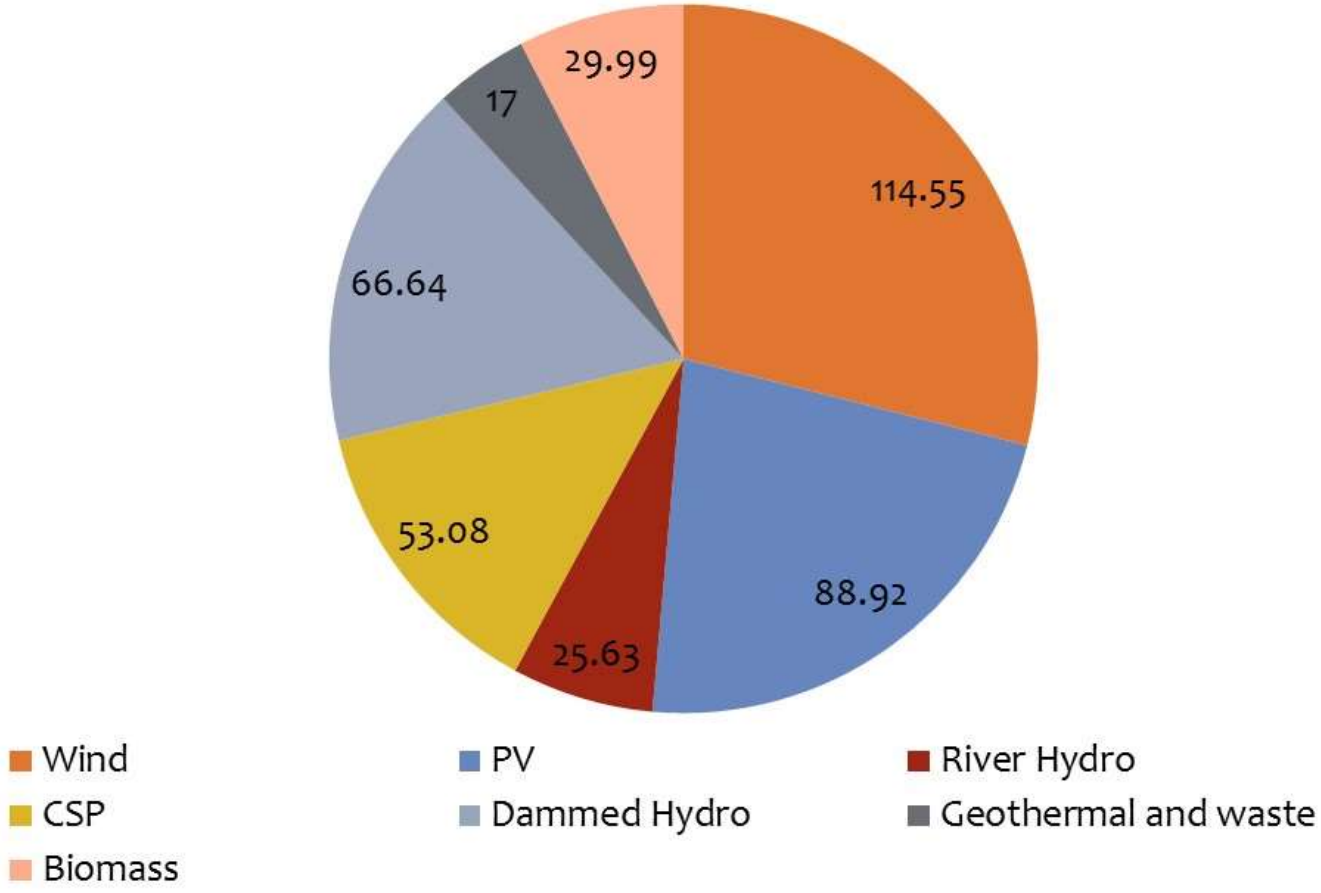
Energy systems: 2012 vs. 2050



Electricity demand in SEE 2050 (TWh)



Electricity generation mix in 2050 [TWh]



Conclusions

- Wind and solar are coming, but difficult to integrate
- Integration of power, heating, cooling, water and transport system necessary
- Smart energy systems – cheap and simple
- Full hourly time serious obligatory for modelling
- Typical day and worst-case approach will not give optimal solutions

5th Southeast European SDEWES Vlore, May 2022
3rd Latin American SDEWES São Paolo, July 2022

THANK YOU FOR YOUR ATTENTION!

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