

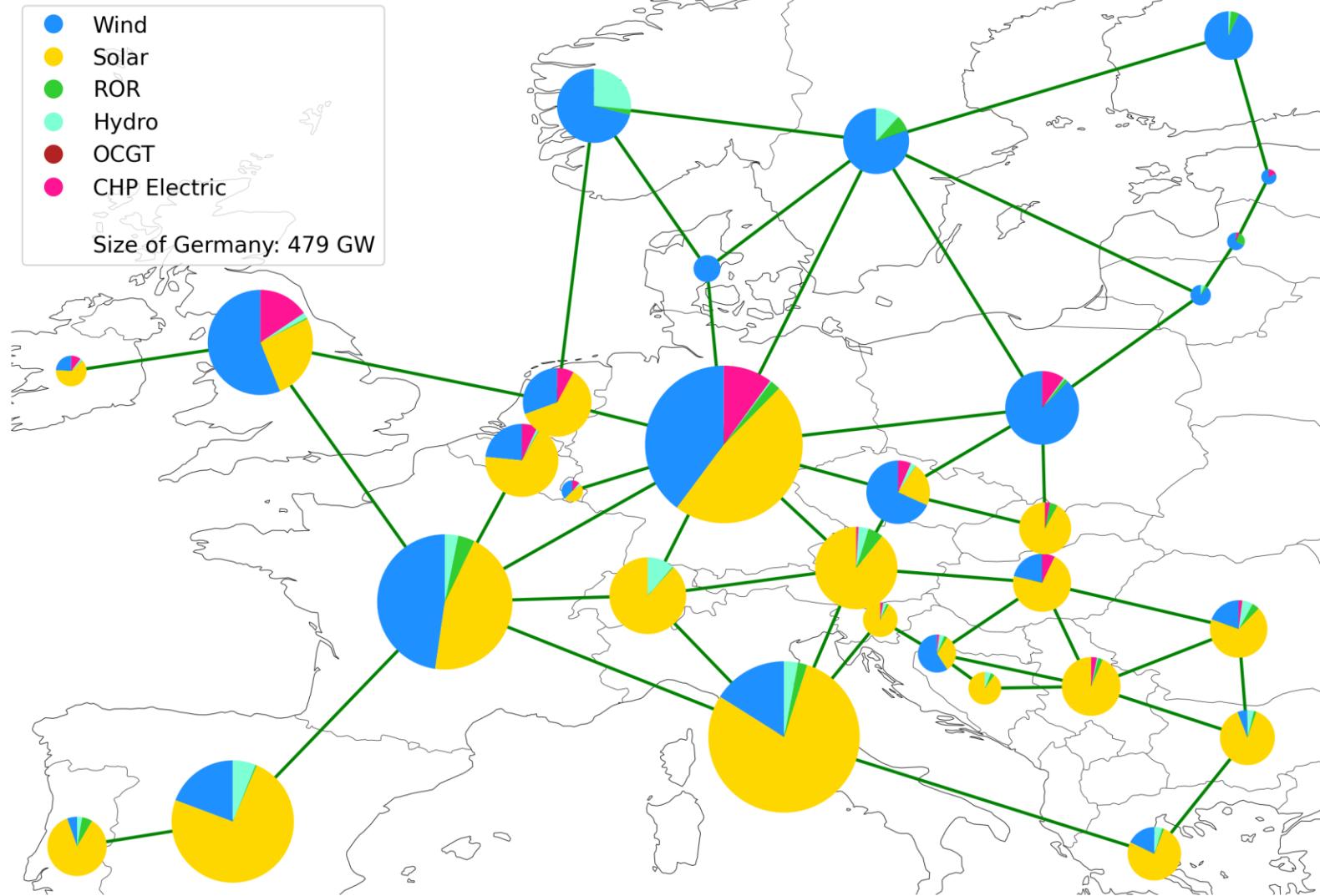
# Electricity Coupled with the Heating and Transport Sector

Electricity Mismatch Analysis

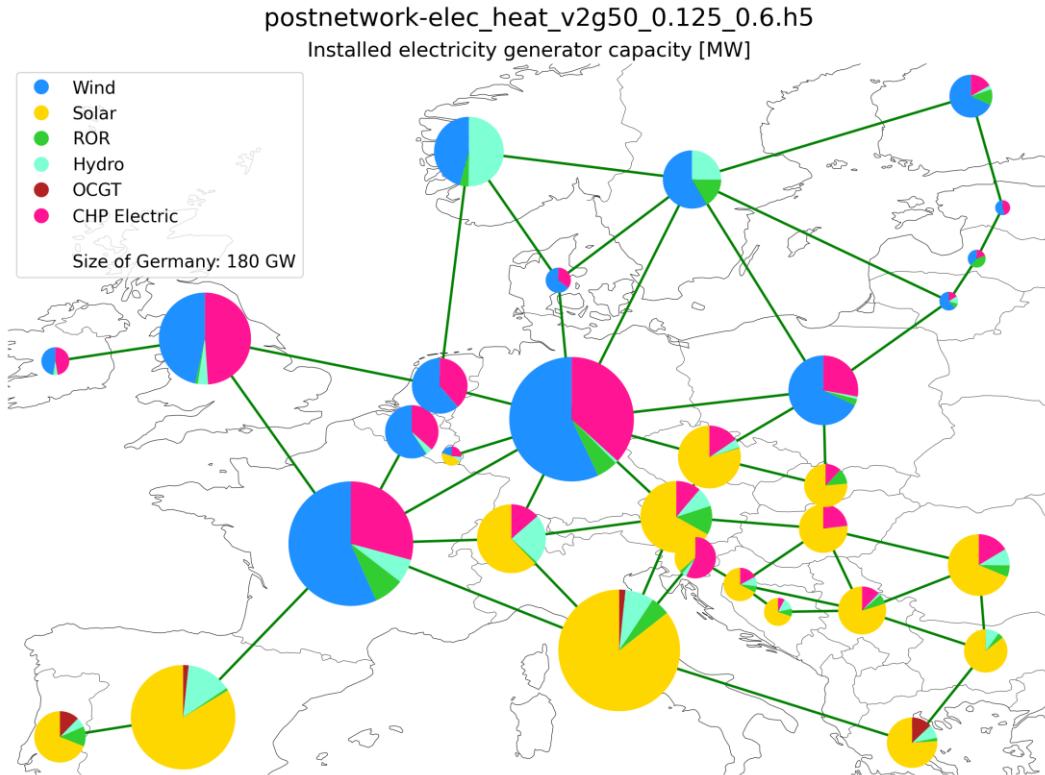
# Installed capacity (95% CO2 reduction)

postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

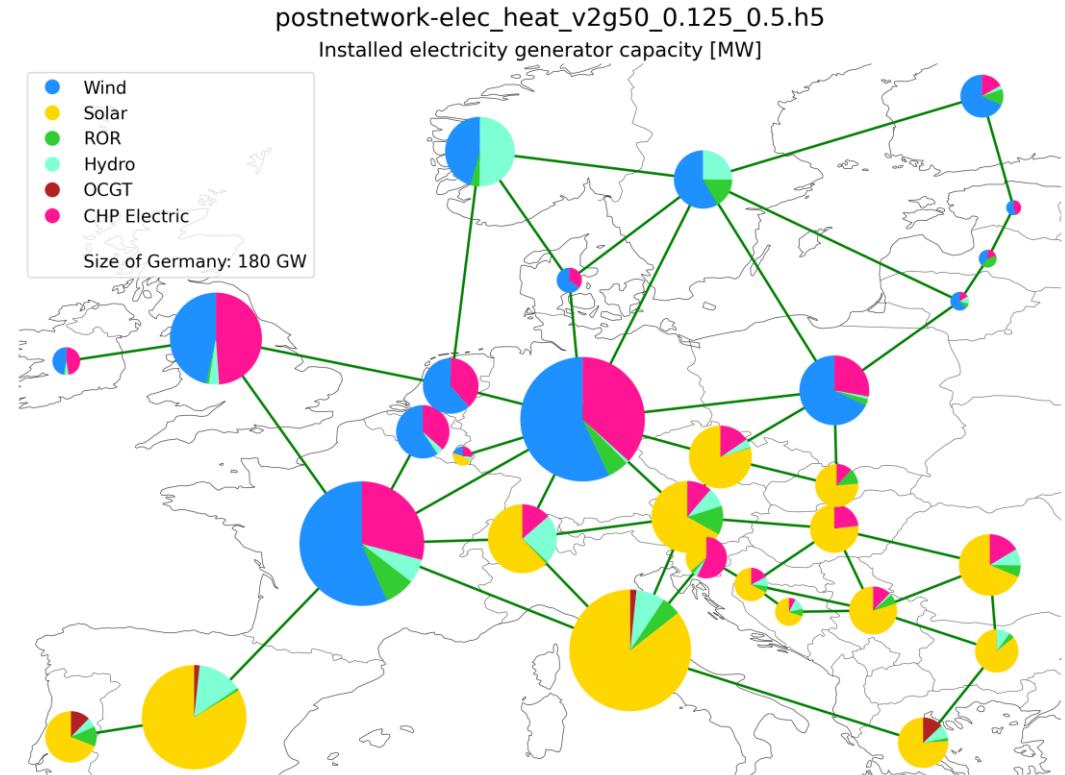
Installed electricity generator capacity [MW]



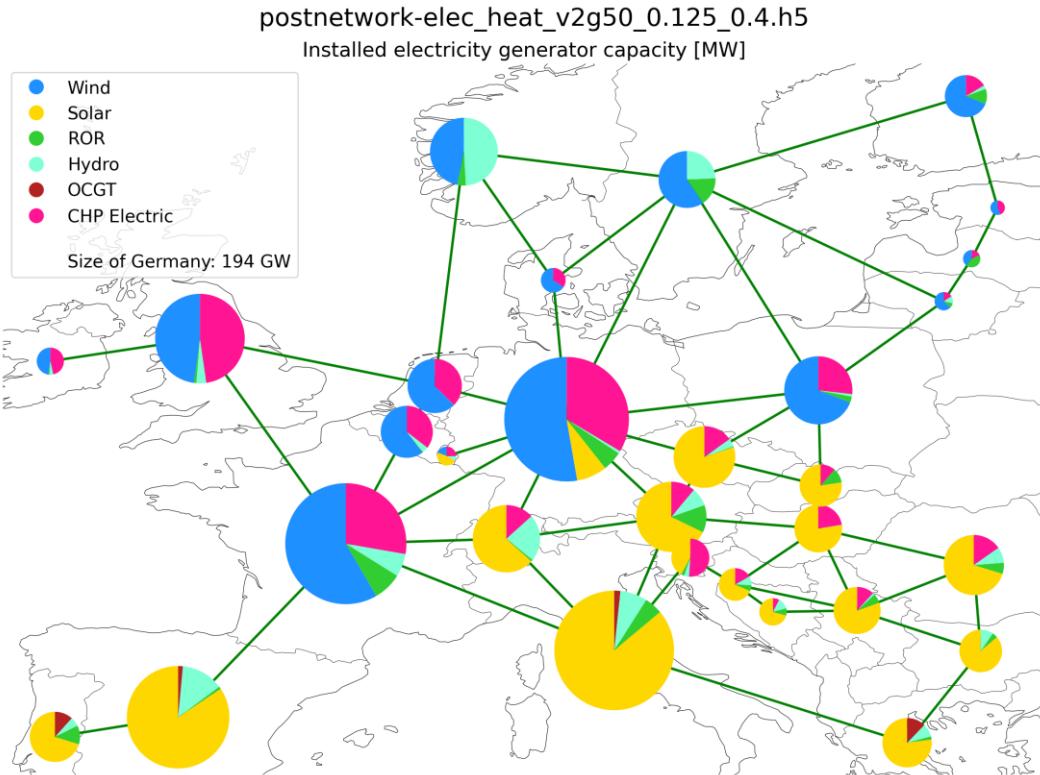
## Installed capacity - 40% CO2 reduction



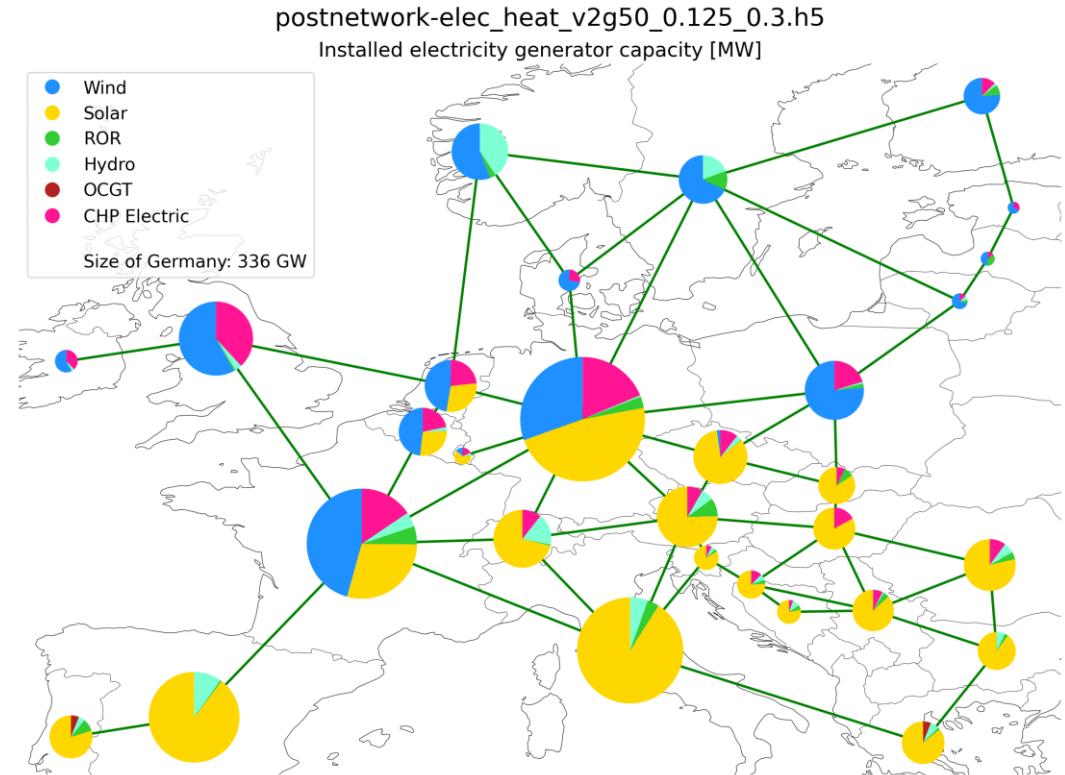
## Installed capacity - 50% CO2 reduction



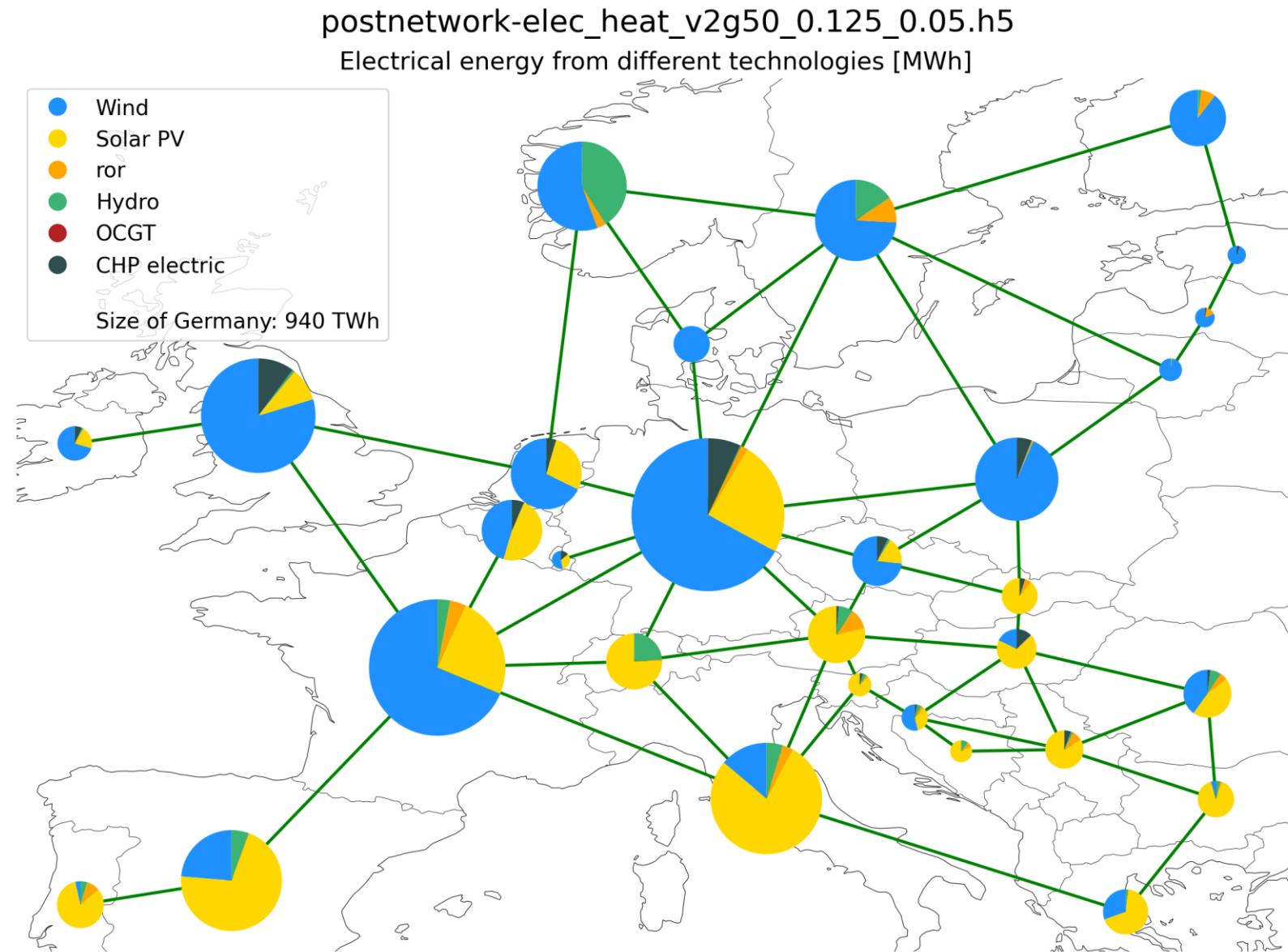
## Installed capacity - 60% CO2 reduction



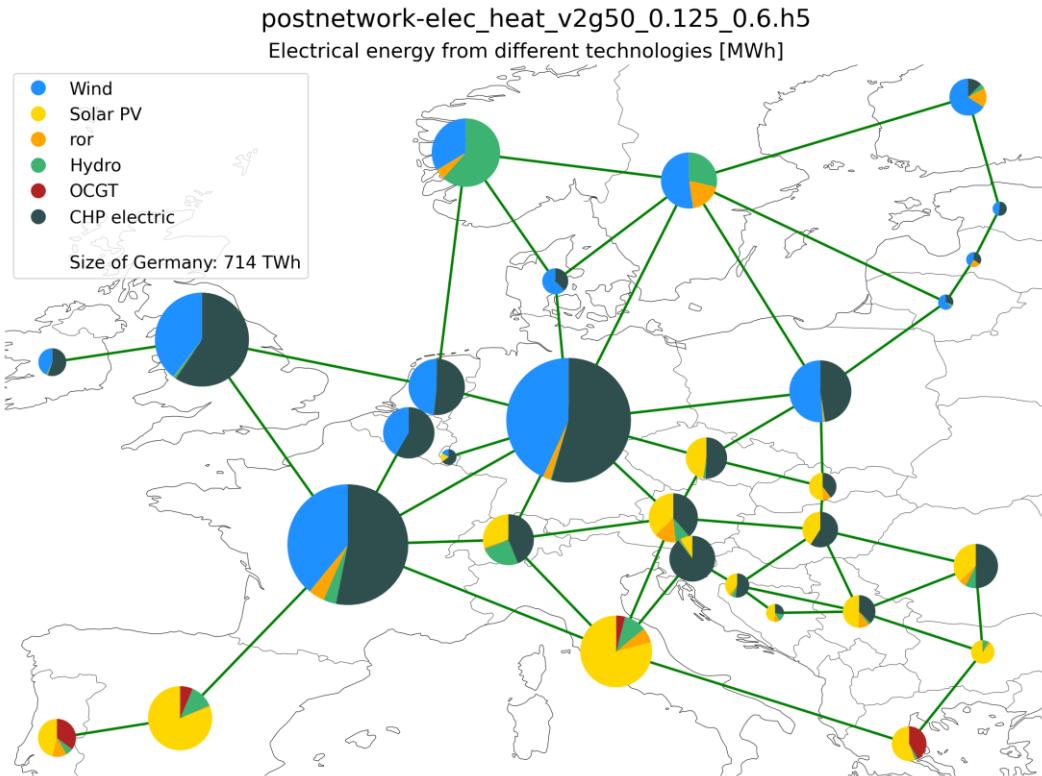
## Installed capacity - 70% CO2 reduction



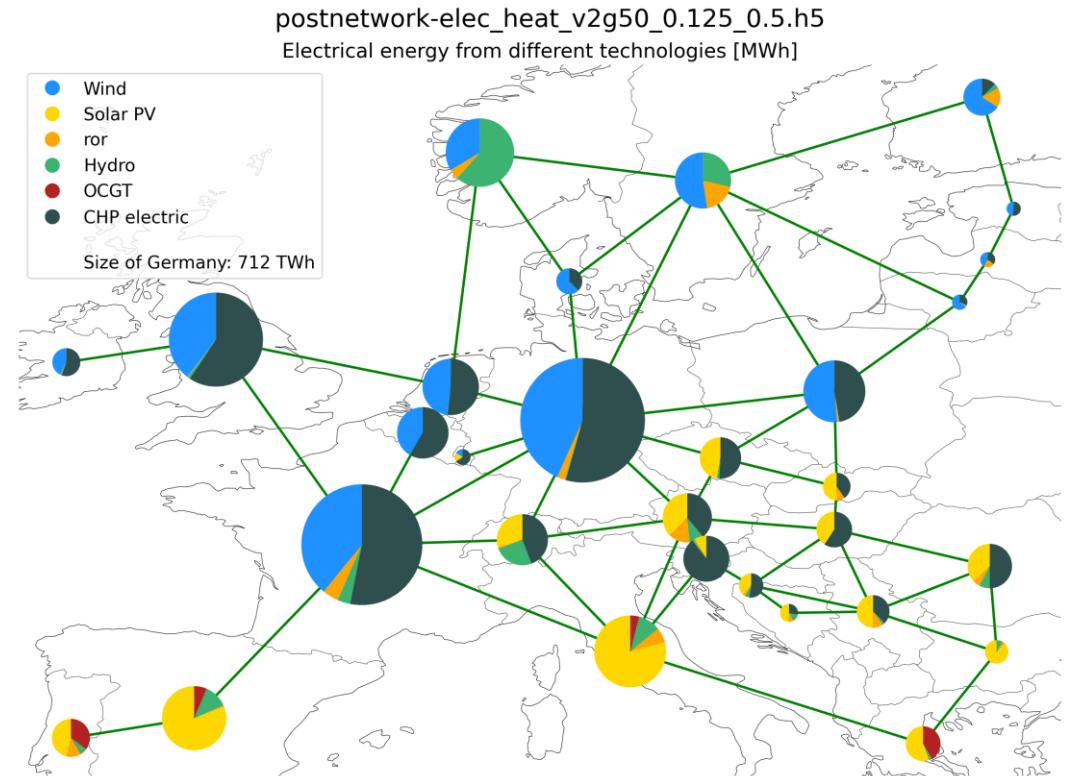
# Electricity Supplied by Different Technologies (95% CO2 reduction)



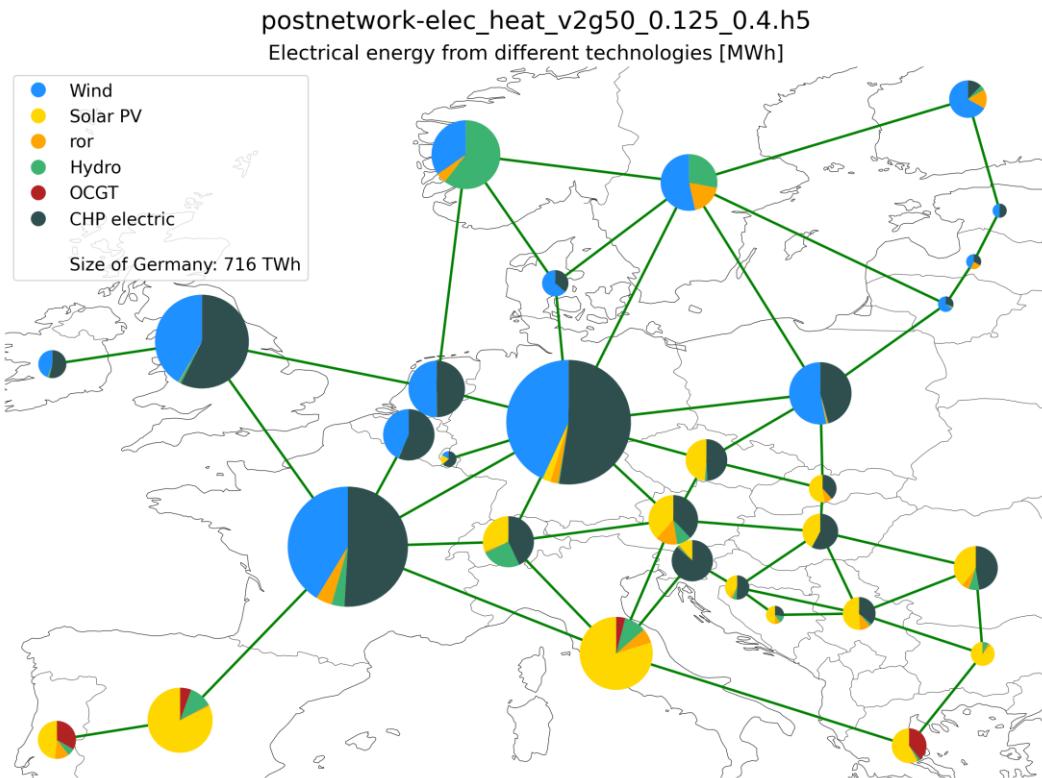
## Electricity Supply - 40% CO2 reduction



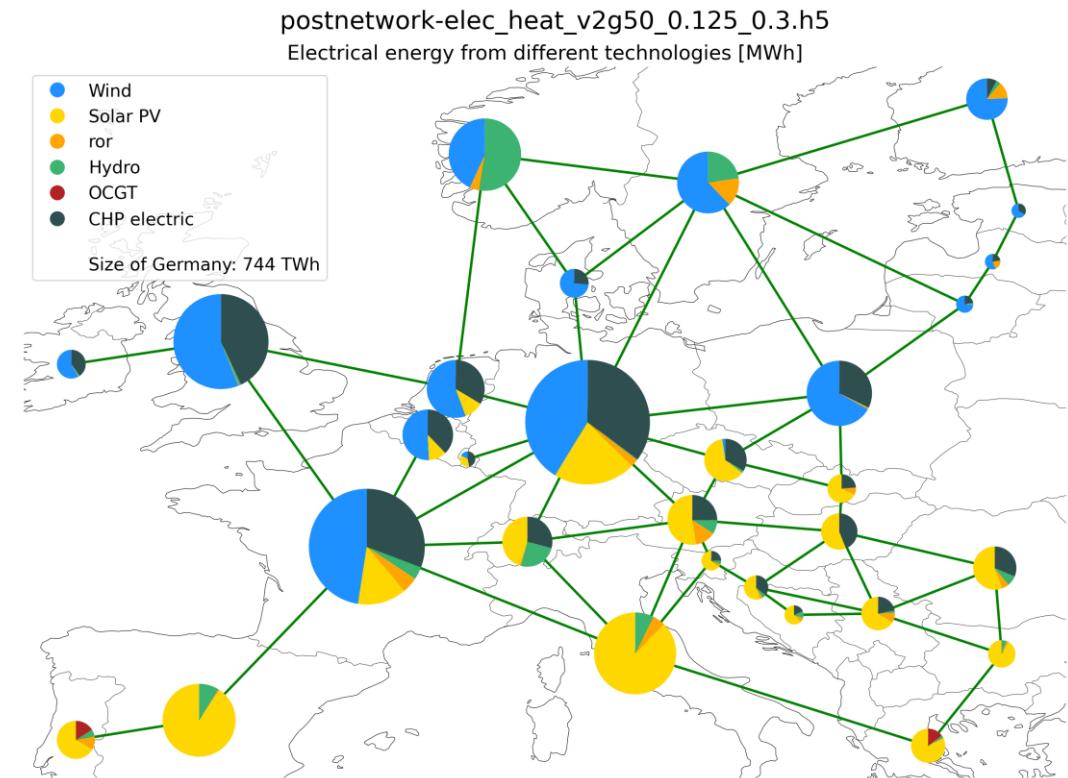
## Electricity Supply - 50% CO2 reduction



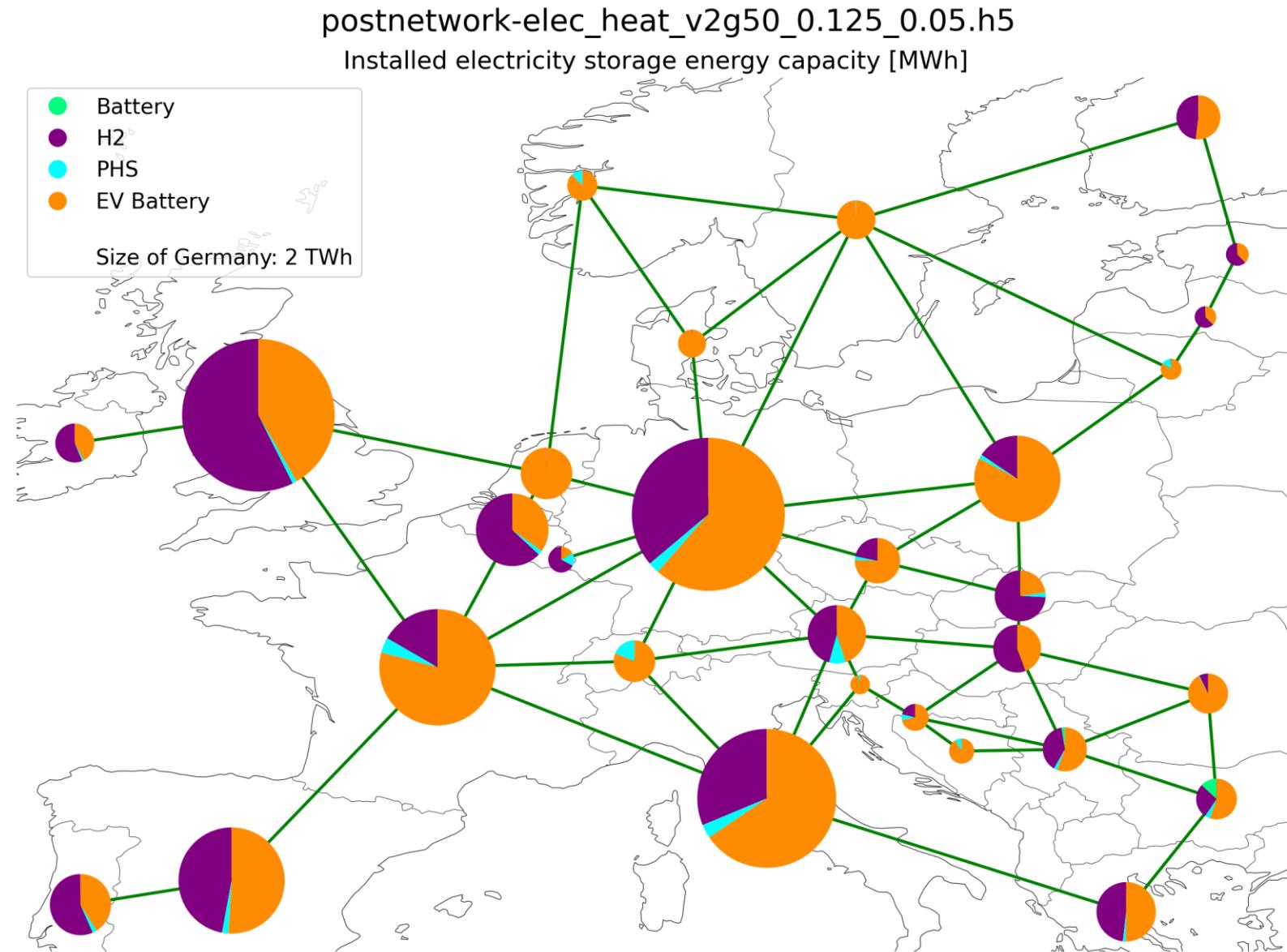
## Electricity Supply - 60% CO2 reduction



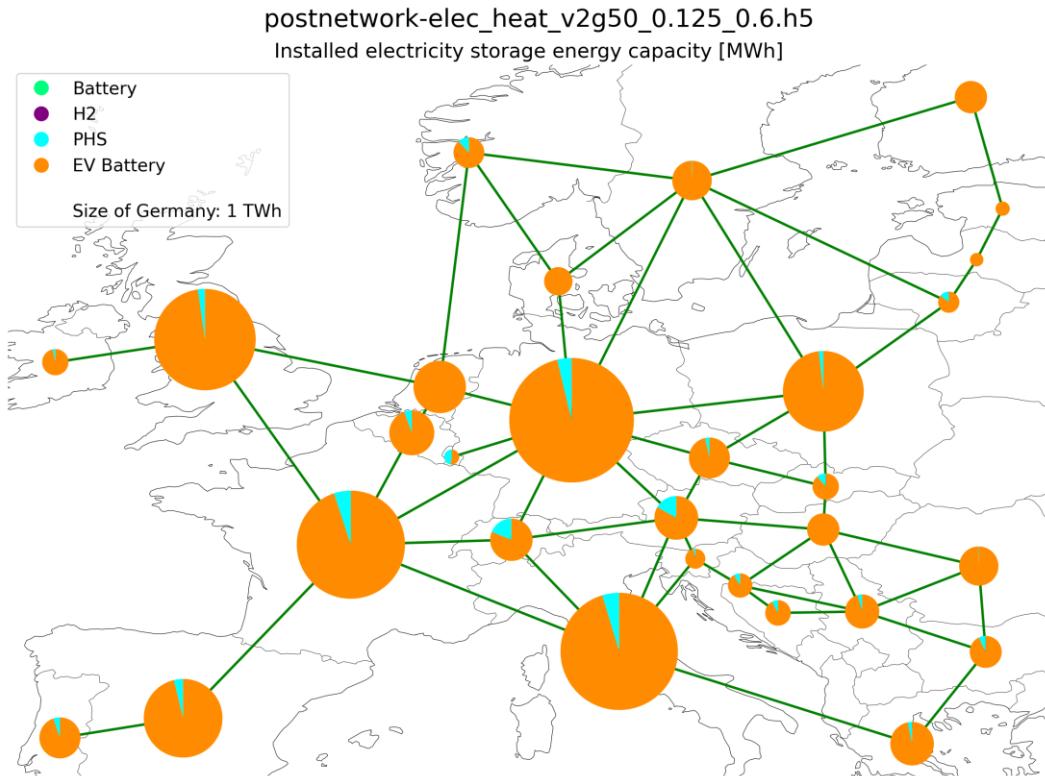
## Electricity Supply - 70% CO2 reduction



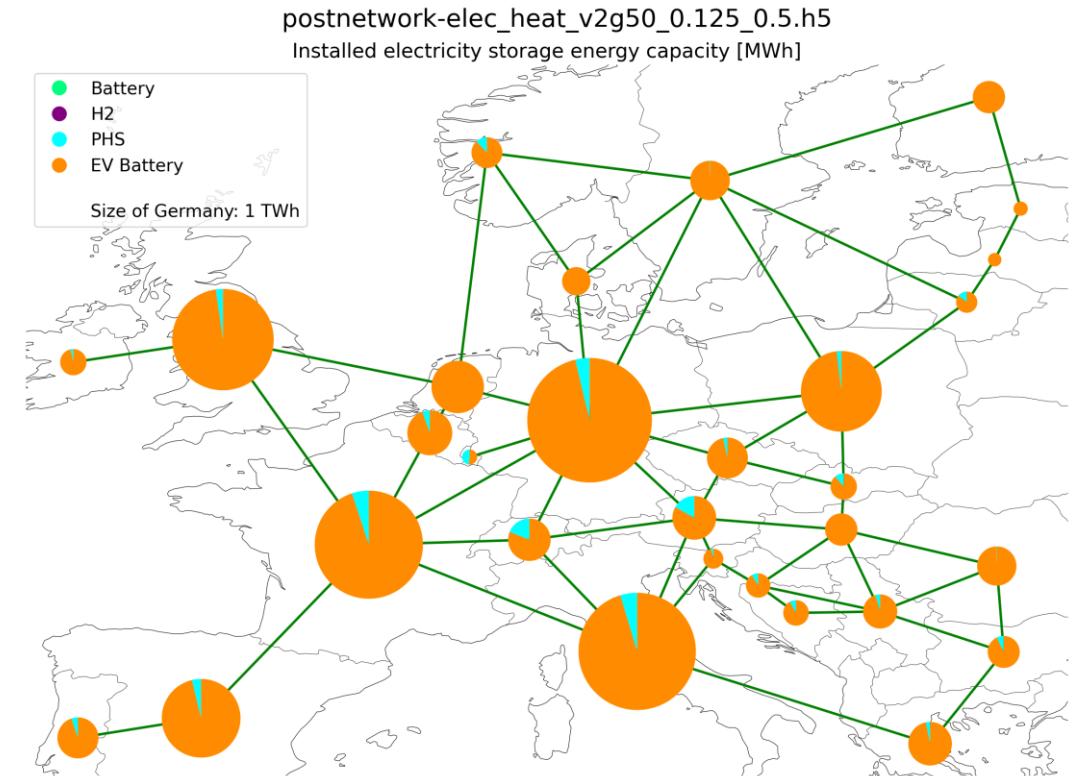
# Installed storage (energy capacity) (95% CO2 reduction)



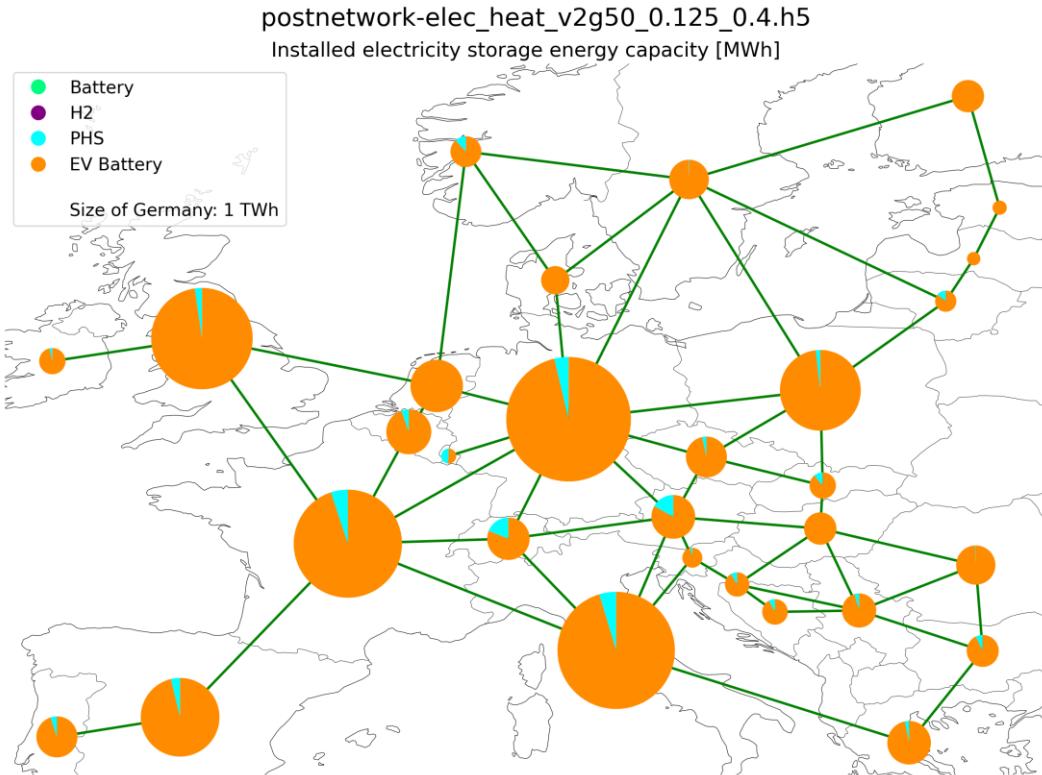
## Electricity Storage Capacity - 40% CO2 reduction



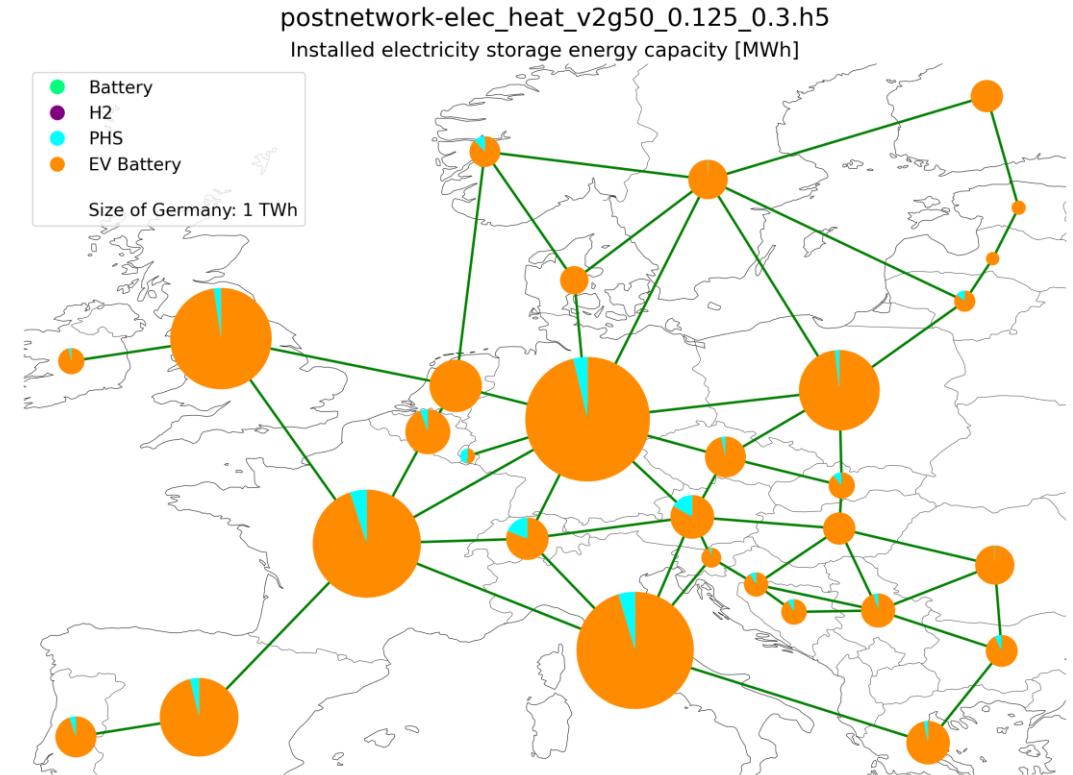
## Electricity Storage Capacity - 50% CO2 reduction



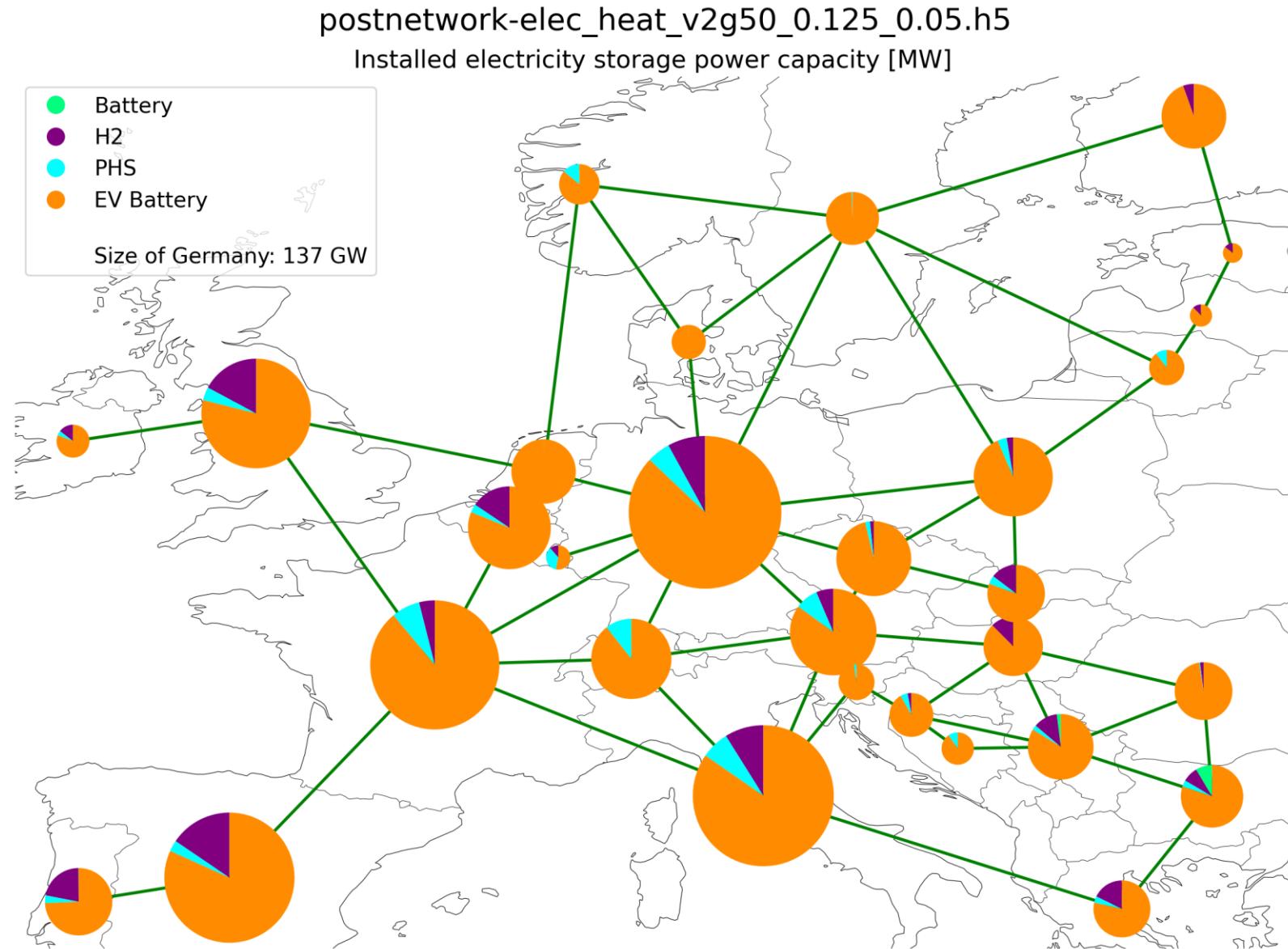
## Electricity Storage Capacity - 60% CO2 reduction



## Electricity Storage Capacity - 70% CO2 reduction

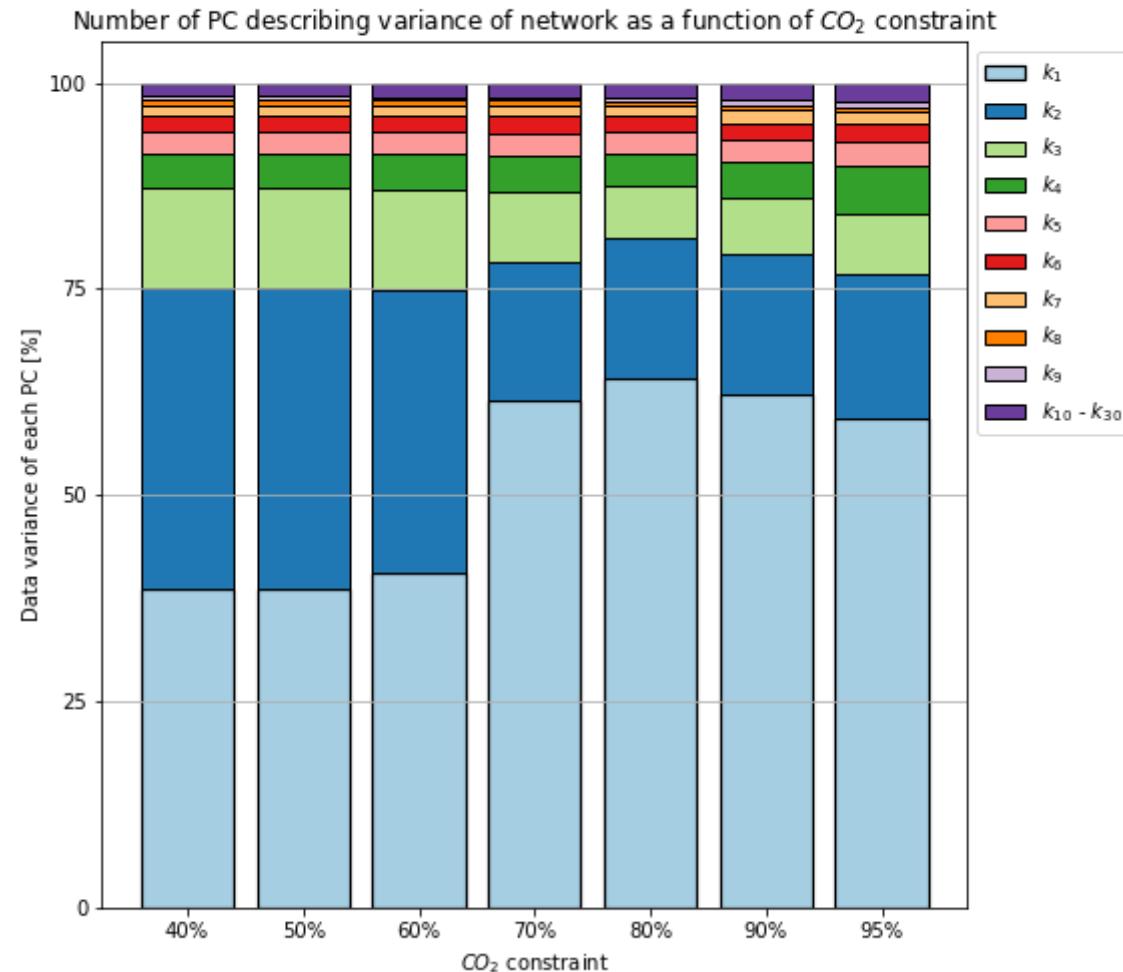


# Installed storage (power capacity) (95% CO2 reduction)

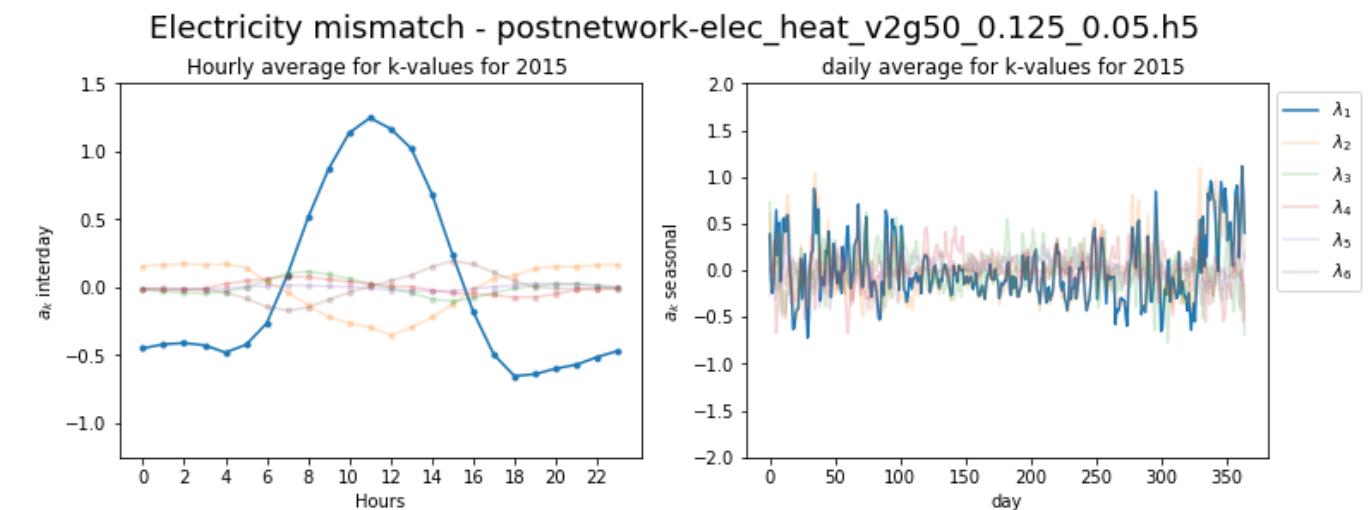
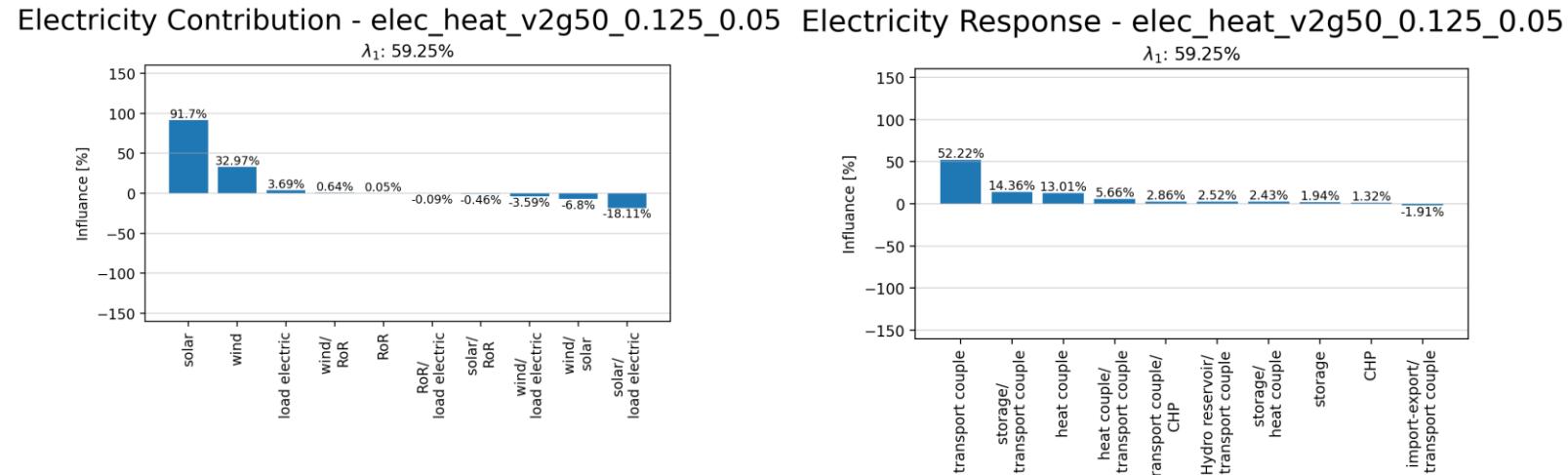
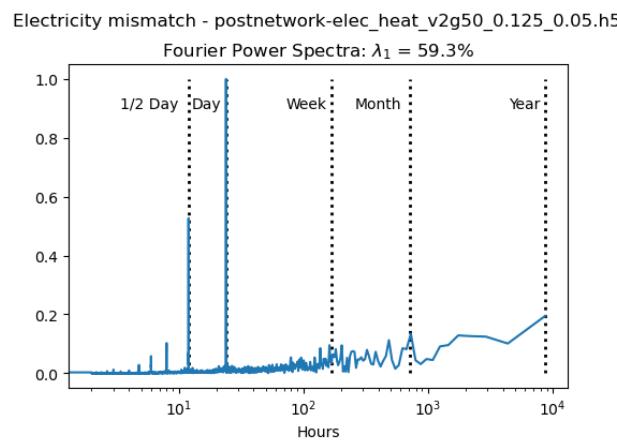
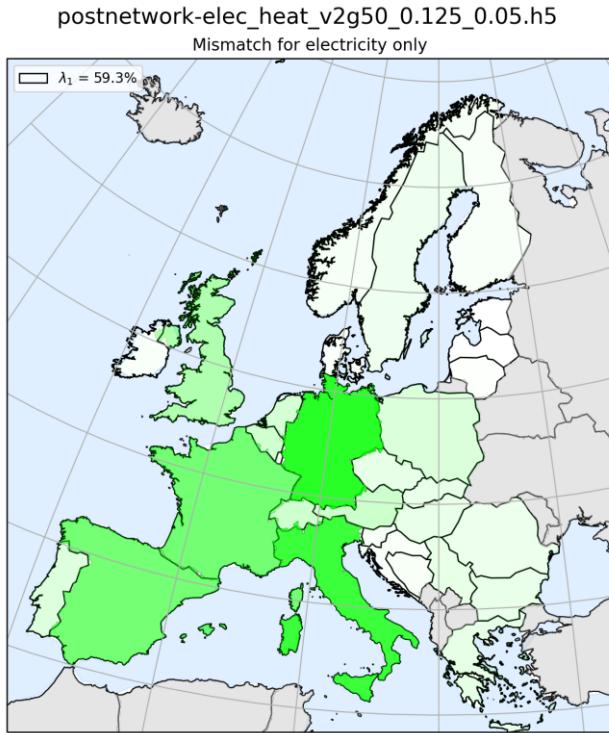


# Change in PC due to CO<sub>2</sub> Constrain

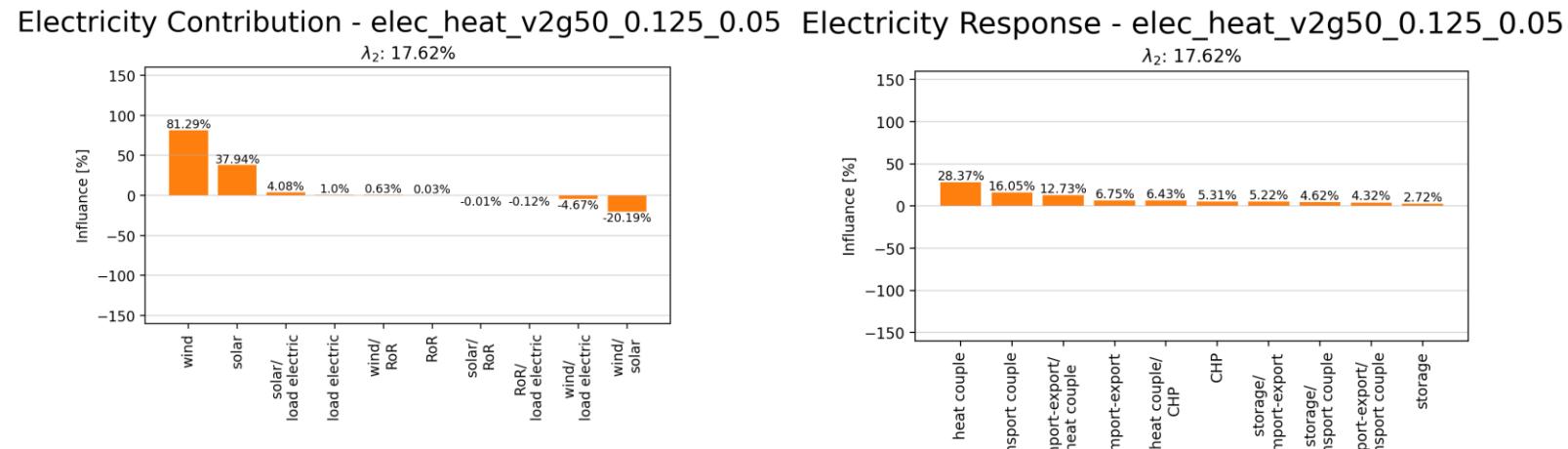
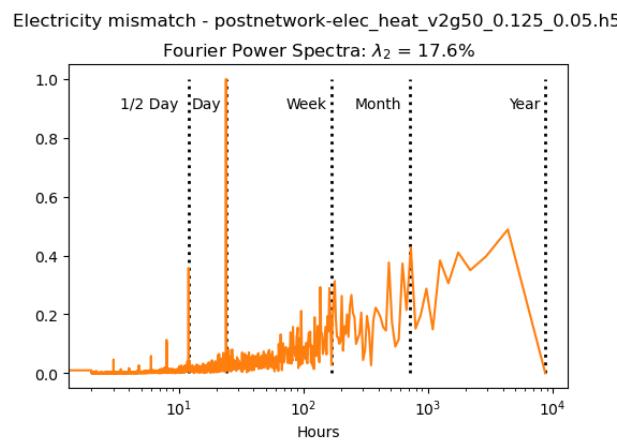
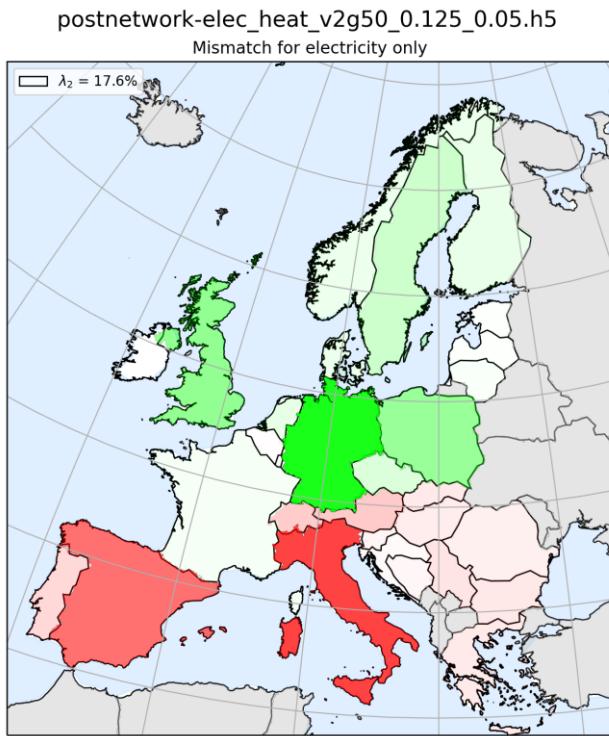
Electricity Mismatch - elec\_heat\_v2g50



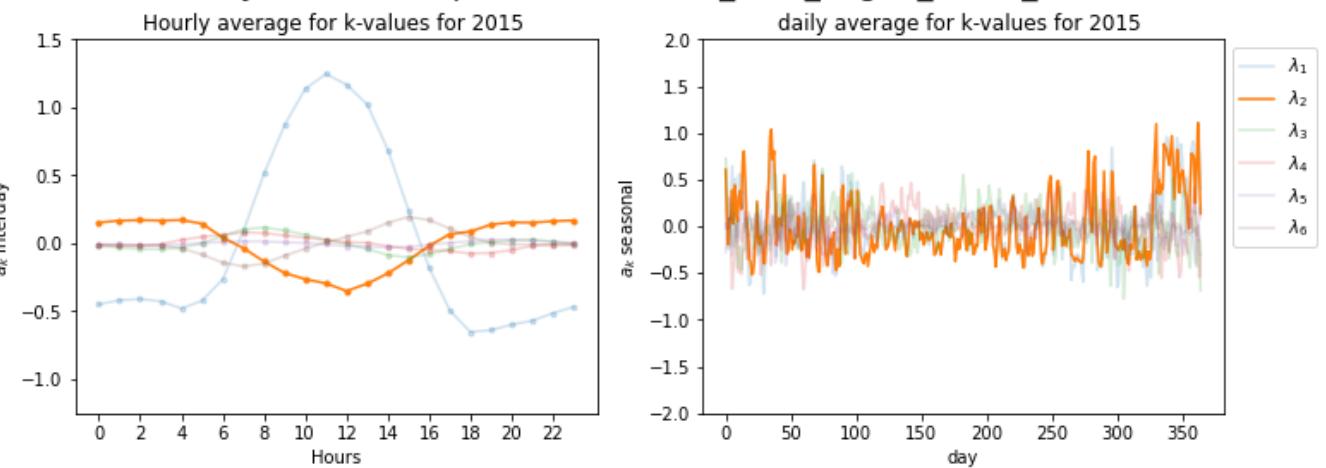
# Principle Component 1



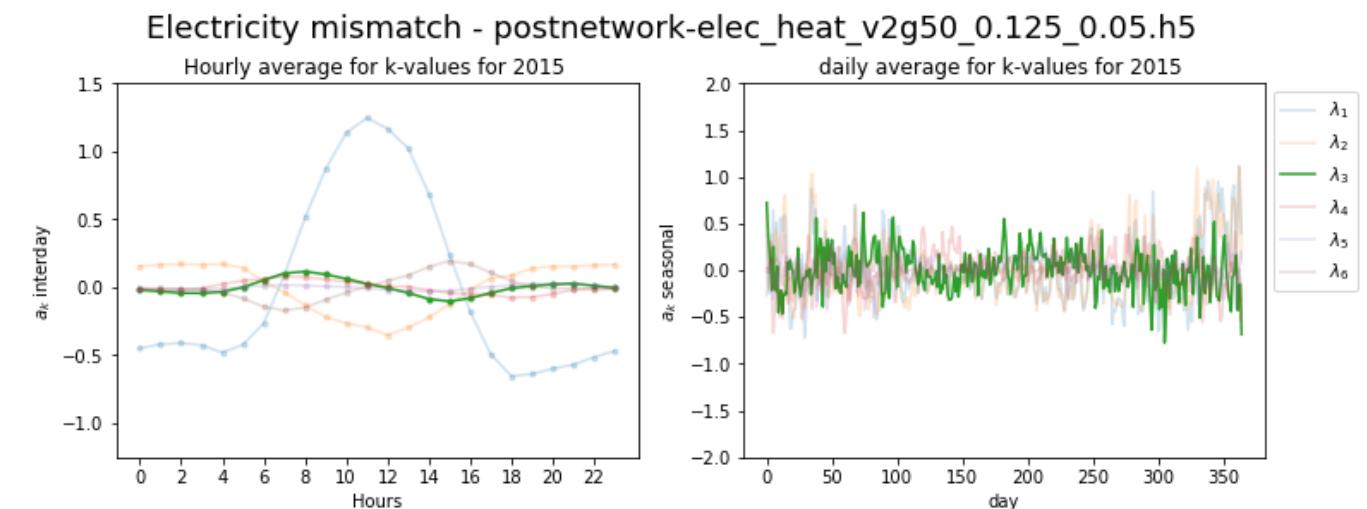
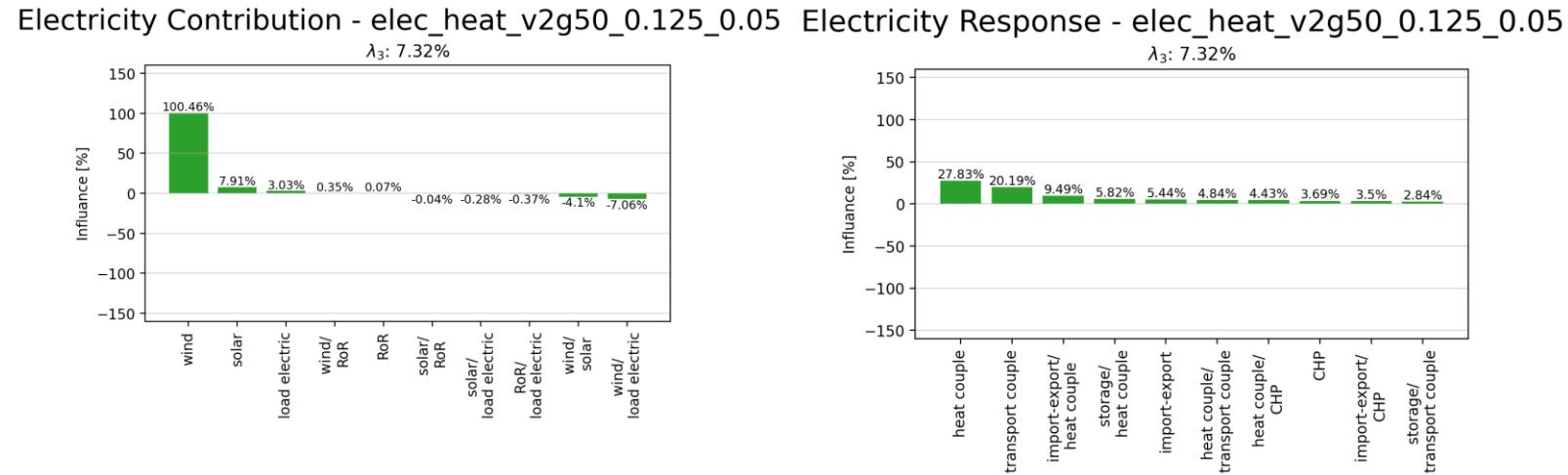
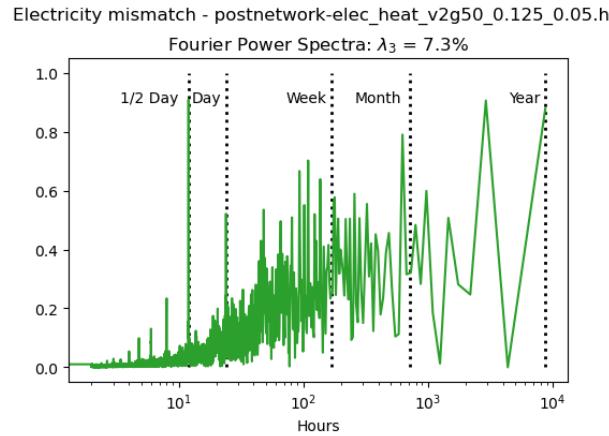
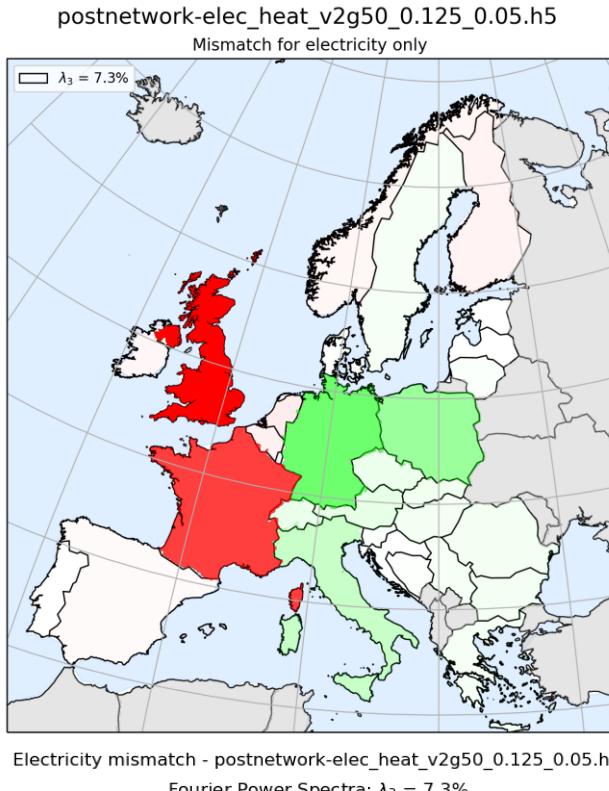
# Principle Component 2



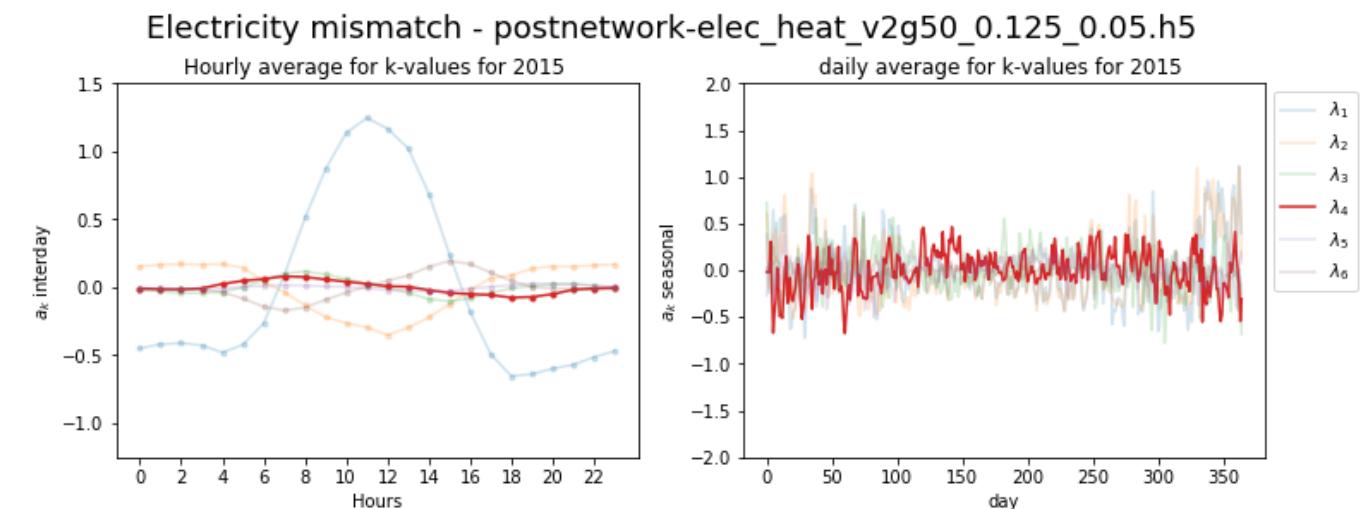
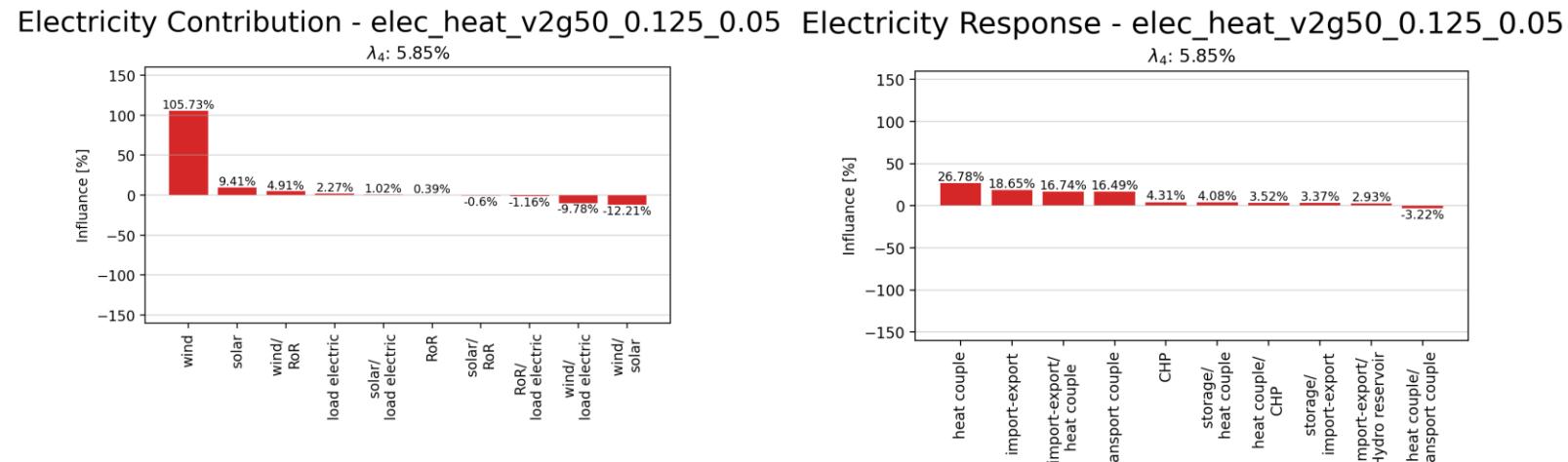
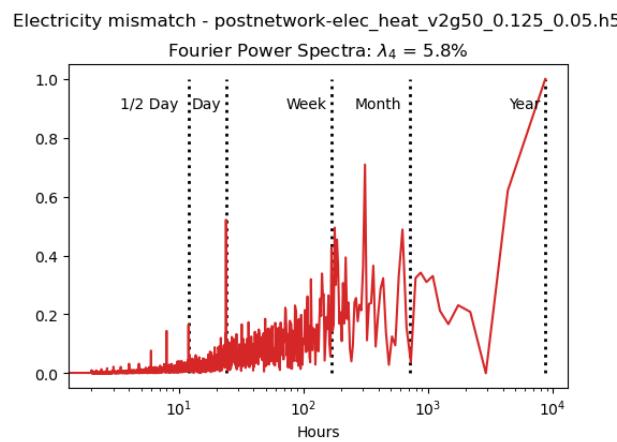
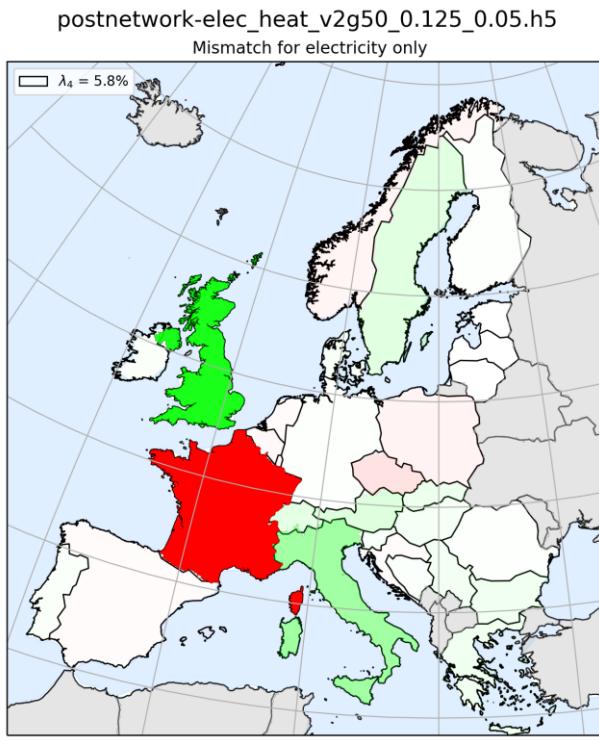
Electricity mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5



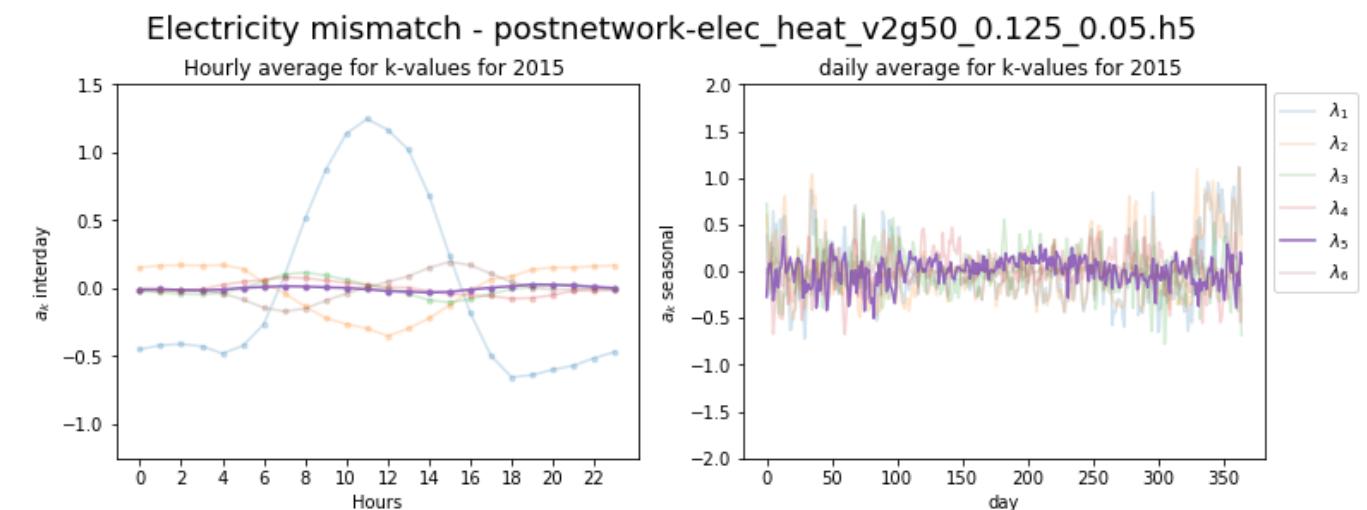
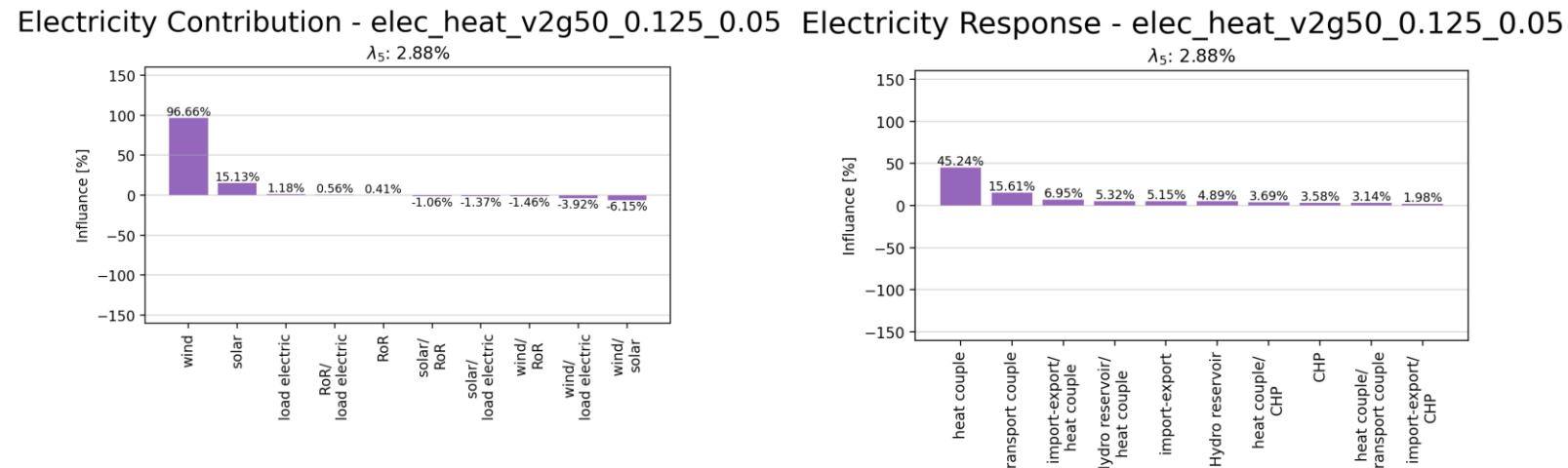
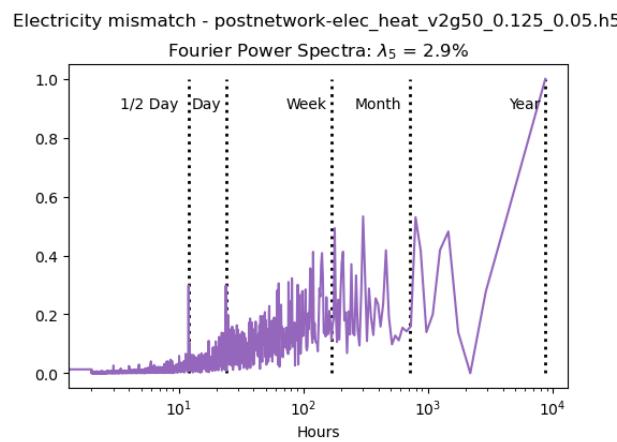
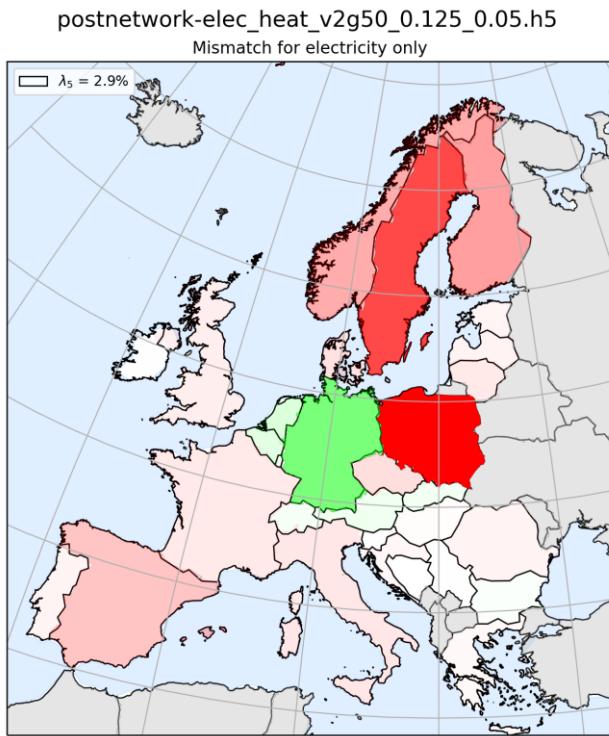
# Principle Component 3



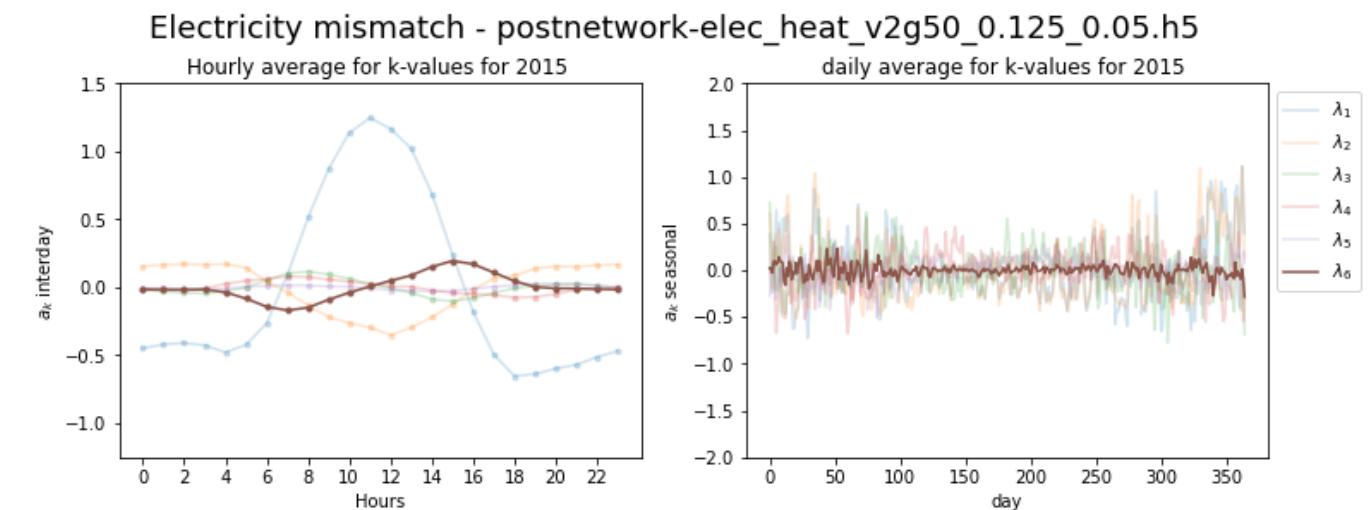
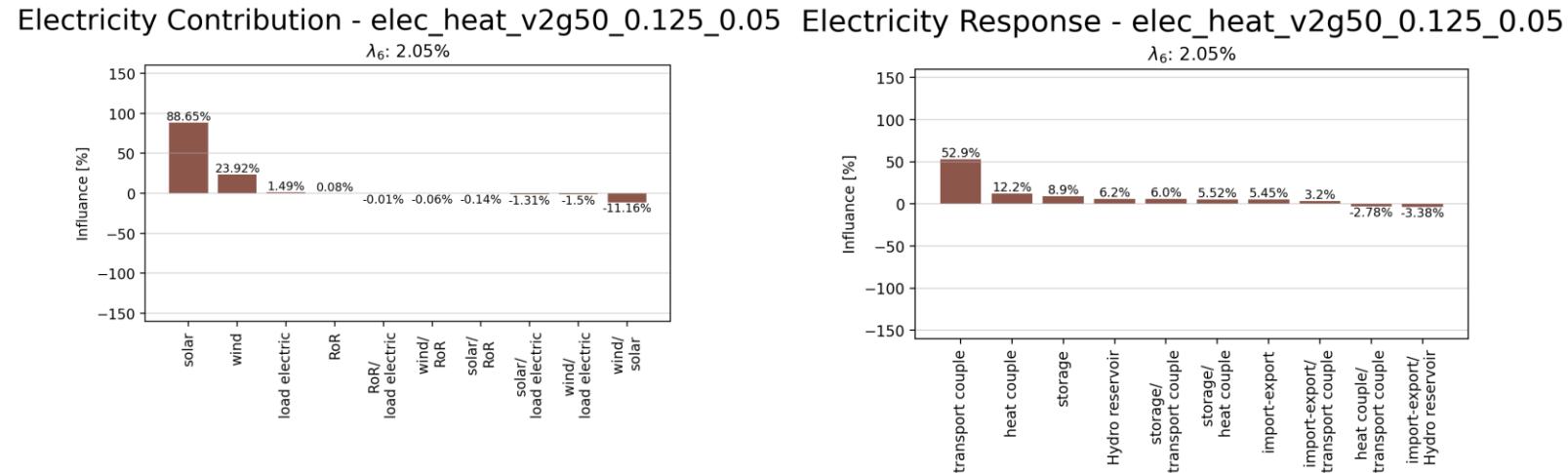
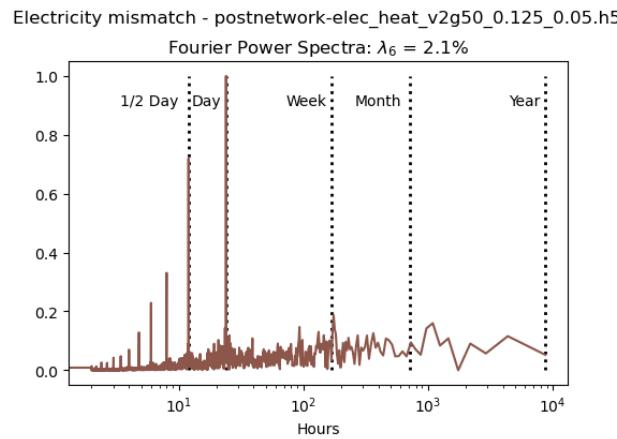
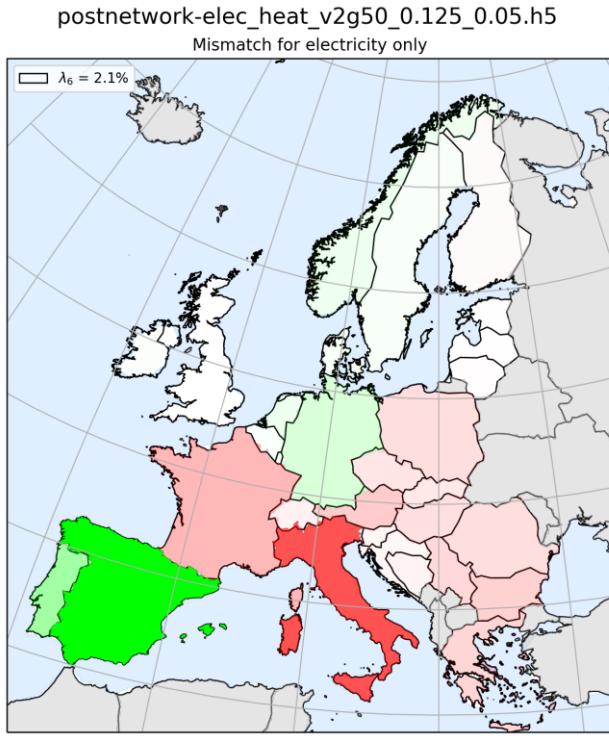
# Principle Component 4



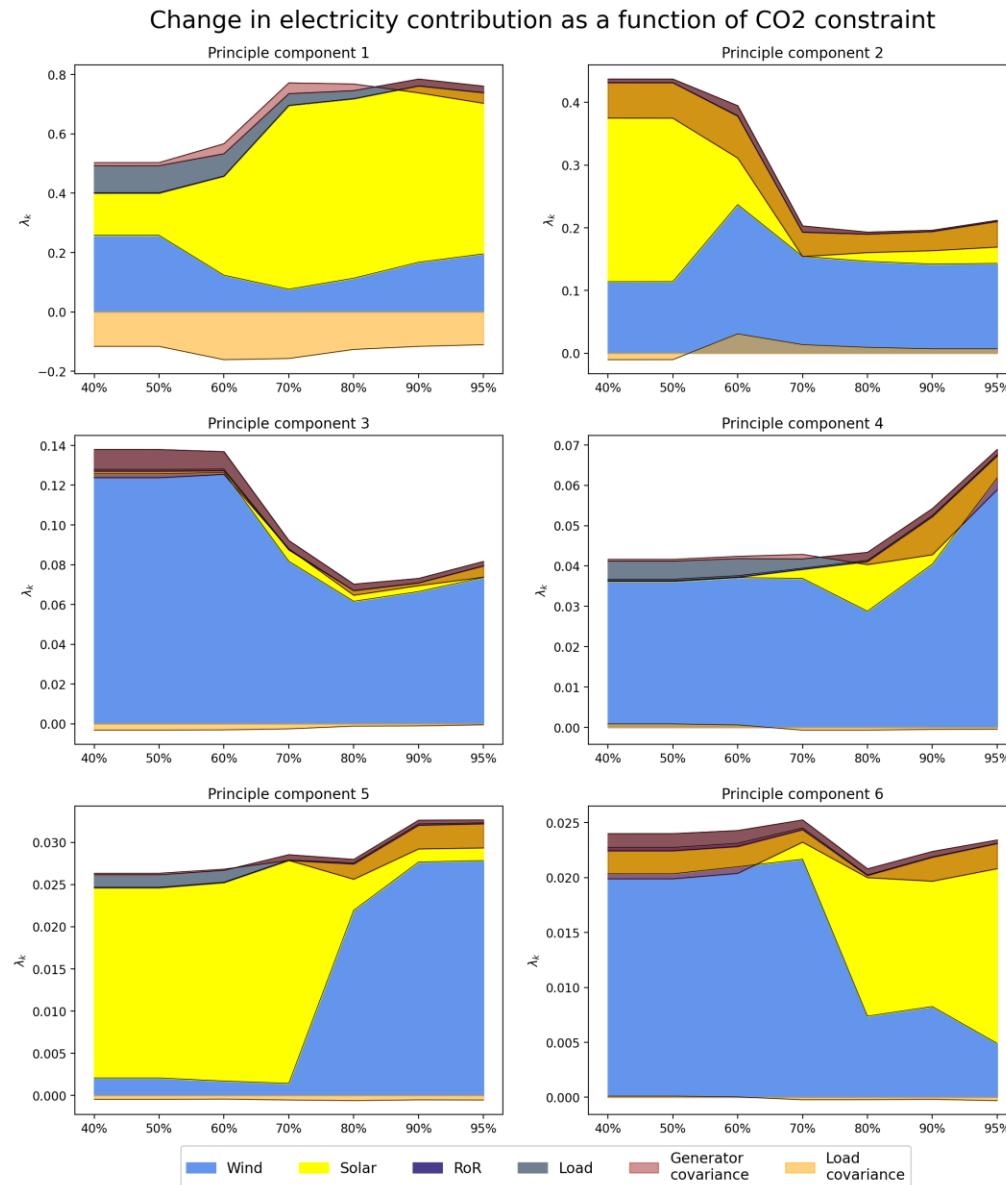
# Principle Component 5



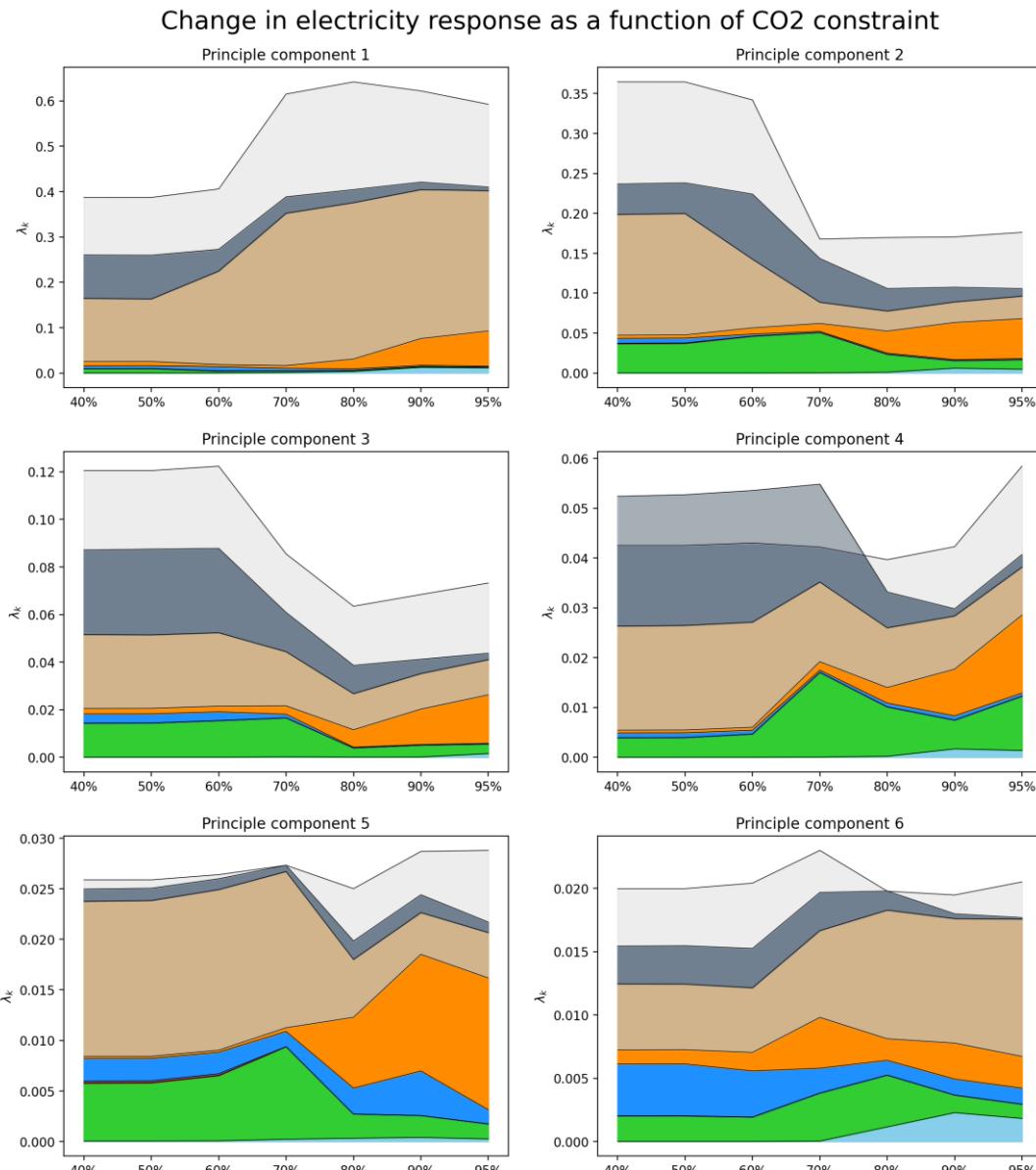
# Principle Component 6



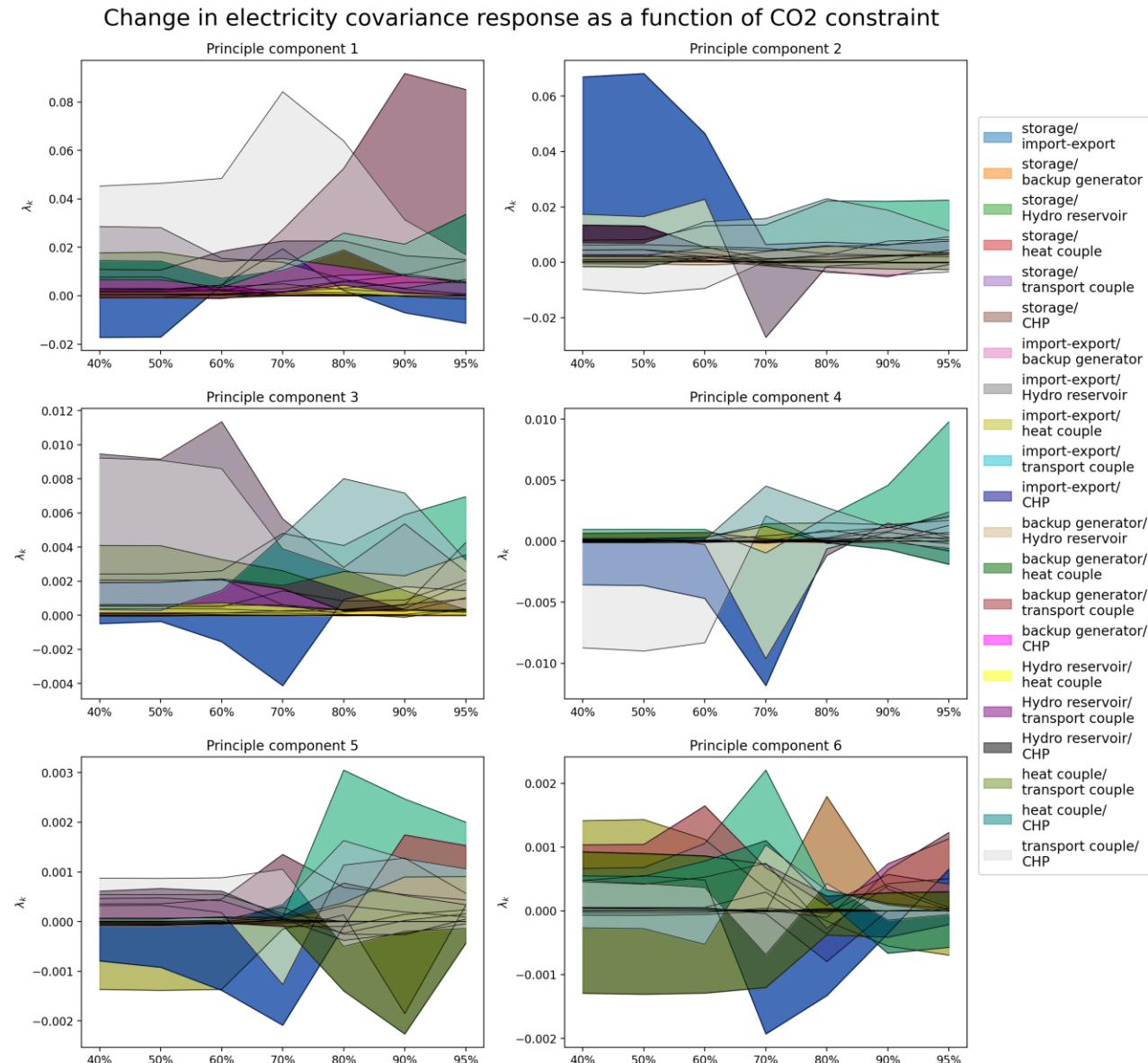
# Change in Contribution due to CO2 Constraint



# Change in Reponse due to CO2 Constraint



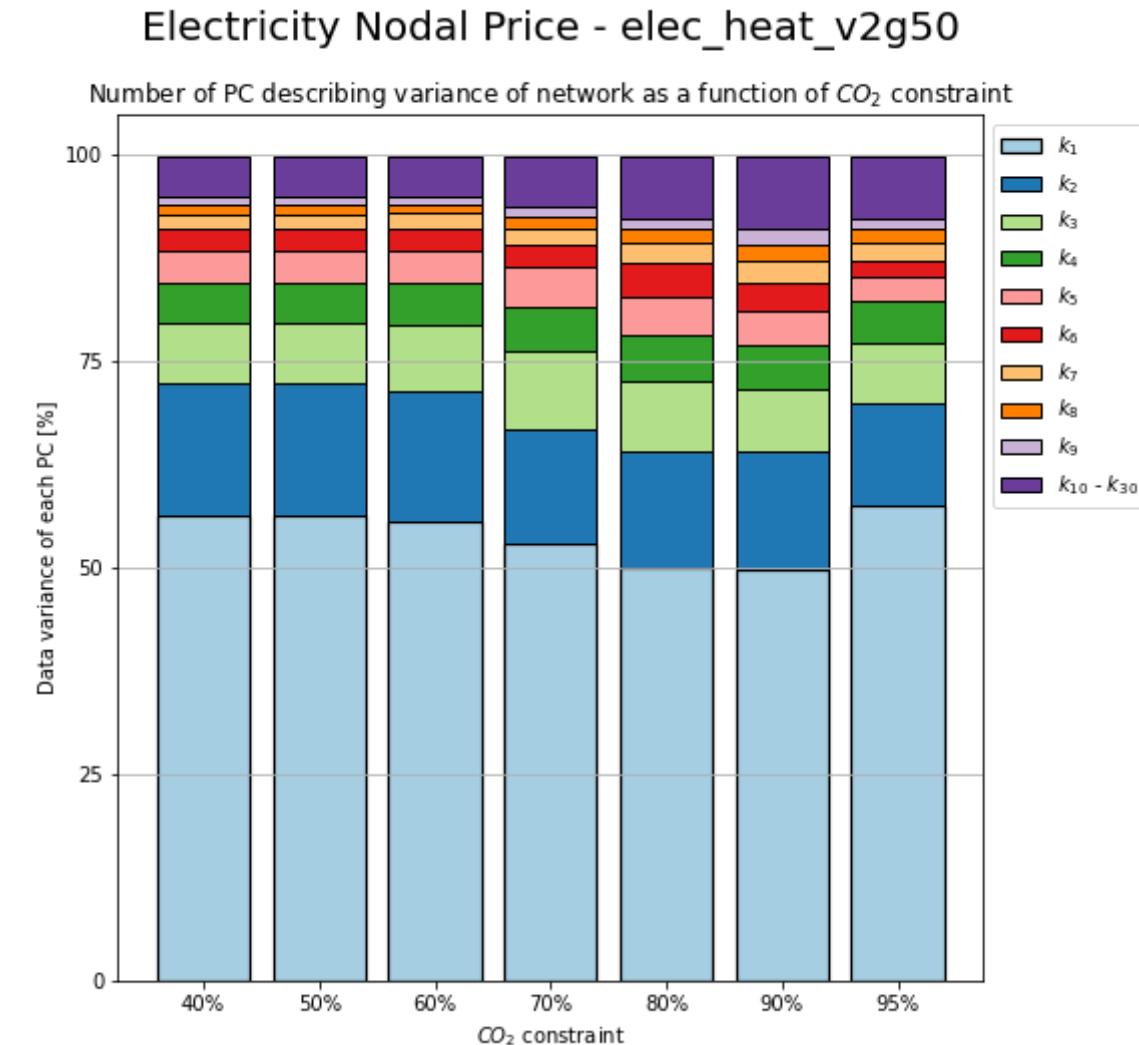
# Change in Cov Reponse due to CO2 Constraint



# Electricity Coupled with the Heating and Transport Sector

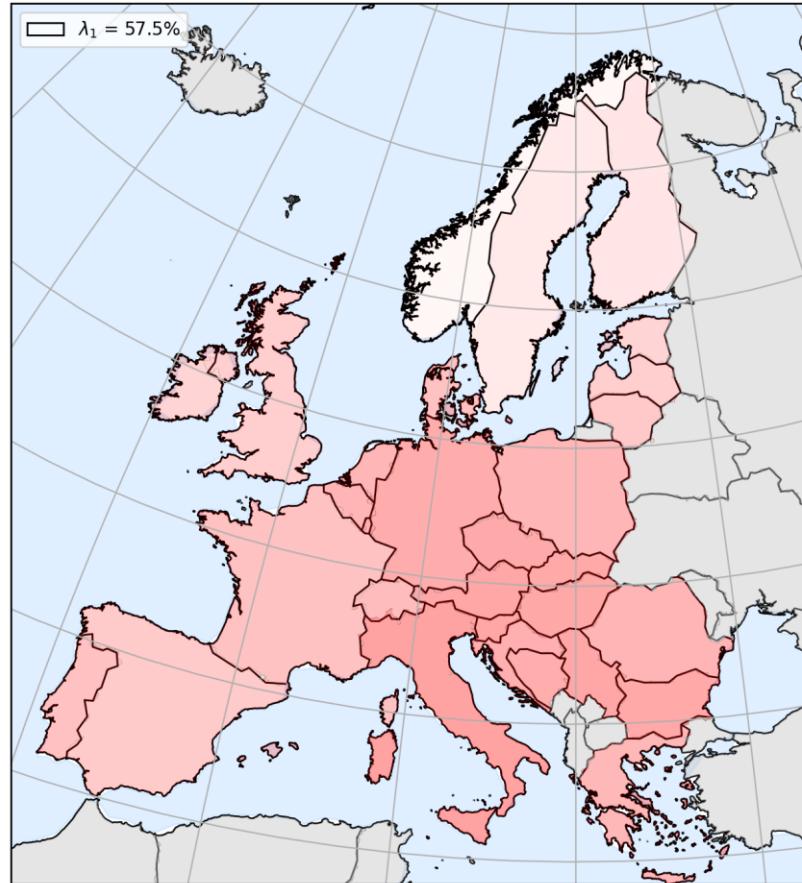
Electricity NP Analysis

# Change in PC due to CO<sub>2</sub> Constrain

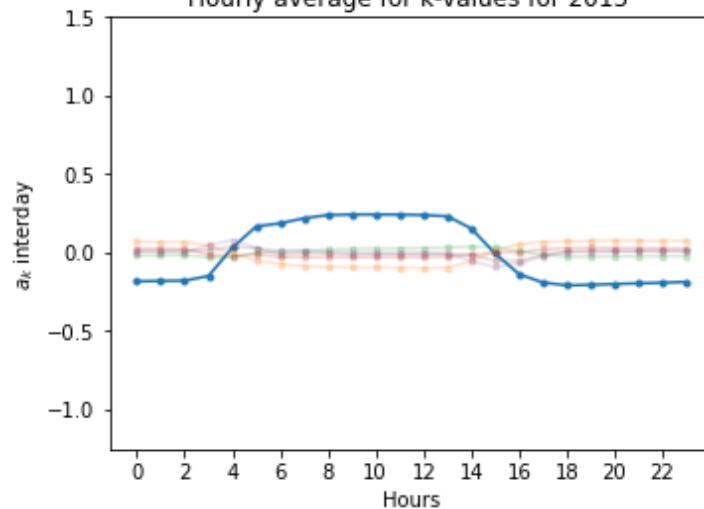


# Principle Component 1

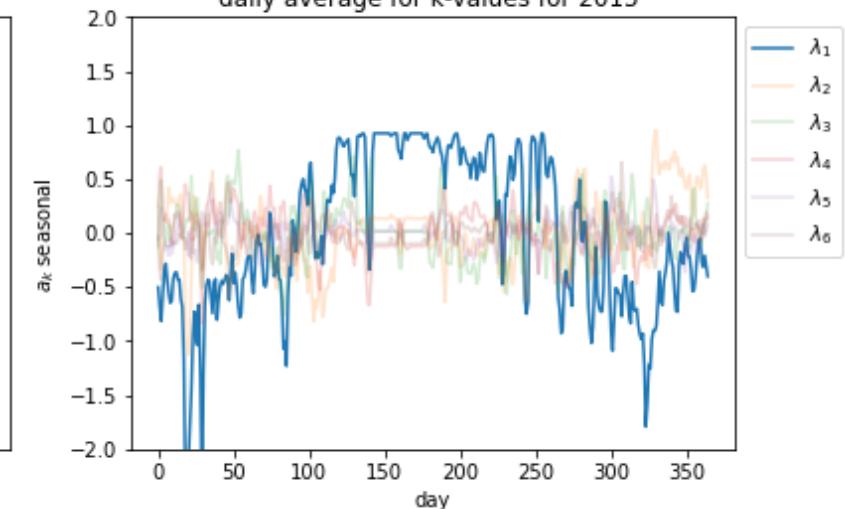
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for electricity only



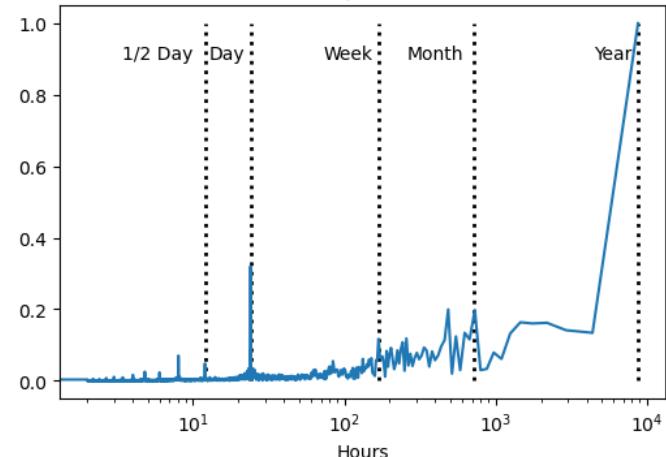
Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

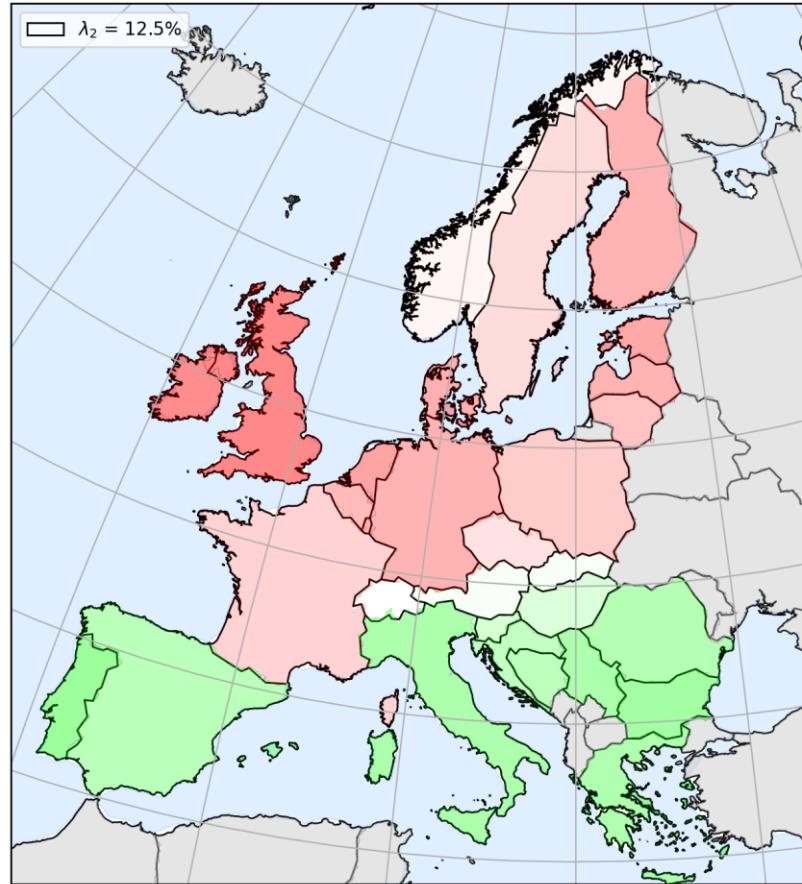


Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_1 = 57.5\%$

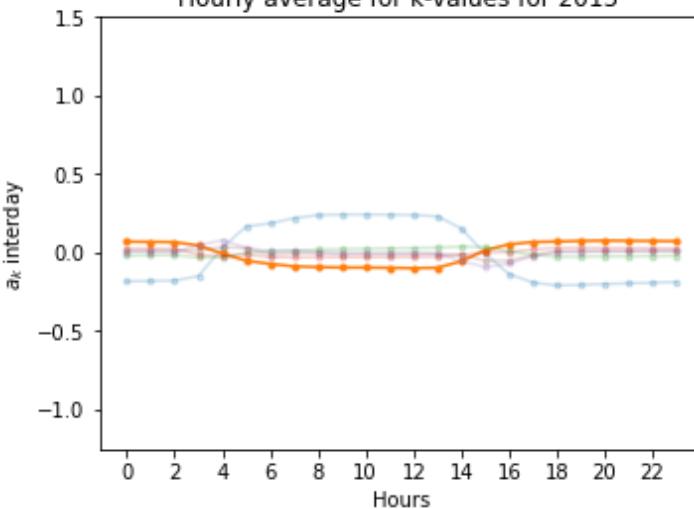


# Principle Component 2

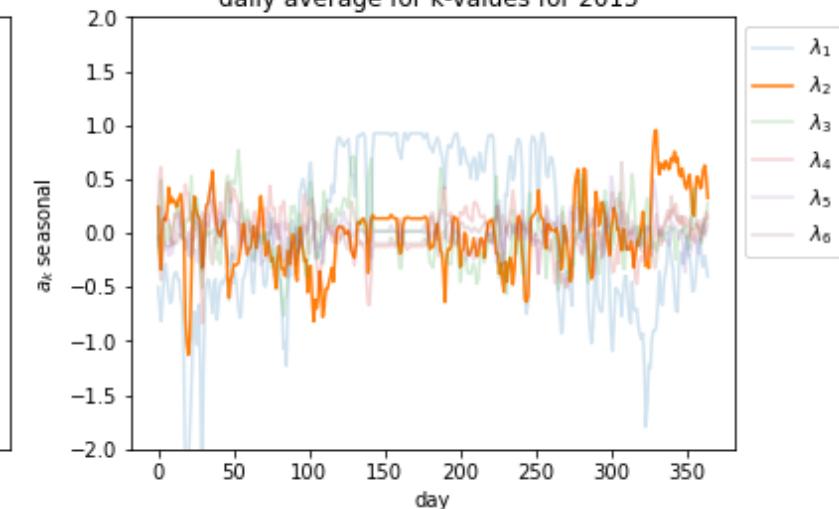
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for electricity only



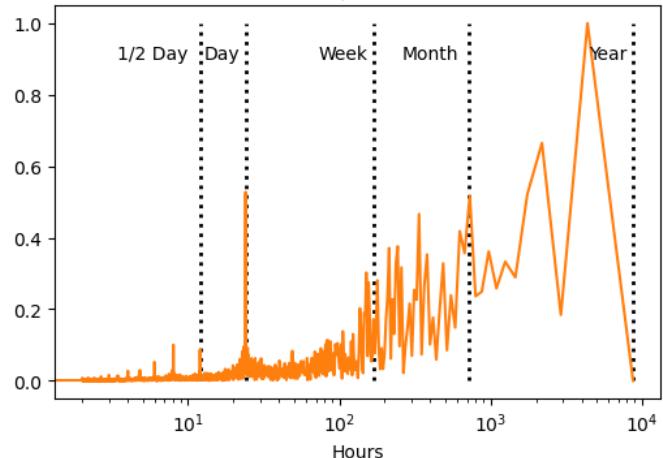
Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

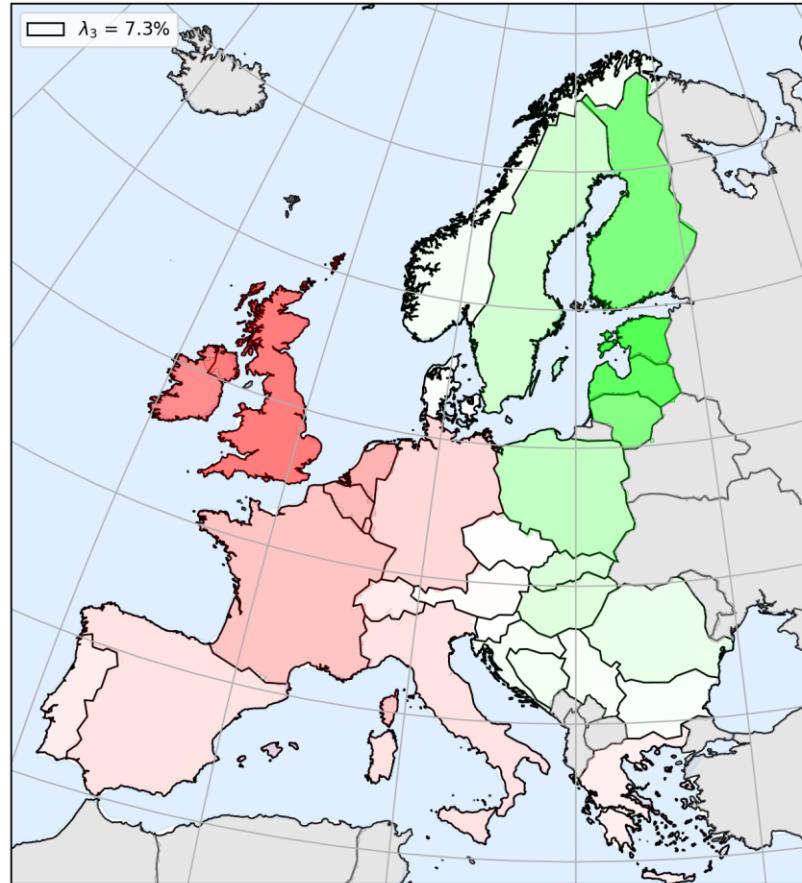


Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_2 = 12.5\%$

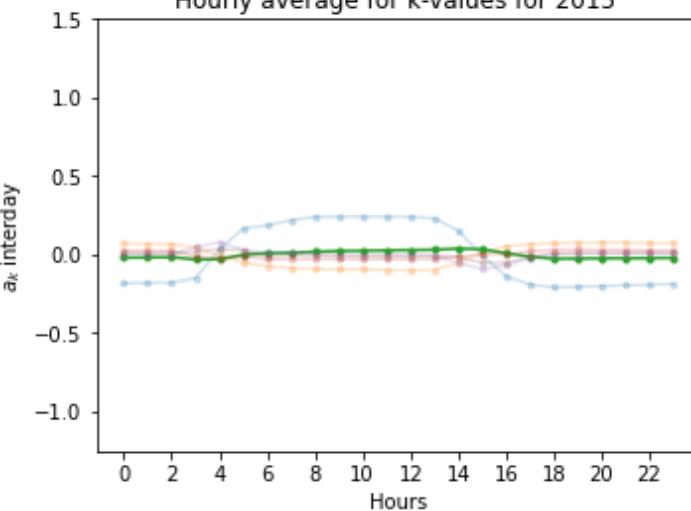


# Principle Component 3

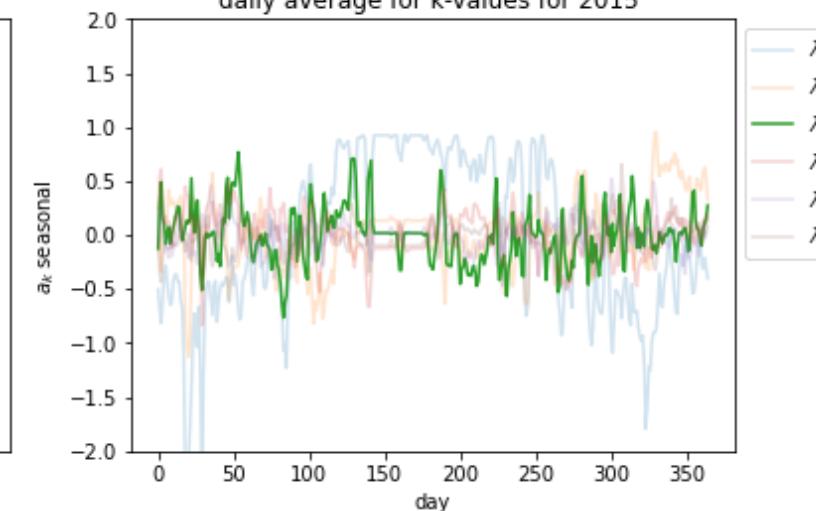
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for electricity only



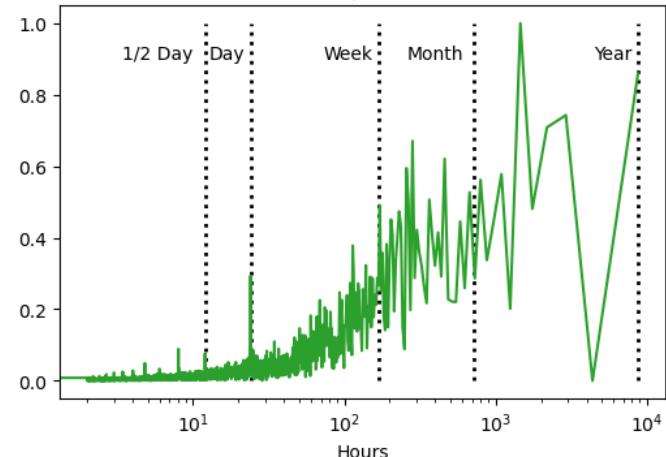
Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

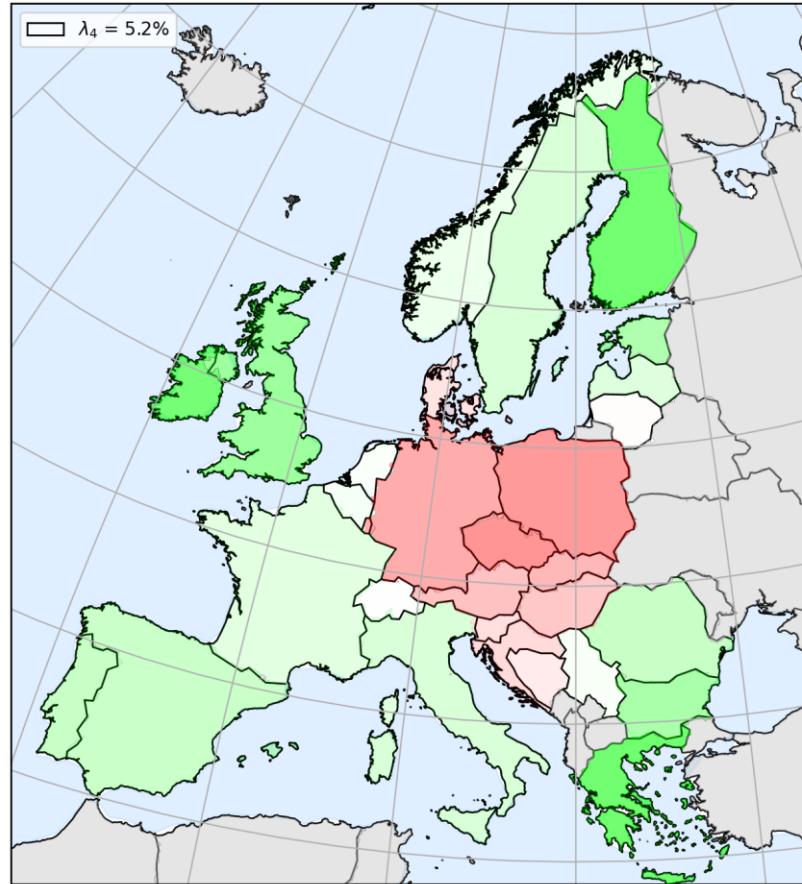


Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_3 = 7.3\%$

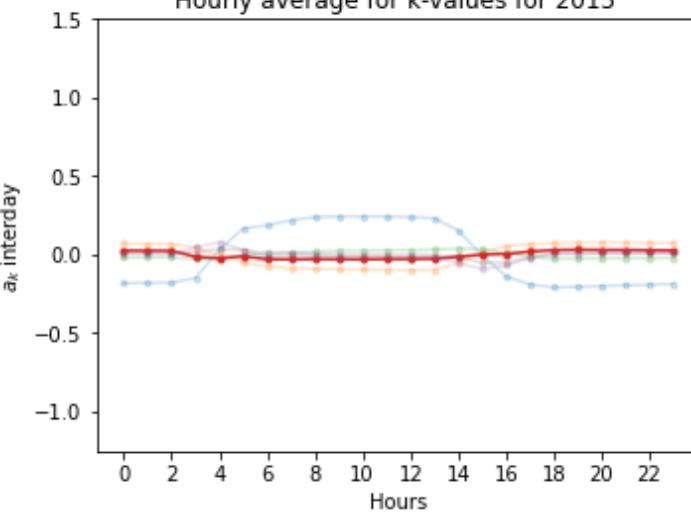


# Principle Component 4

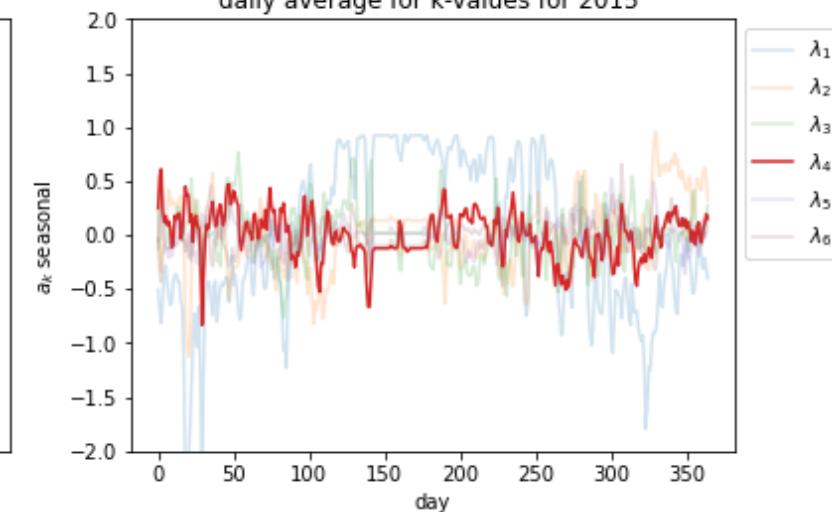
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for electricity only



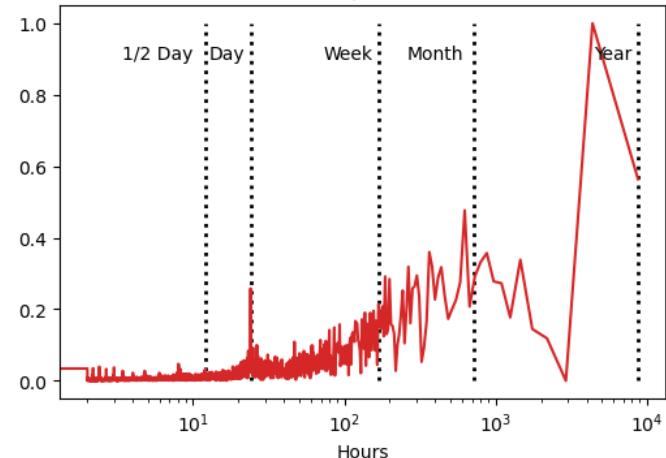
Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

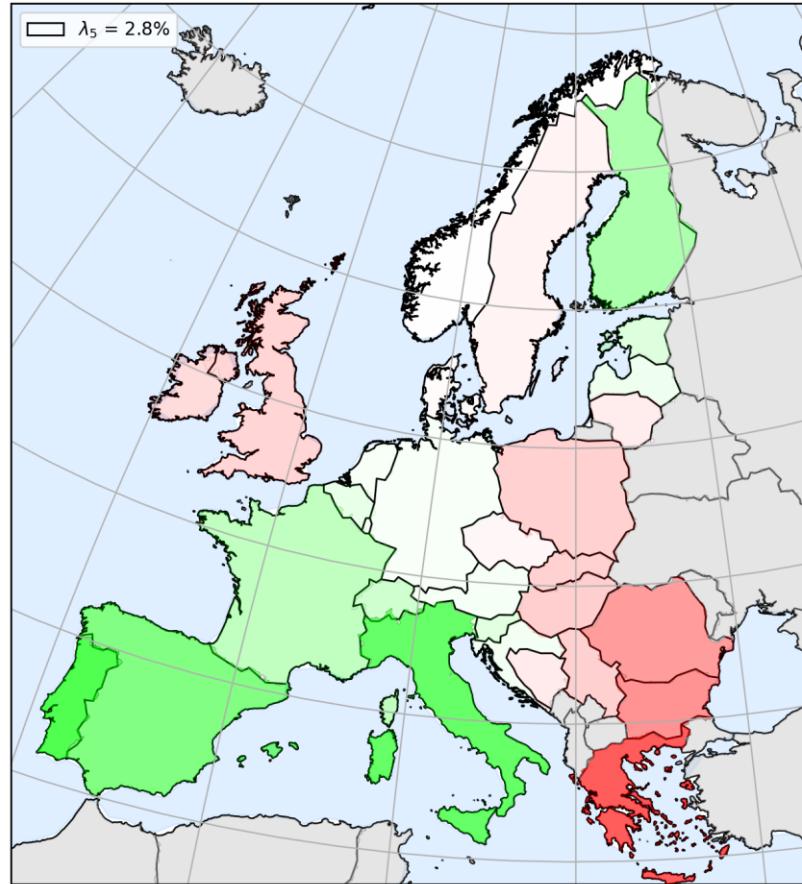


Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_4 = 5.2\%$

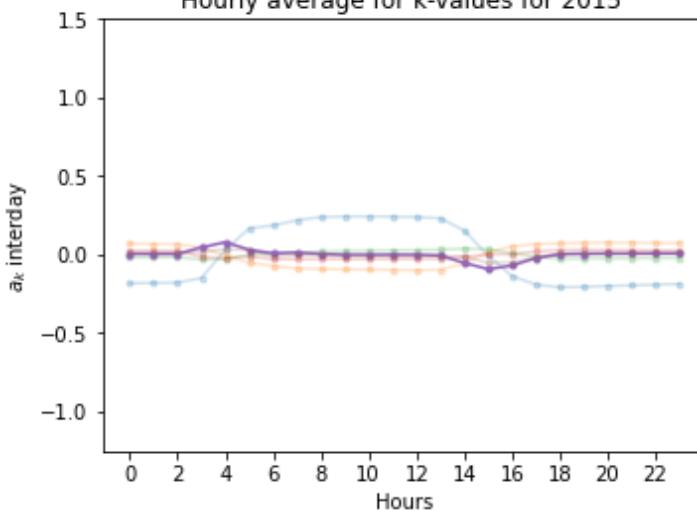


# Principle Component 5

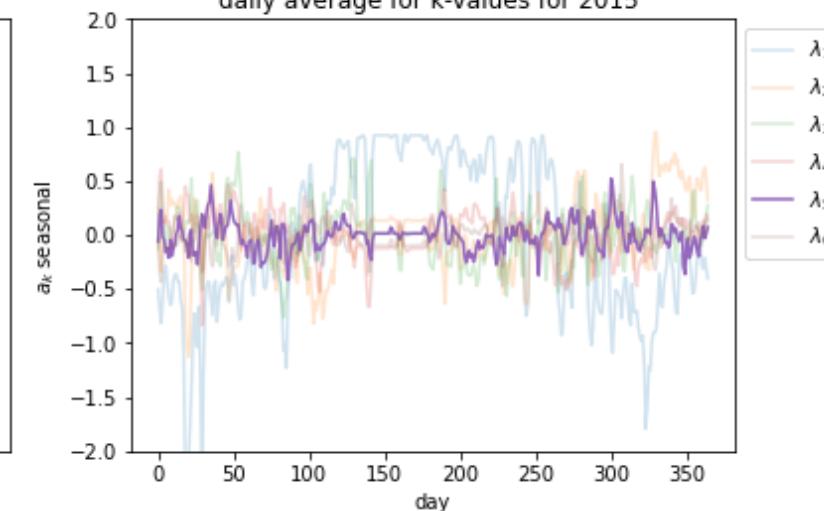
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for electricity only



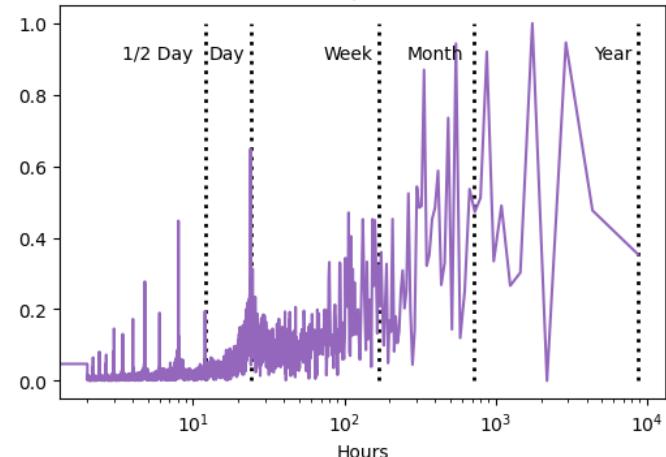
Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

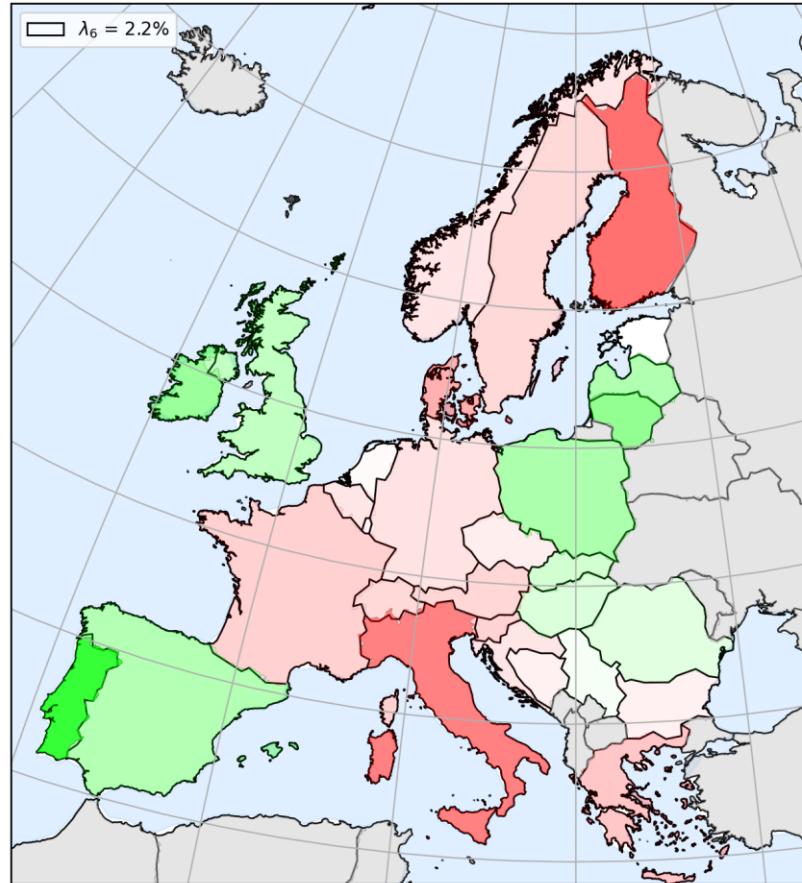


Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_5 = 2.8\%$

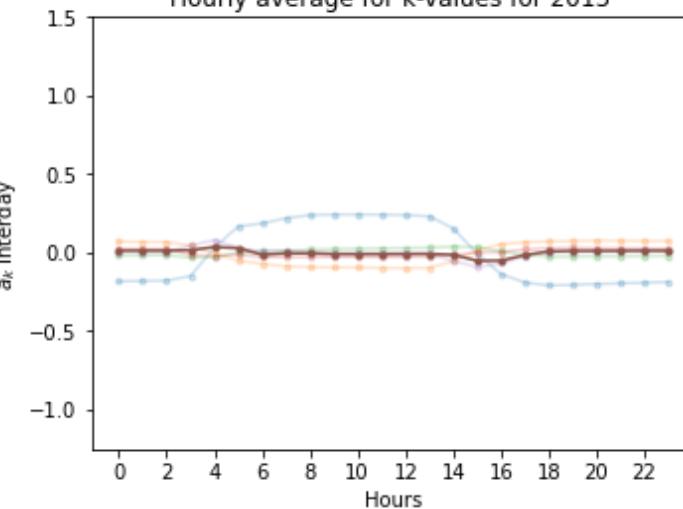


# Principle Component 6

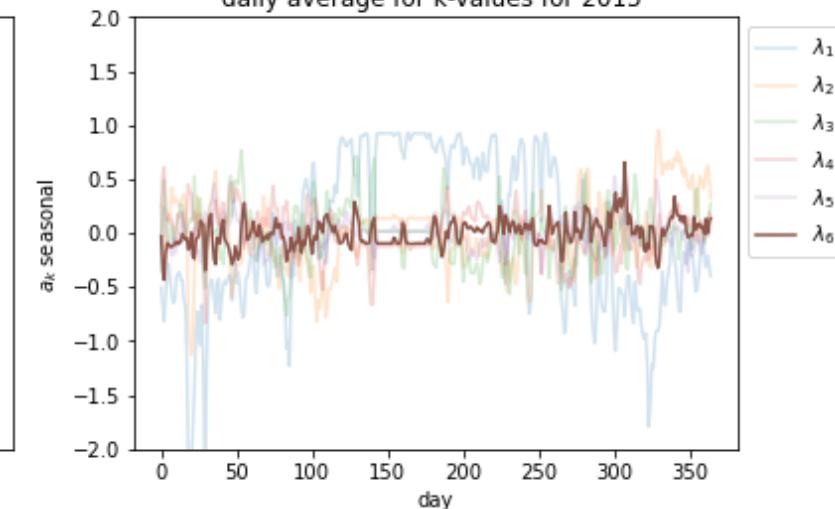
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for electricity only



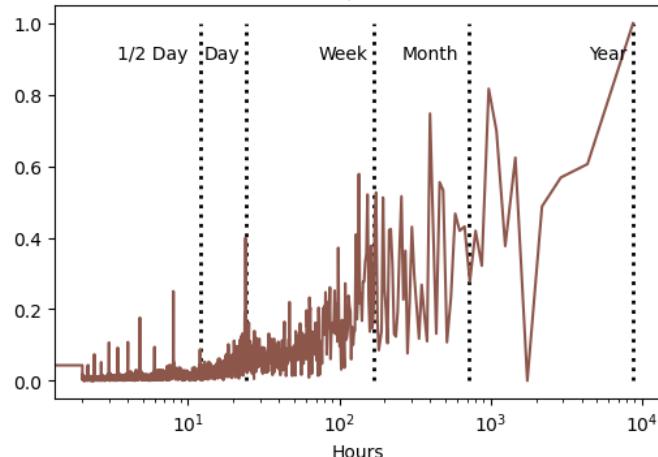
Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015



Electricity Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_6 = 2.2\%$

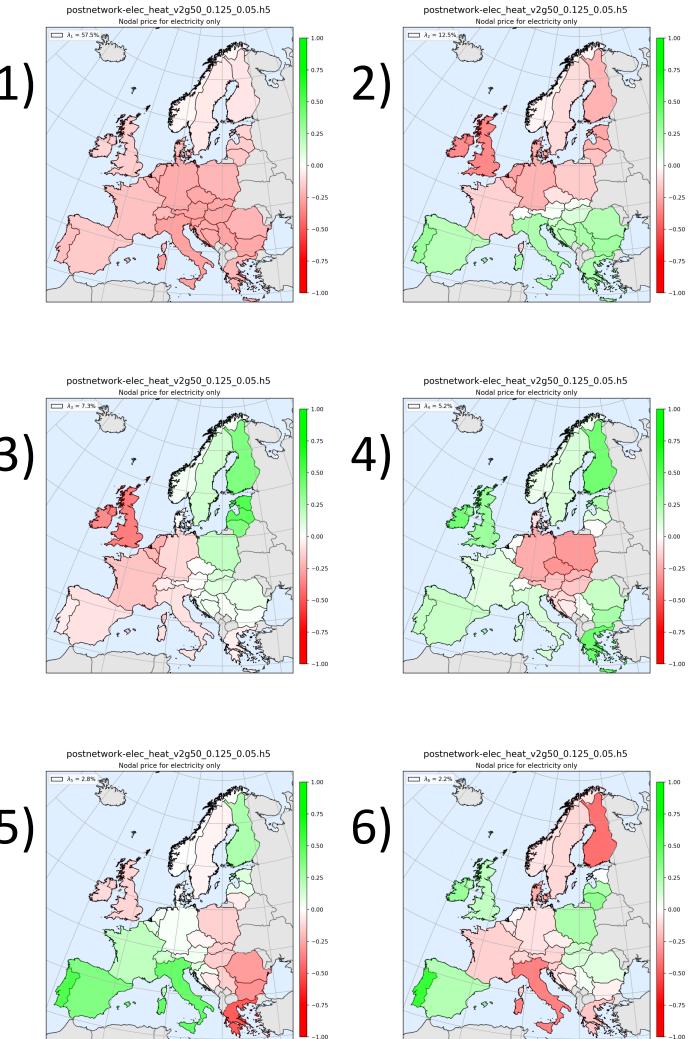


# Electricity Coupled with the Heating and Transport Sector

Electricity Mismatch and NP Coherence

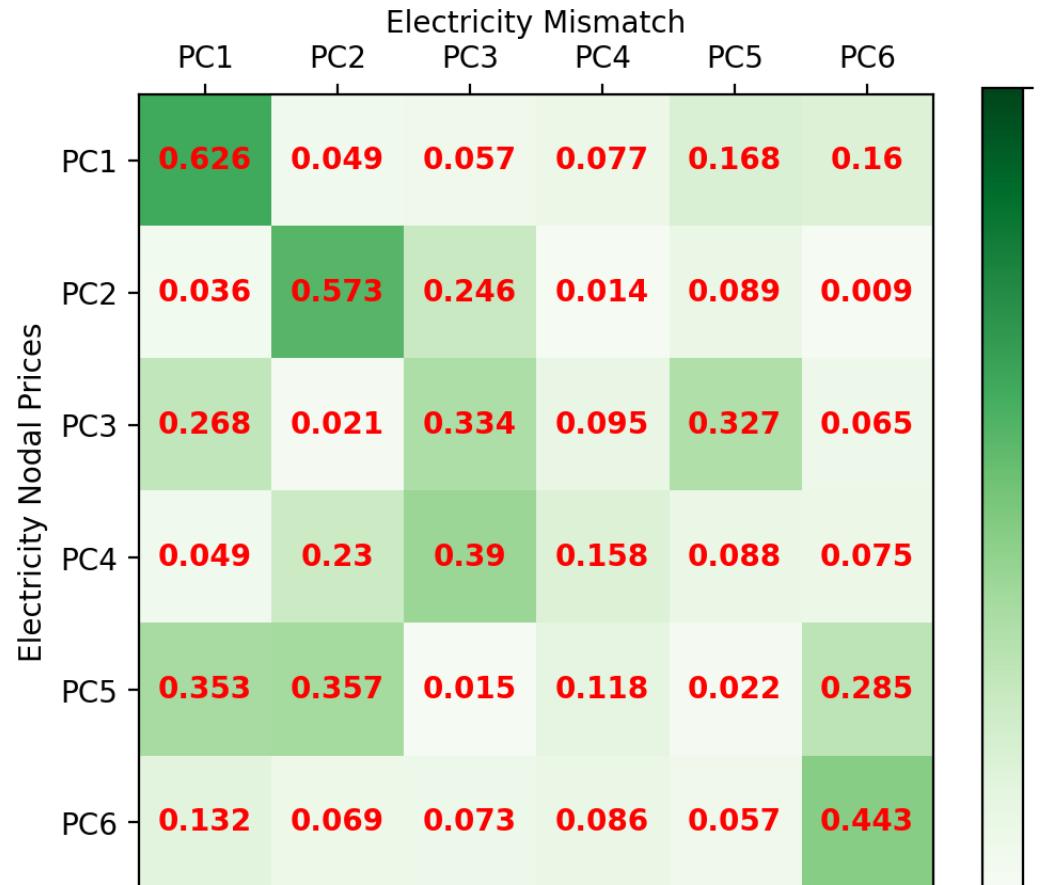
# Coherence Method 1

## Nodal Price

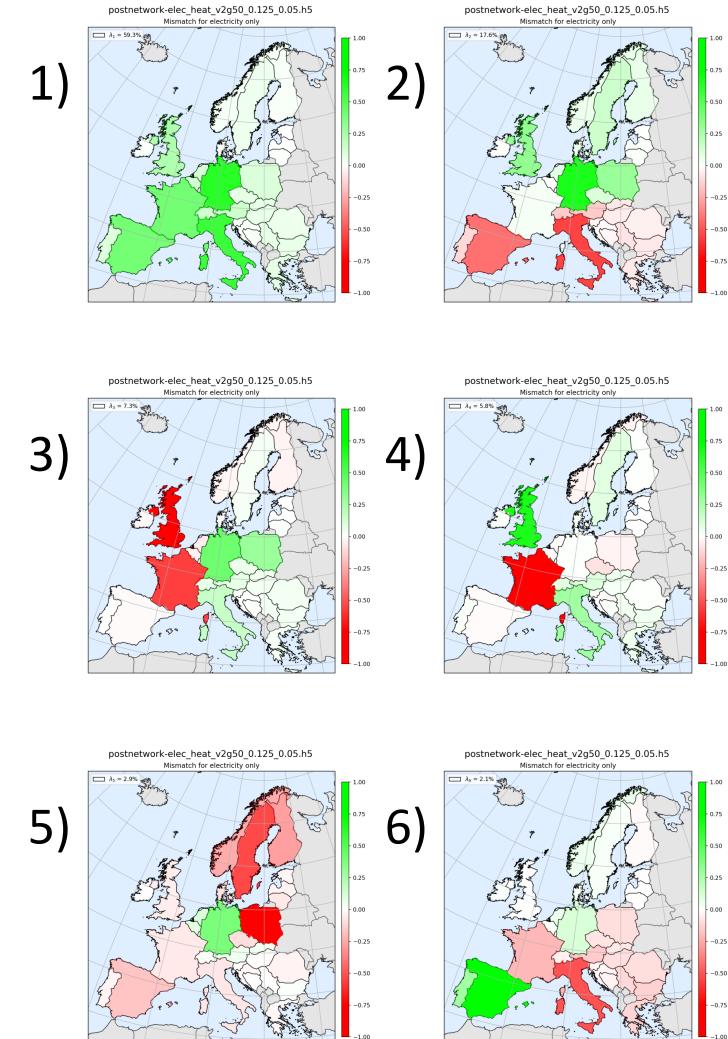


postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

Coherence 1: Electricity mismatch and nodal price

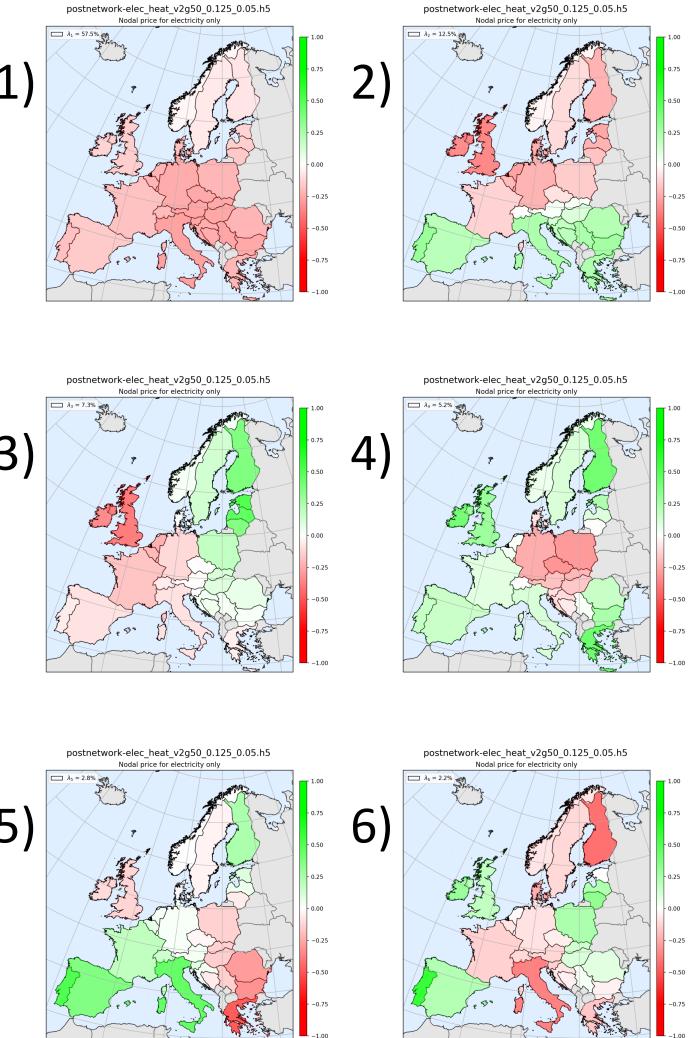


## Mismatch



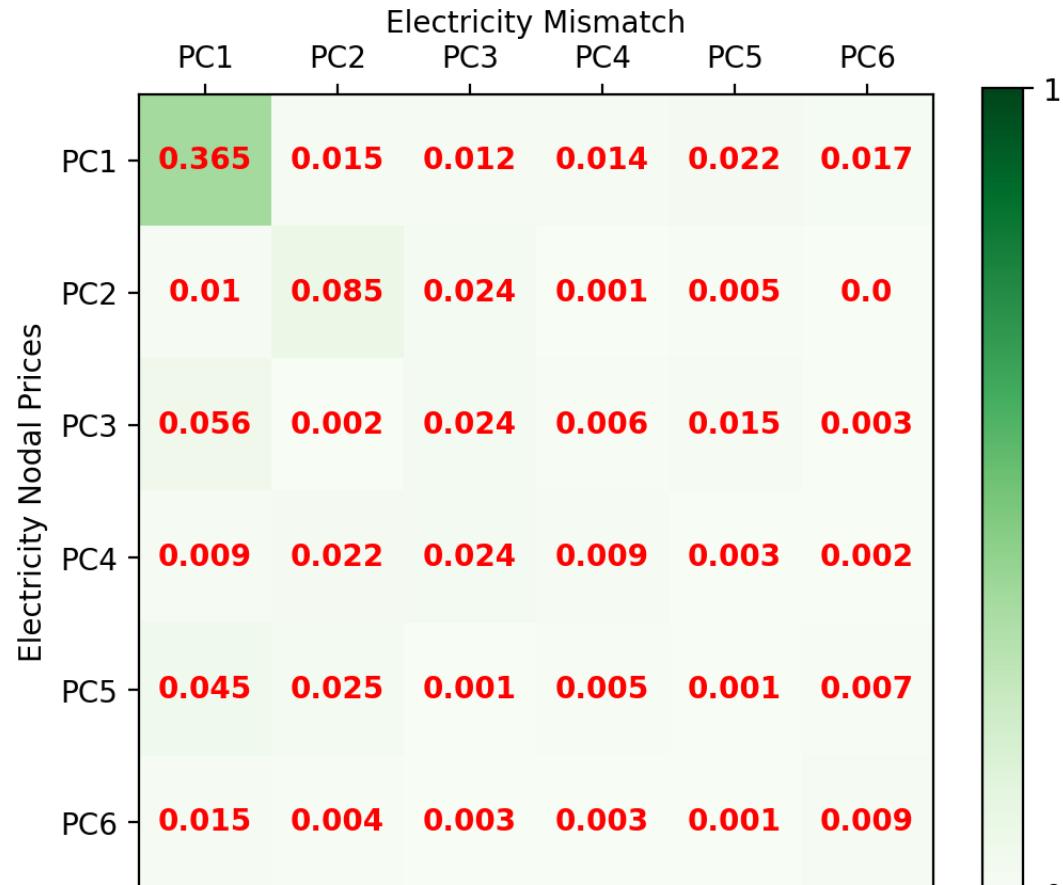
# Coherence Method 2

## Nodal Price

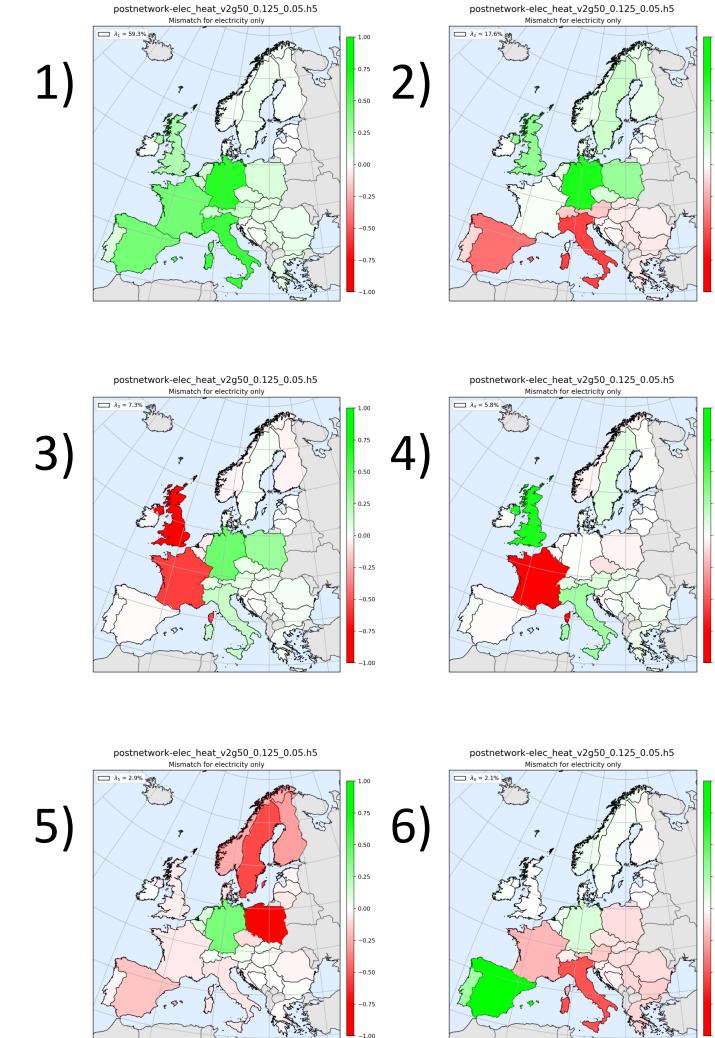


postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

Coherence 2: Electricity mismatch and nodal price

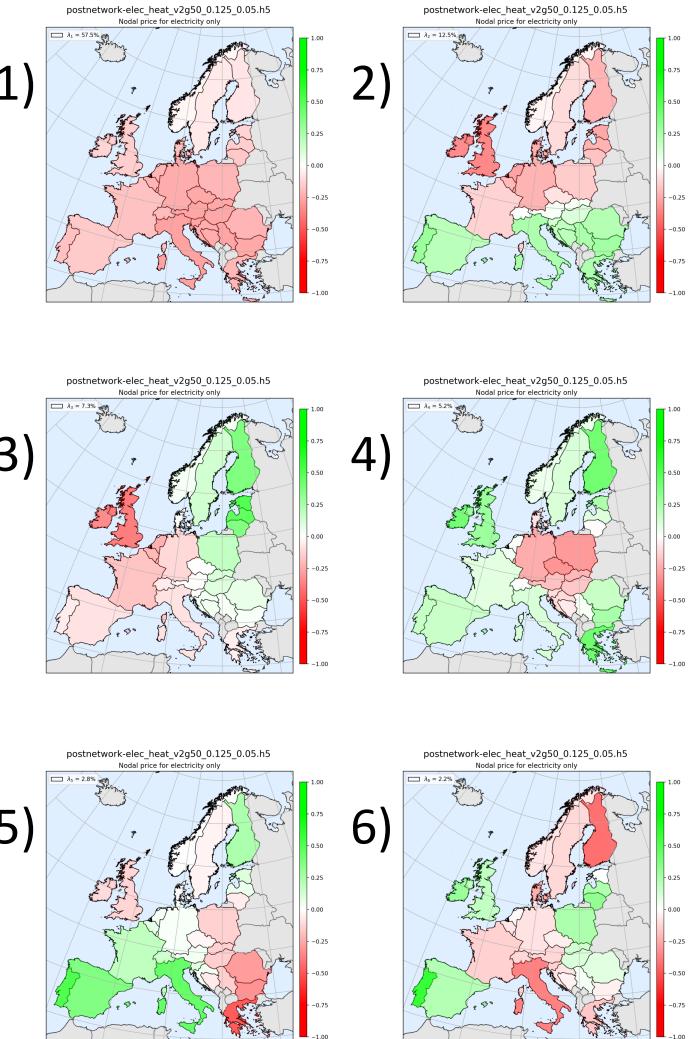


## Mismatch



# Coherence Method 3

## Nodal Price

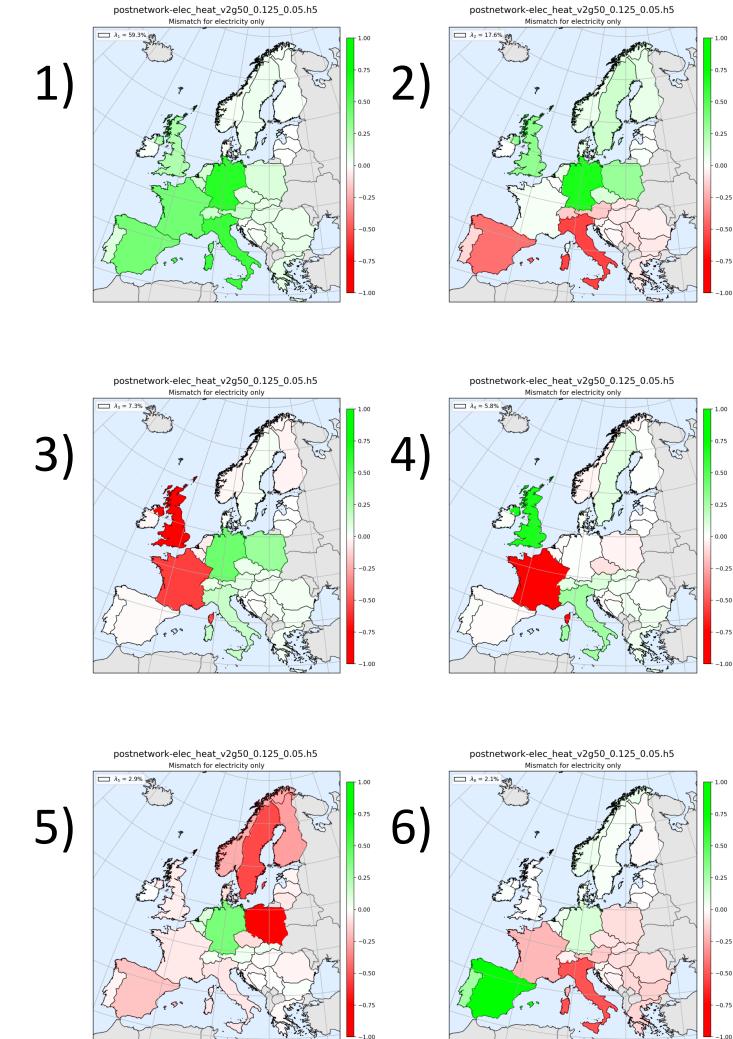


postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

Coherence 3: Electricity mismatch and nodal price

	Electricity Mismatch					
	PC1	PC2	PC3	PC4	PC5	PC6
Electricity Nodal Prices	0.257	-0.041	0.121	0.288	0.199	-0.076
PC1	0.117	0.676	-0.241	0.058	-0.128	0.035
PC2	0.162	0.054	-0.313	0.081	0.308	0.018
PC3	0.064	0.259	0.35	-0.262	0.07	0.027
PC4	-0.073	0.131	0.031	0.188	-0.067	-0.136
PC5	-0.022	0.024	0.003	-0.079	0.09	-0.245
PC6						

## Mismatch



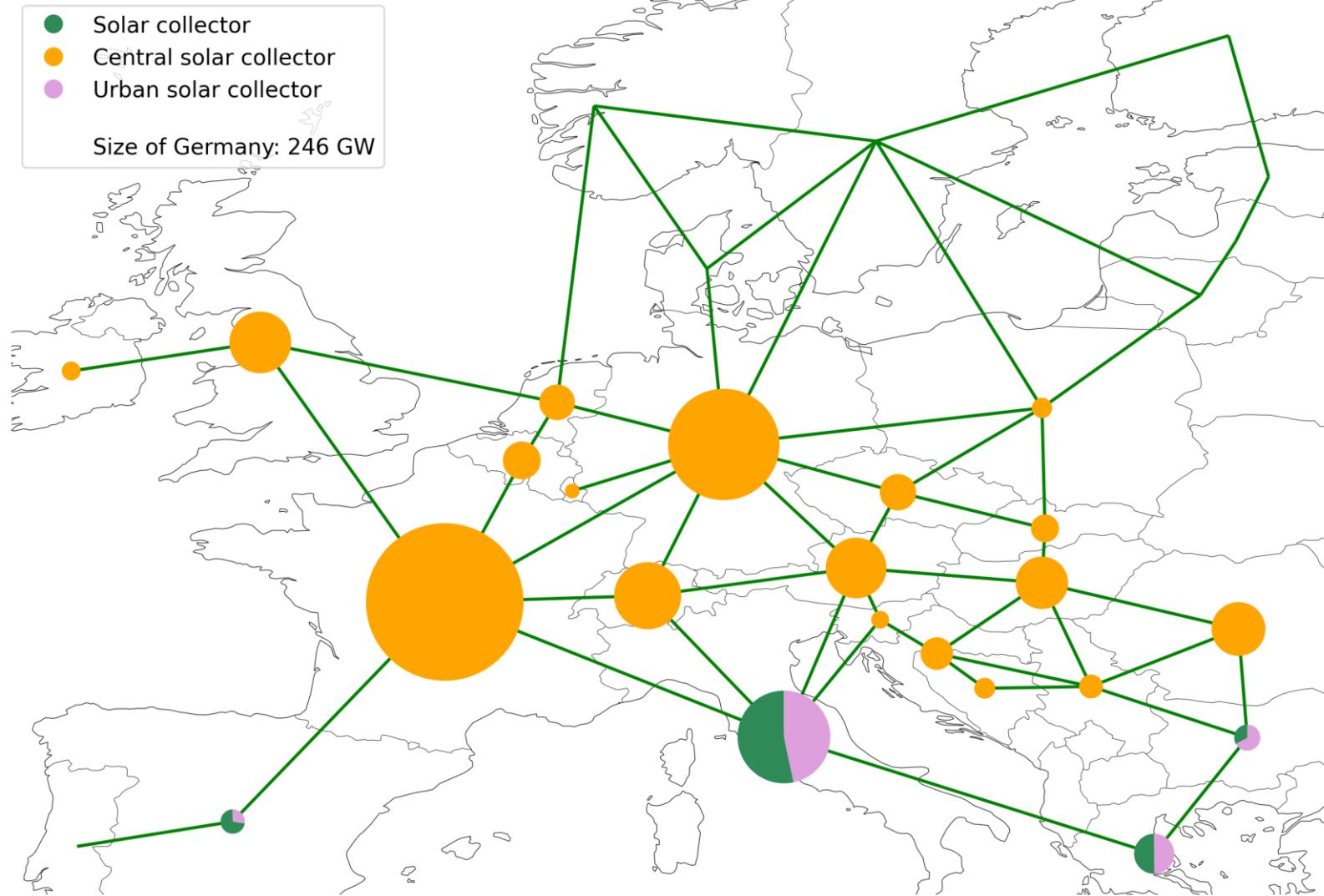
# Electricity Coupled with the Heating and Transport Sector

Heating Mismatch Analysis

# Installed capacity

postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

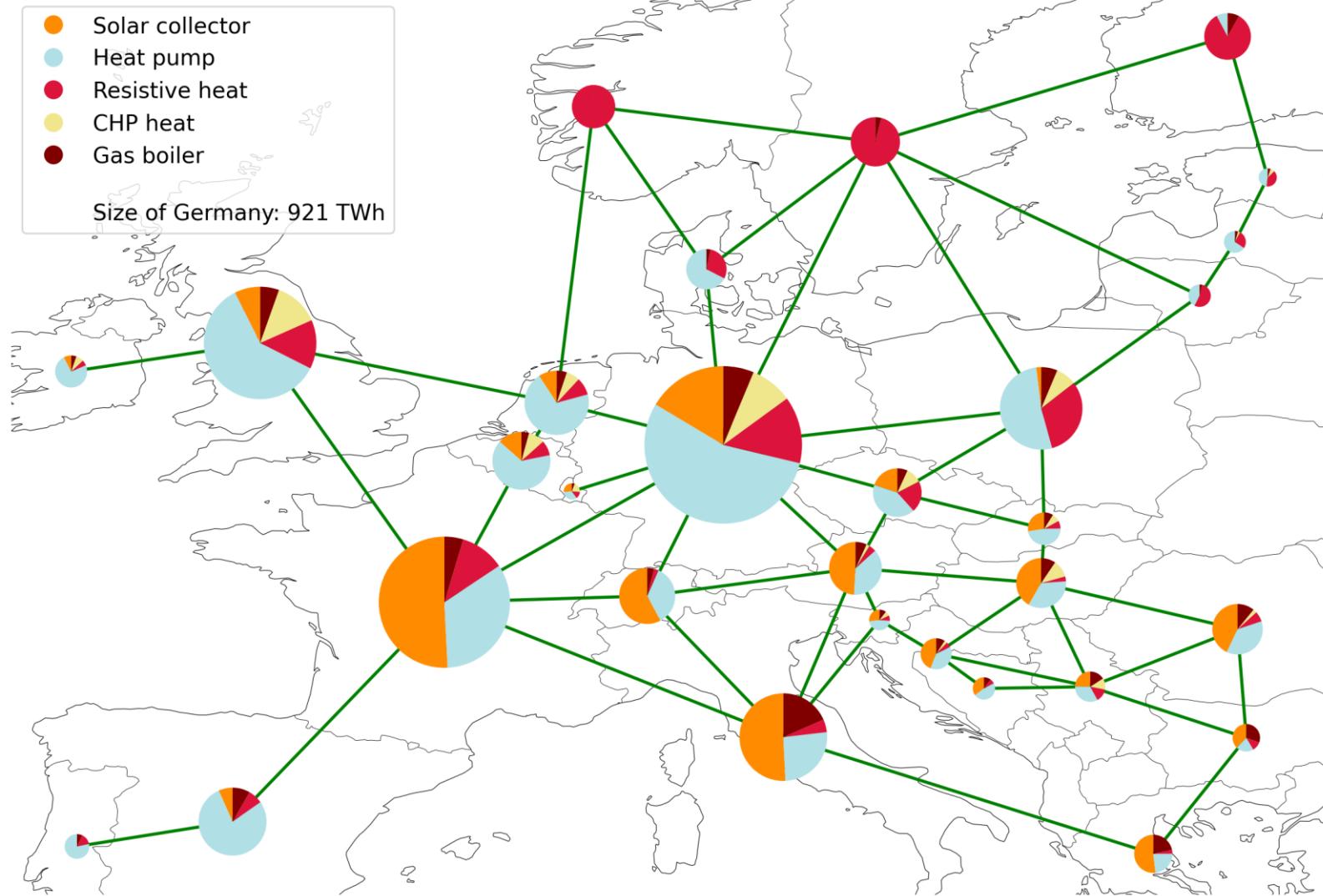
Installed heating generator capacity [MW]



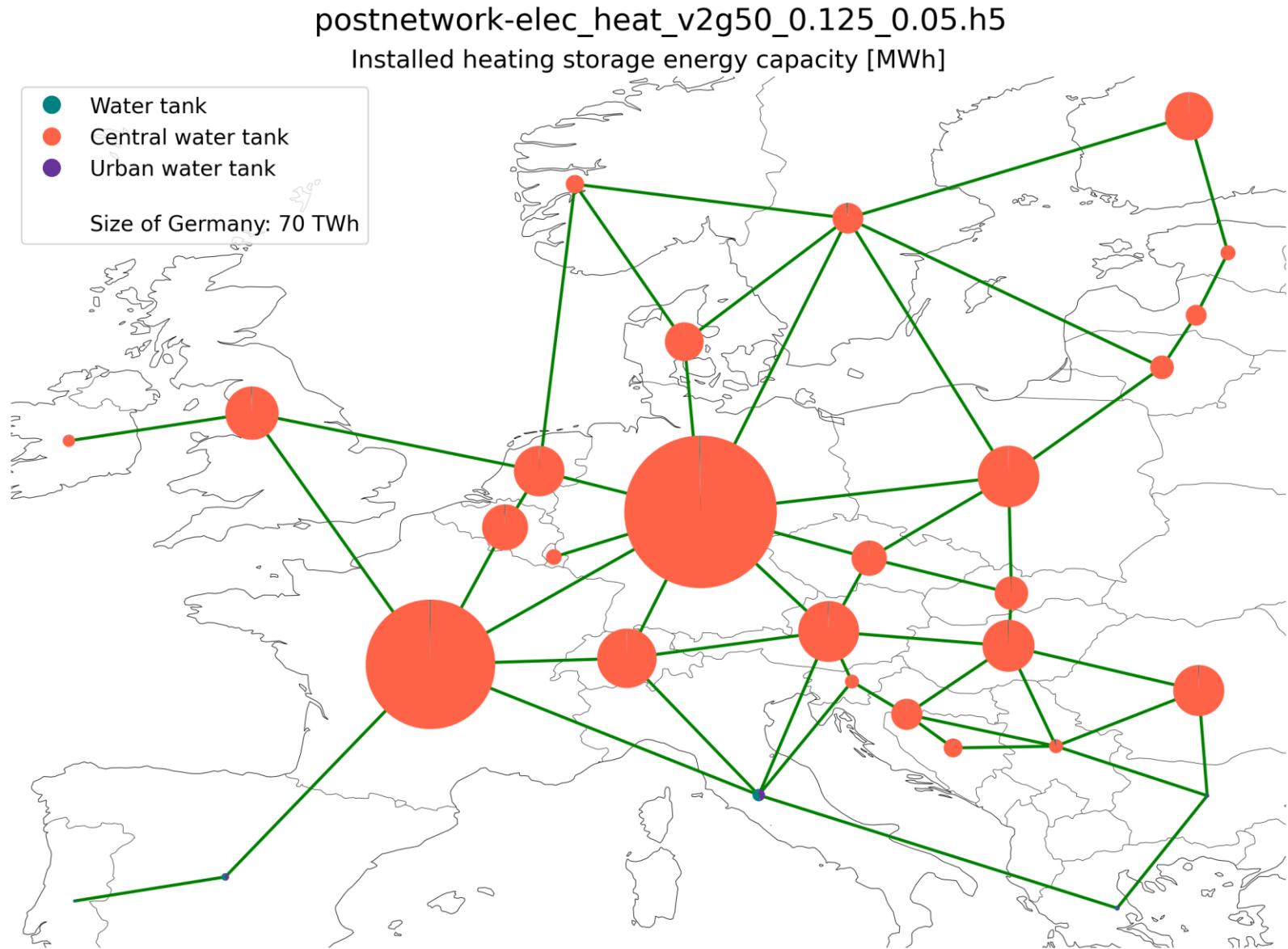
# Heating Supplied by Different Technologies

postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

Heating energy from different technologies [MWh]



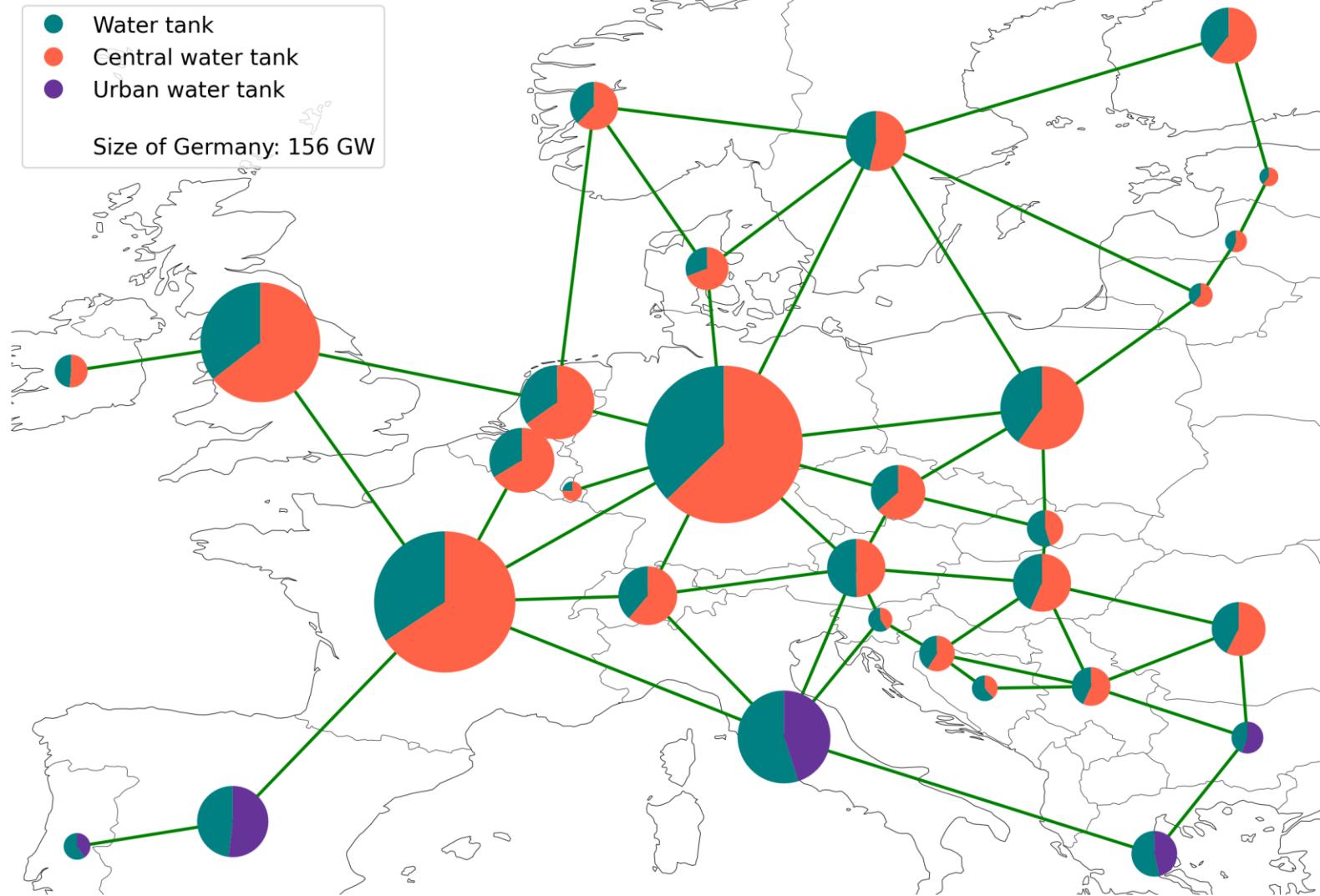
# Installed storage (energy capacity)



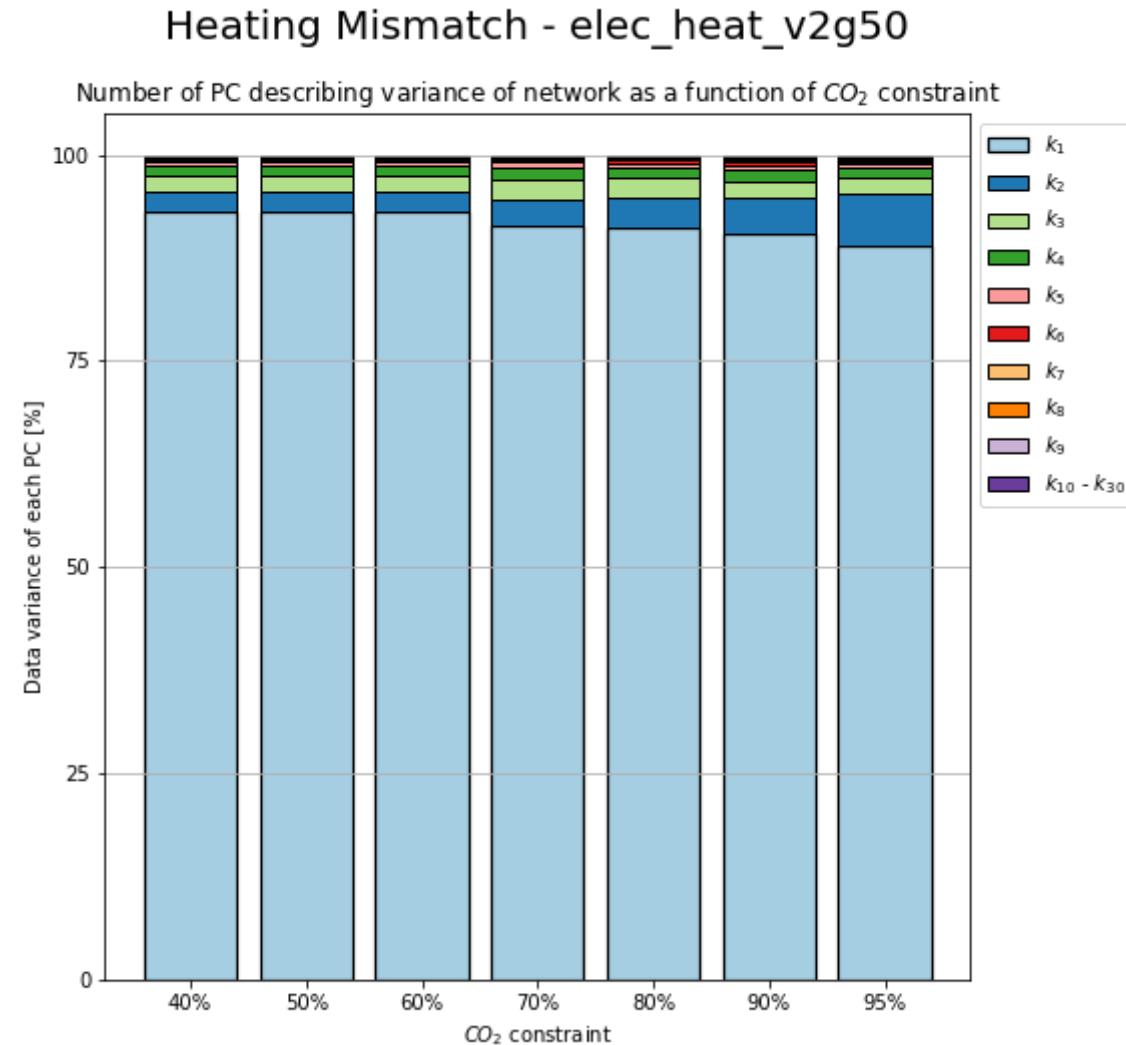
# Installed storage (power capacity)

postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

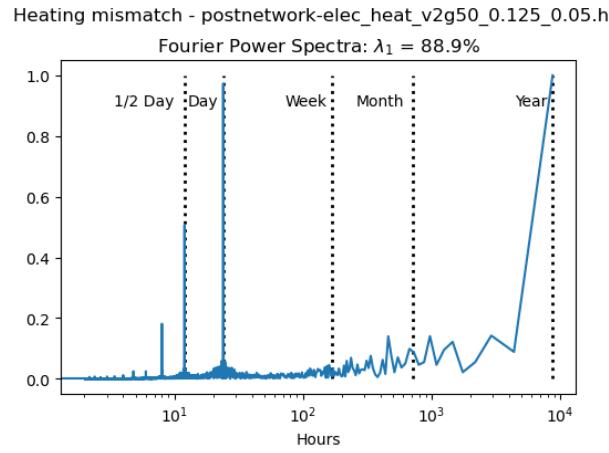
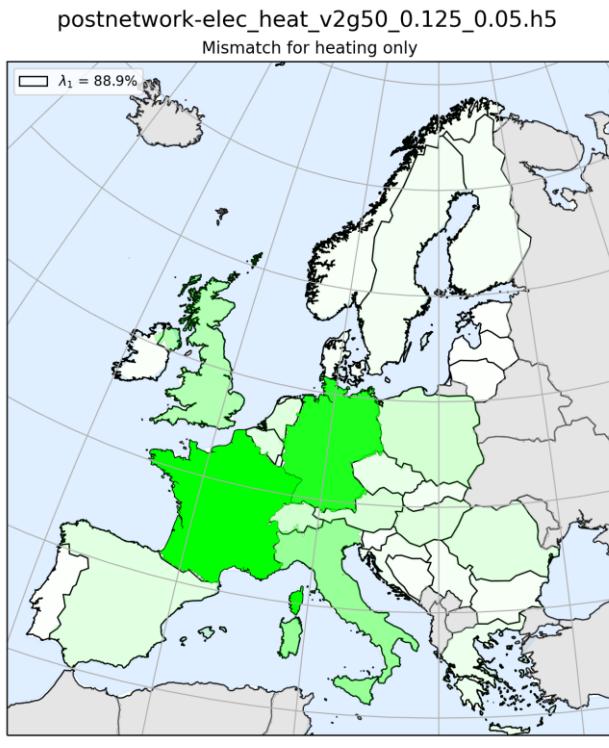
Installed heating storage power capacity [MW]



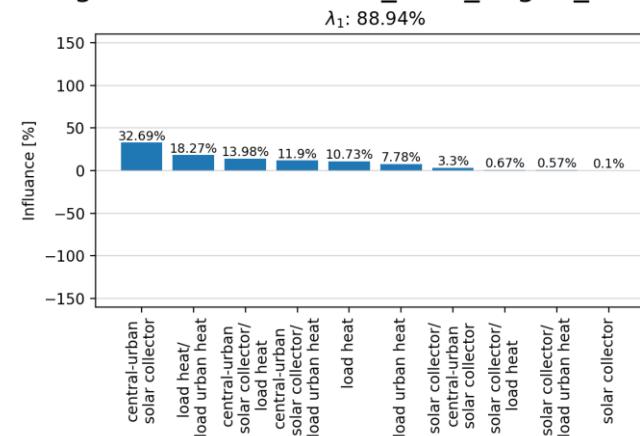
# Change in PC due to CO<sub>2</sub> and Transmission Constraint



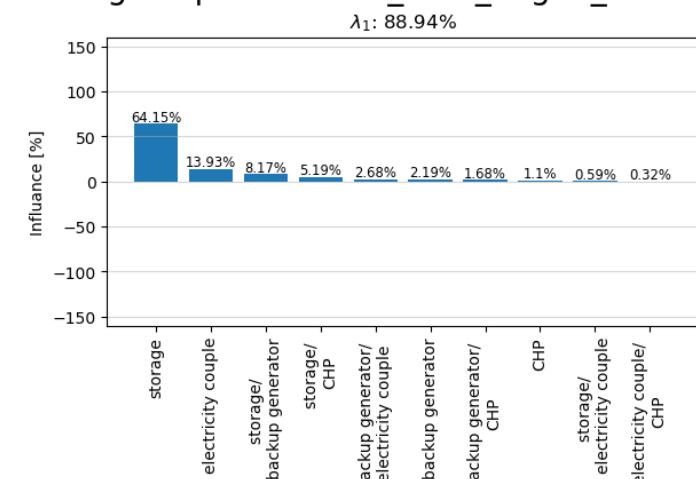
# Principle Component 1



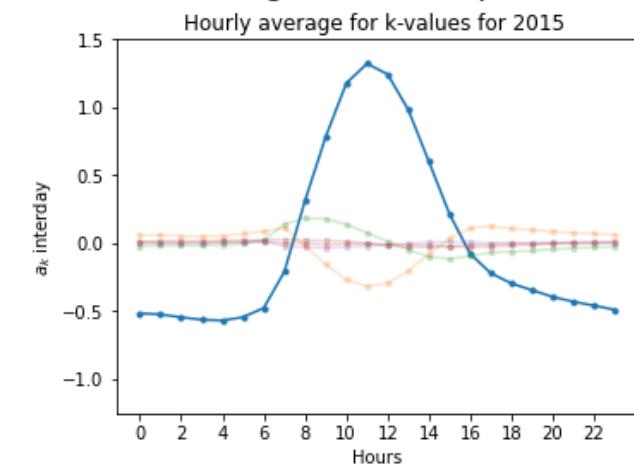
Heating Contribution - elec\_heat\_v2g50\_0.125\_0.05



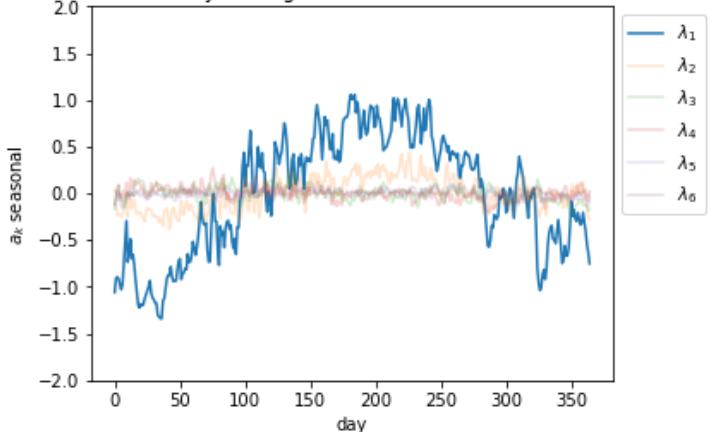
Heating Response - elec\_heat\_v2g50\_0.125\_0.05



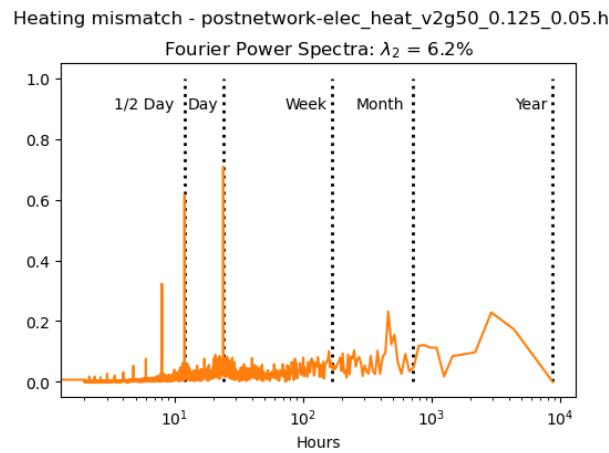
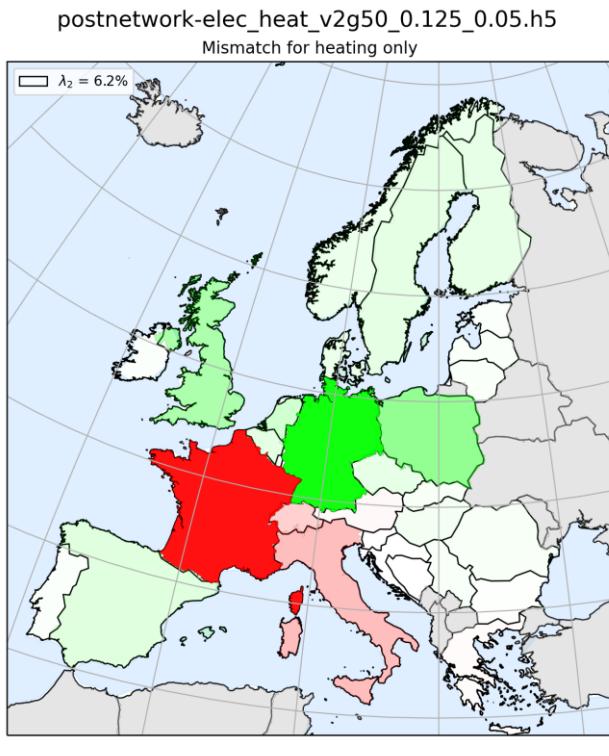
Heating mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5



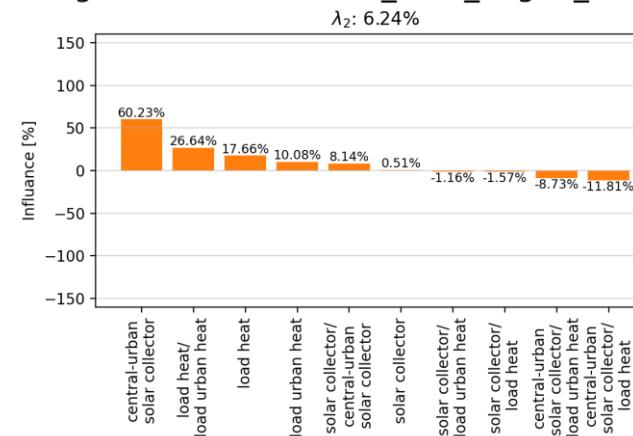
daily average for k-values for 2015



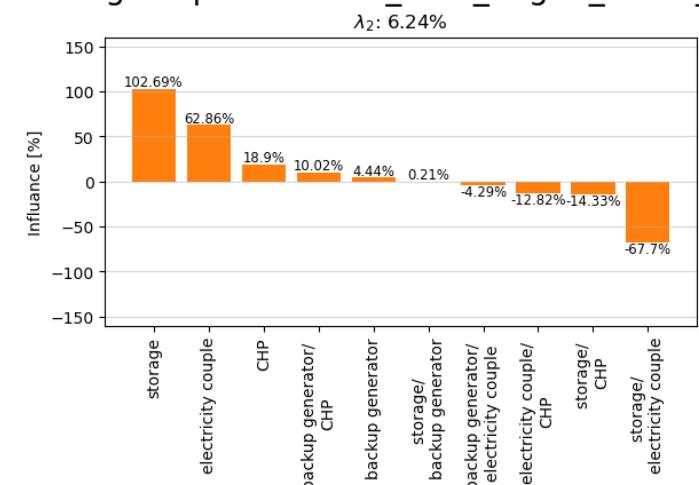
# Principle Component 2



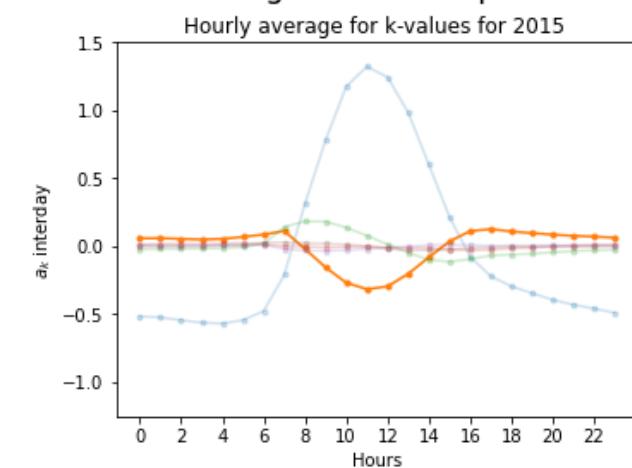
Heating Contribution - elec\_heat\_v2g50\_0.125\_0.05



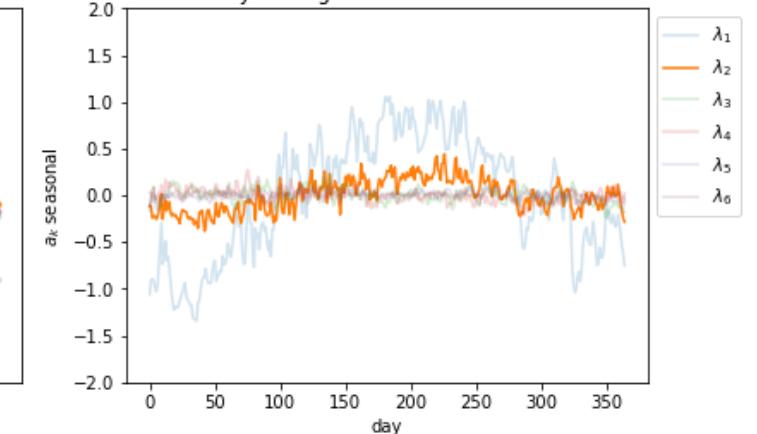
Heating Response - elec\_heat\_v2g50\_0.125\_0.05



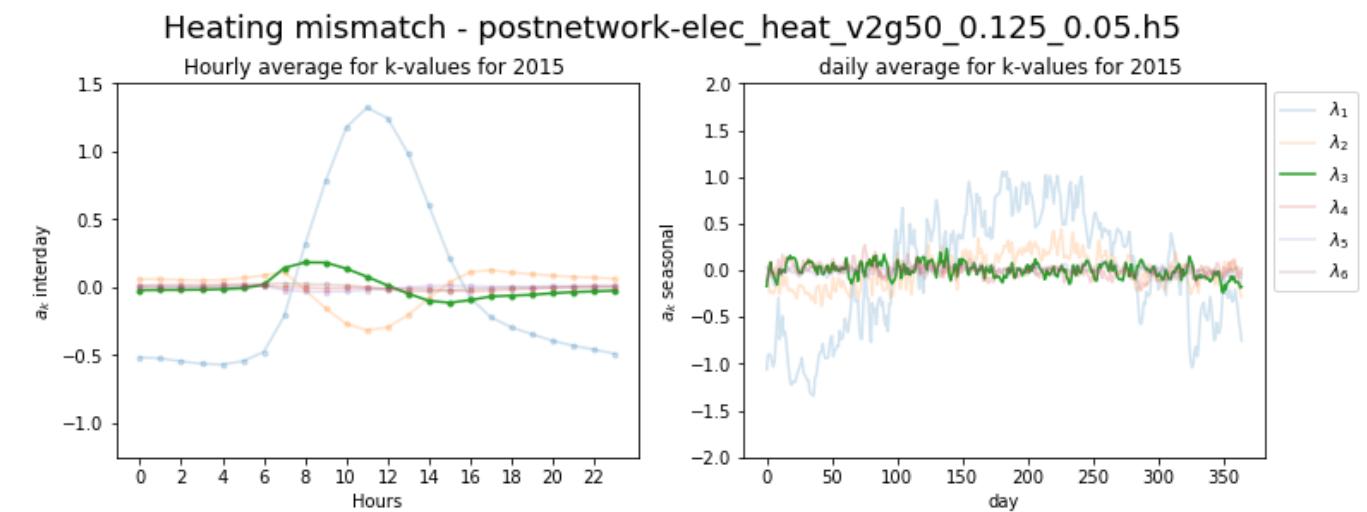
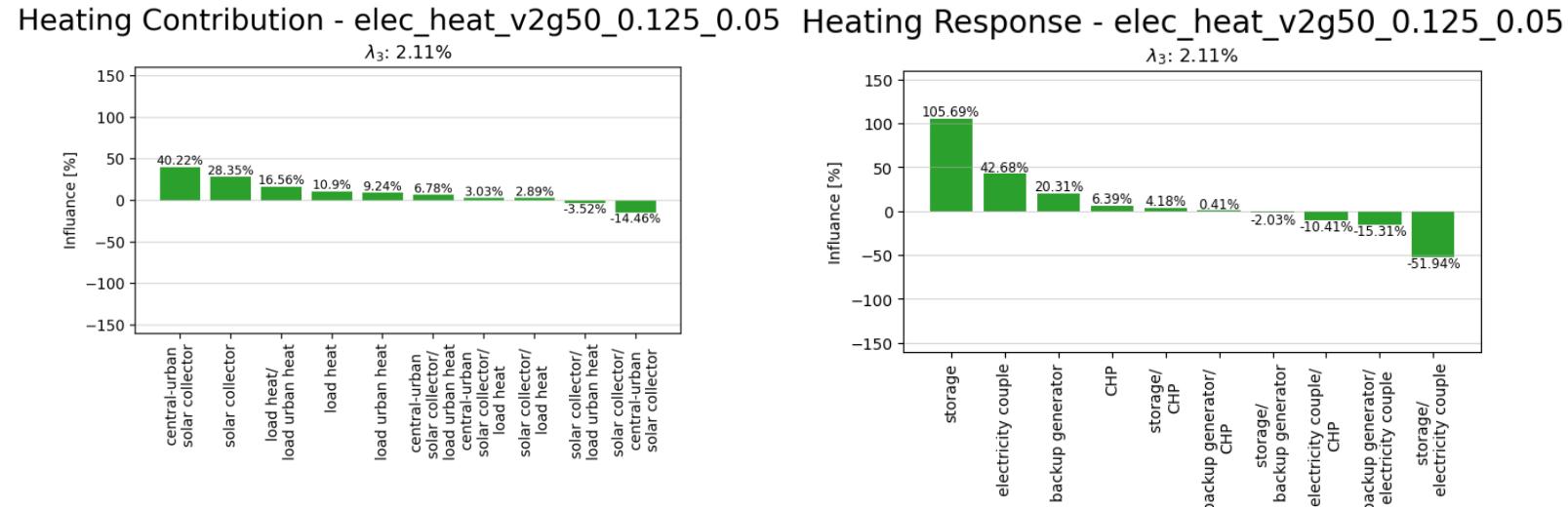
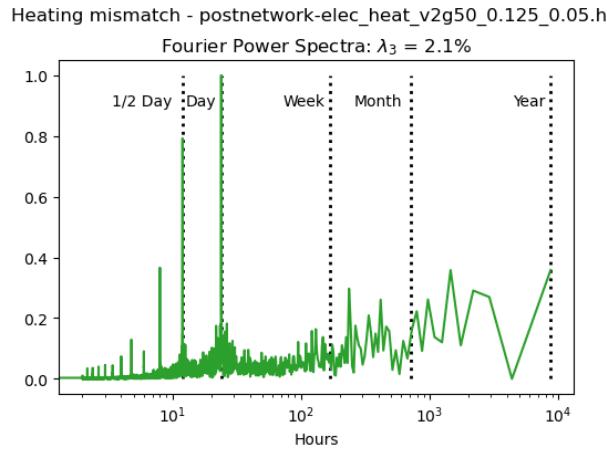
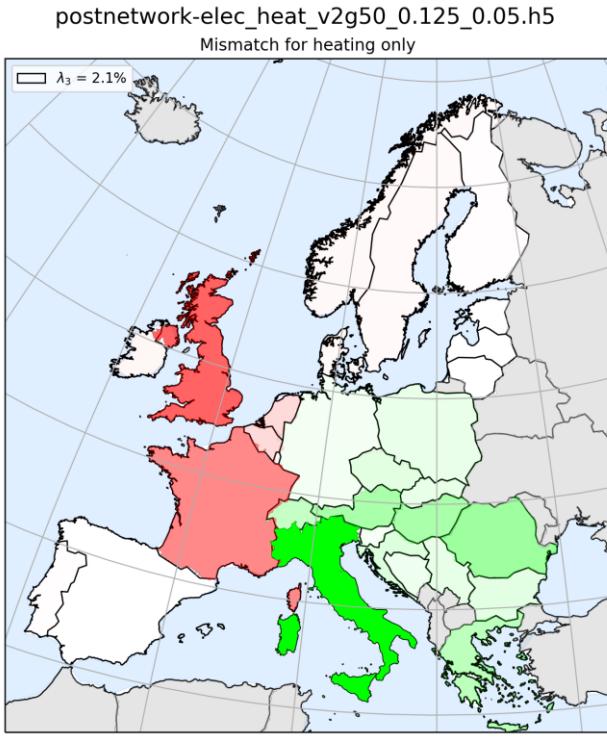
Heating mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5



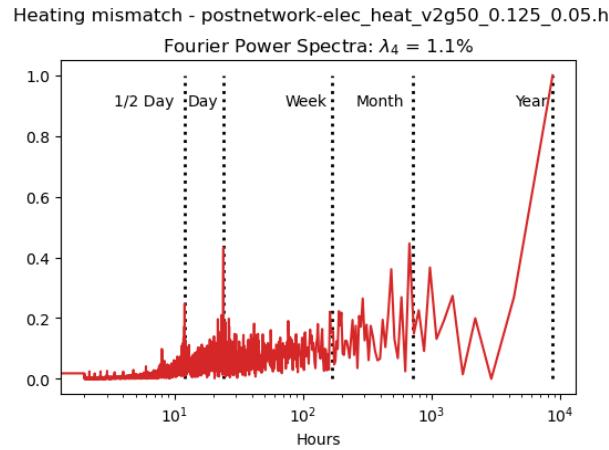
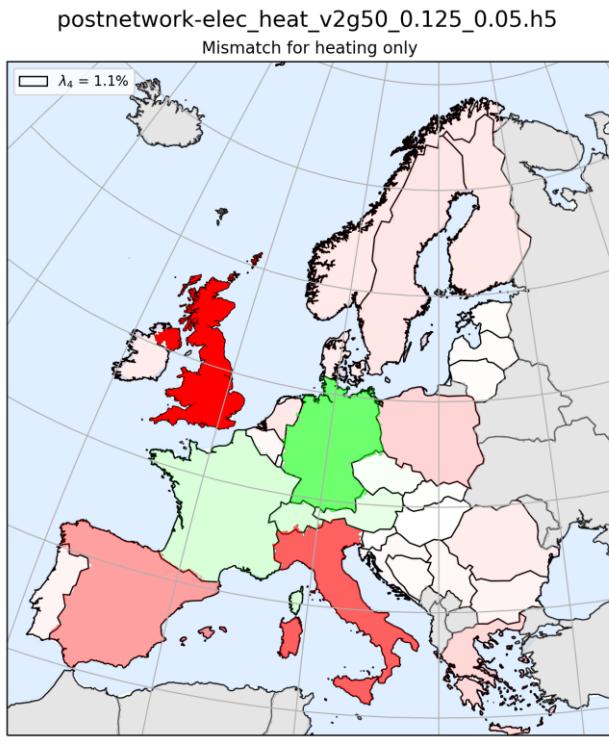
daily average for k-values for 2015



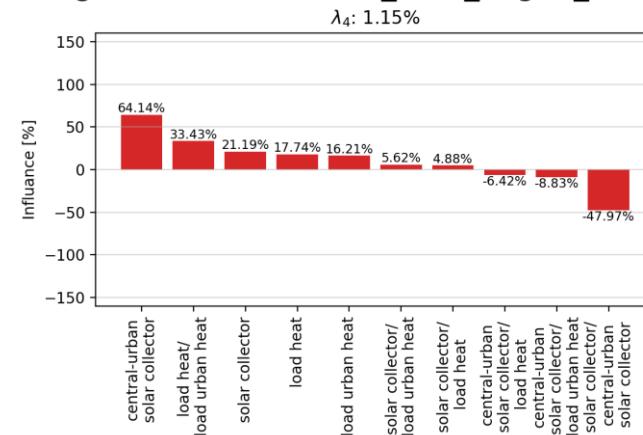
# Principle Component 3



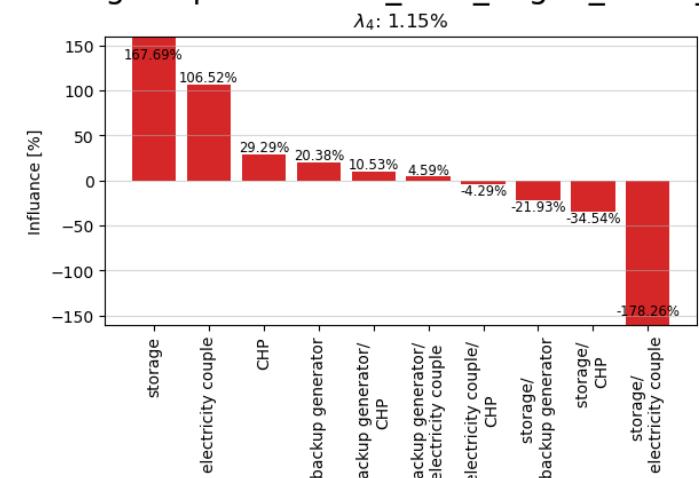
# Principle Component 4



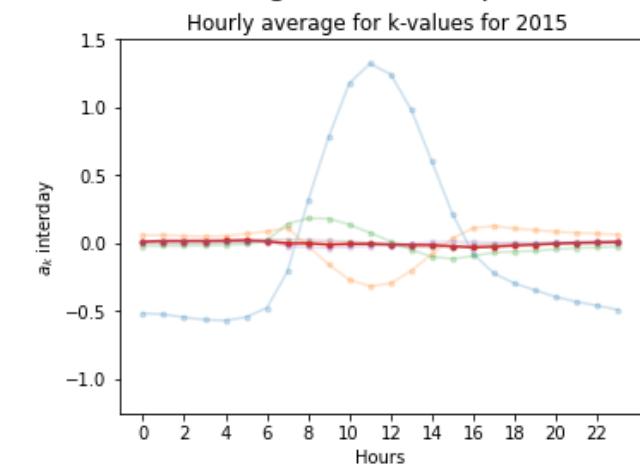
Heating Contribution - elec\_heat\_v2g50\_0.125\_0.05



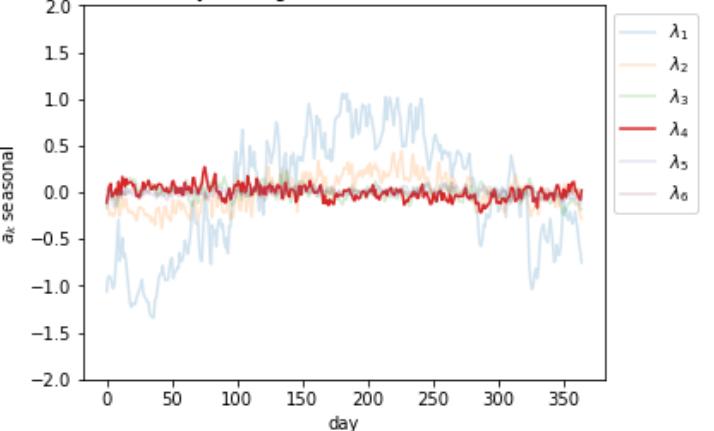
Heating Response - elec\_heat\_v2g50\_0.125\_0.05



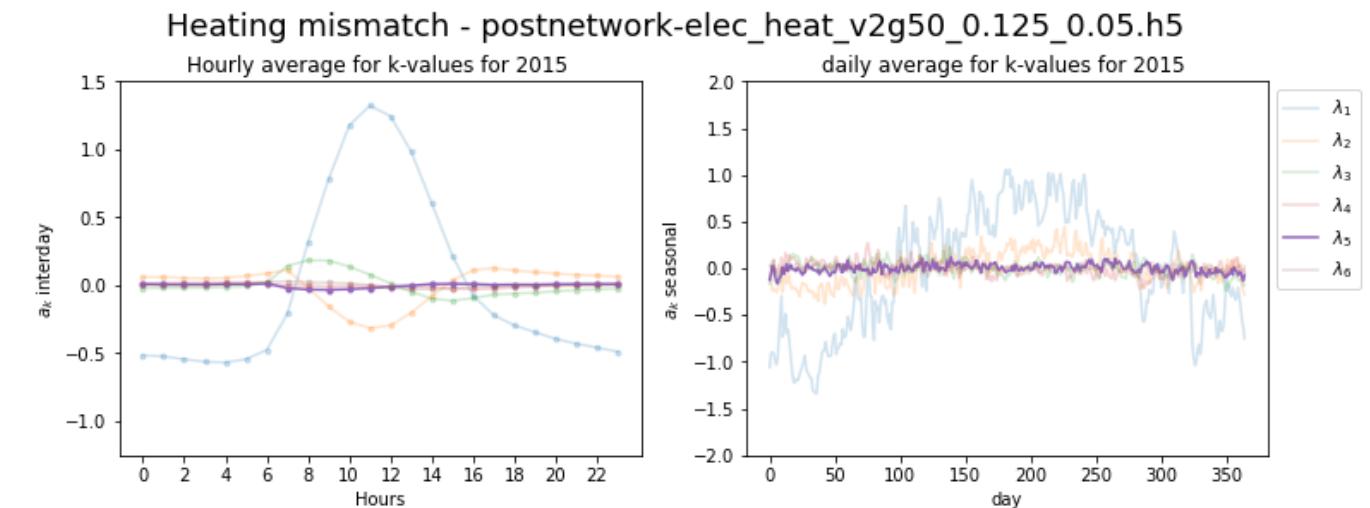
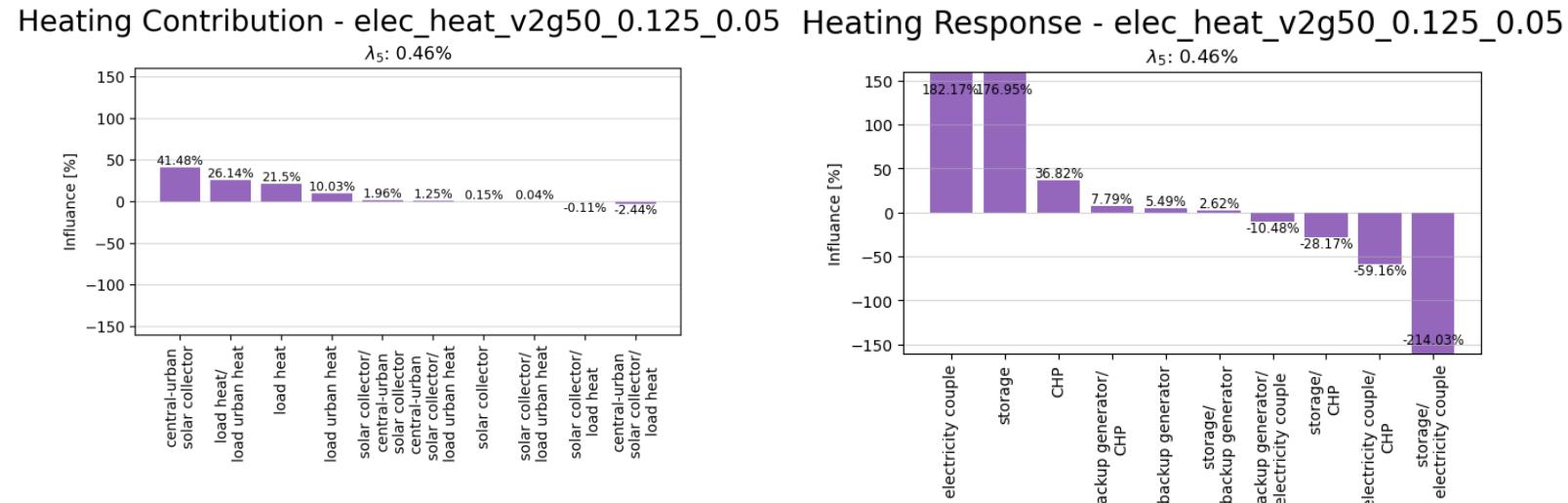
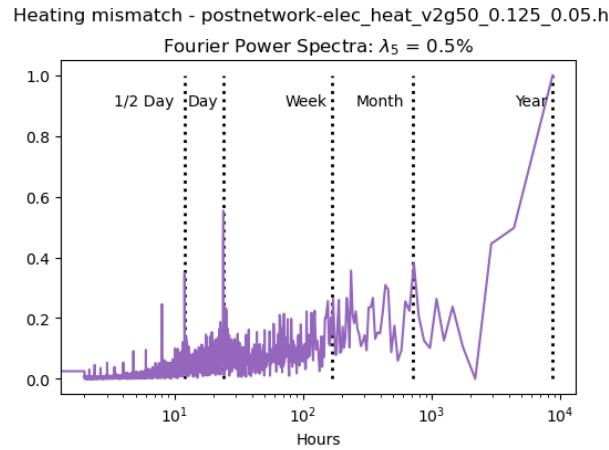
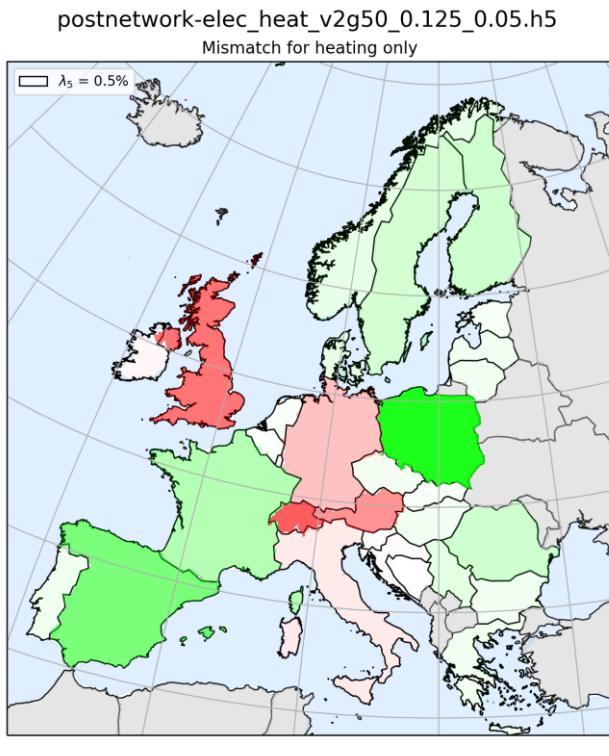
Heating mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5



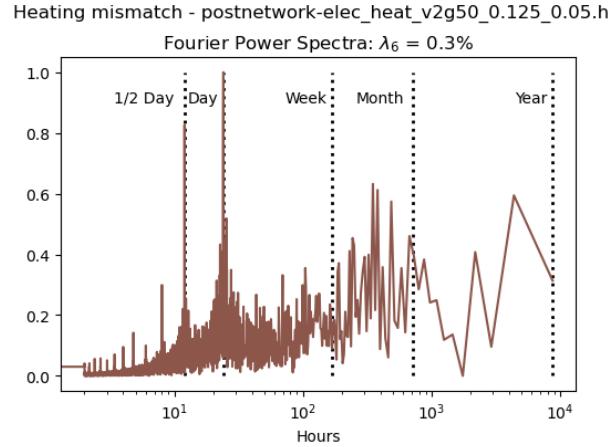
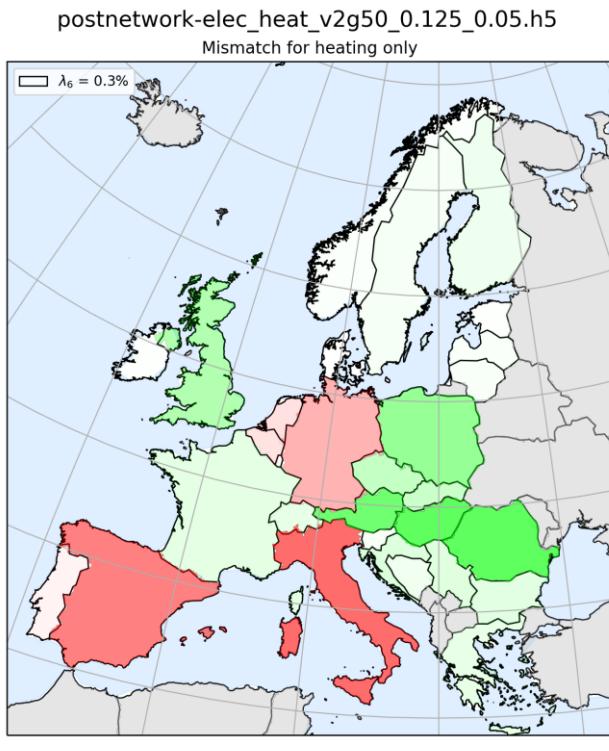
daily average for k-values for 2015



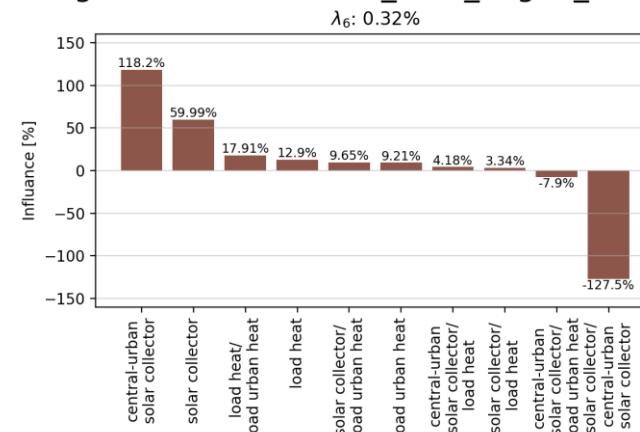
# Principle Component 5



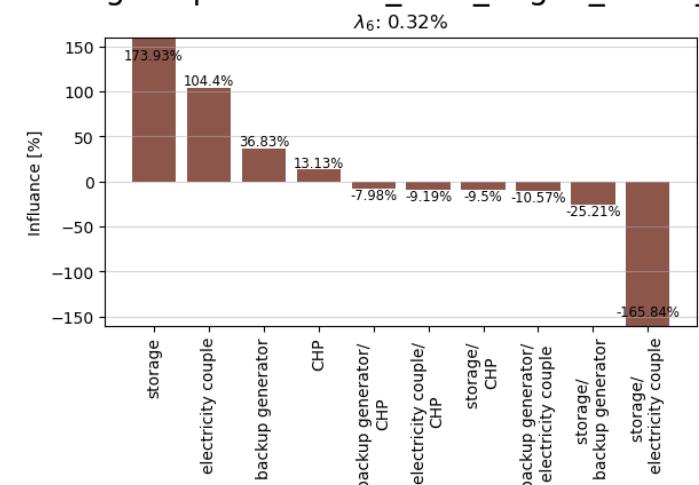
# Principle Component 6



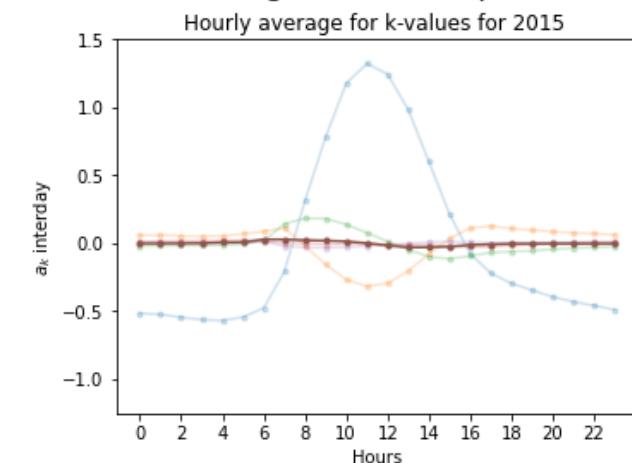
Heating Contribution - elec\_heat\_v2g50\_0.125\_0.05



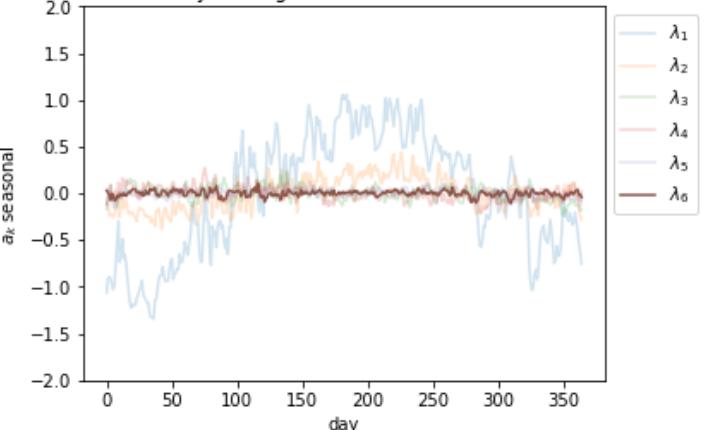
Heating Response - elec\_heat\_v2g50\_0.125\_0.05



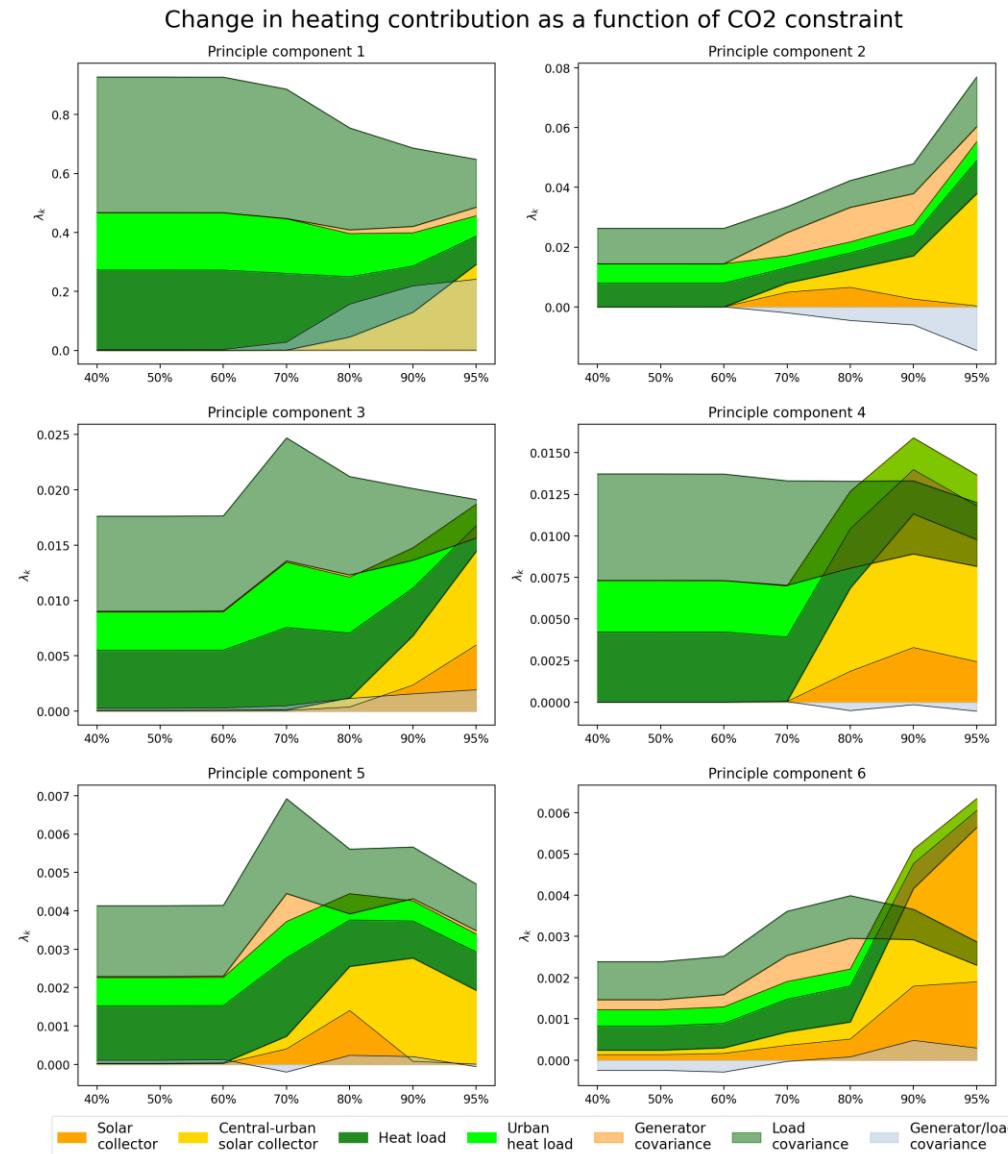
Heating mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5



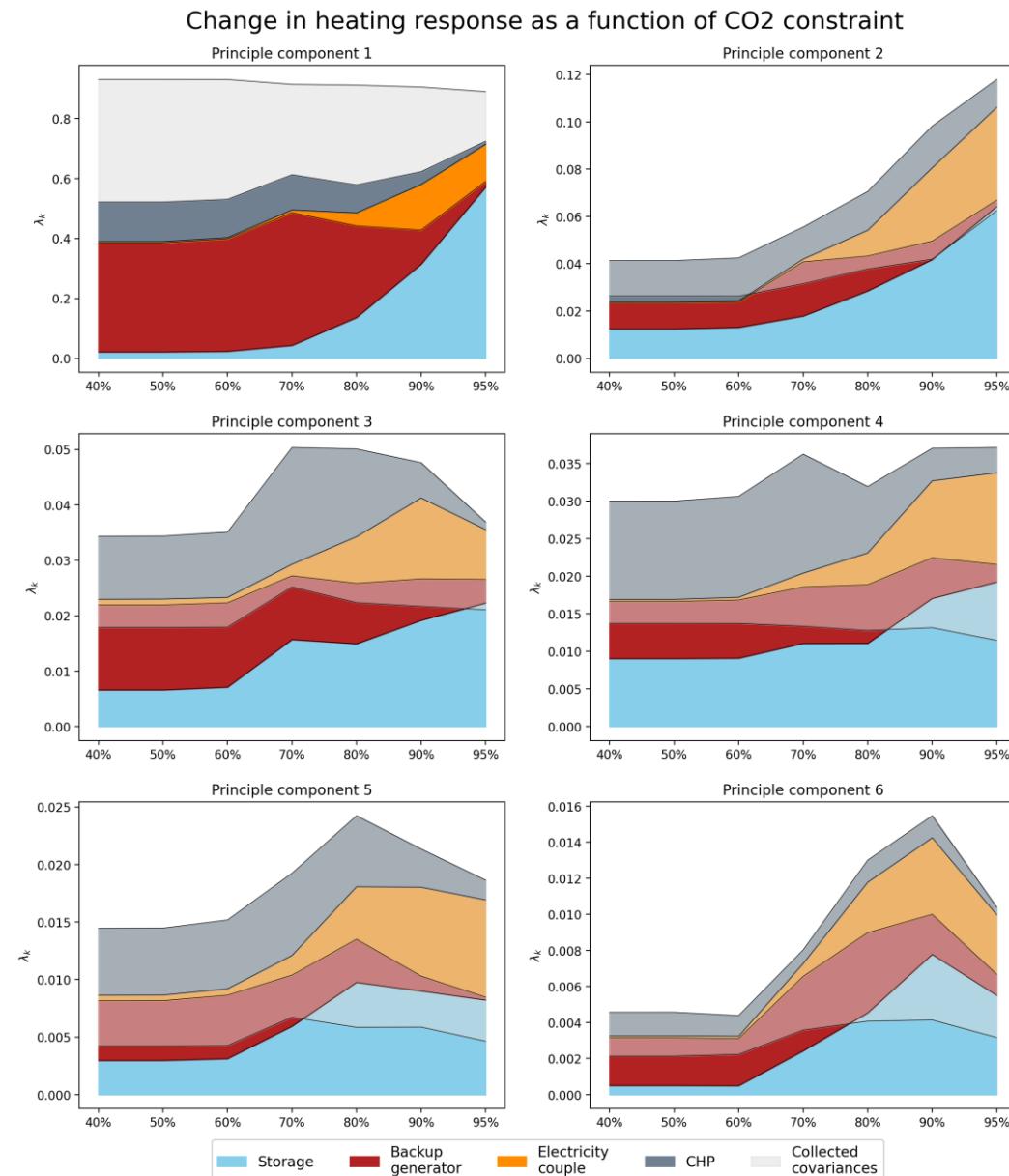
daily average for k-values for 2015



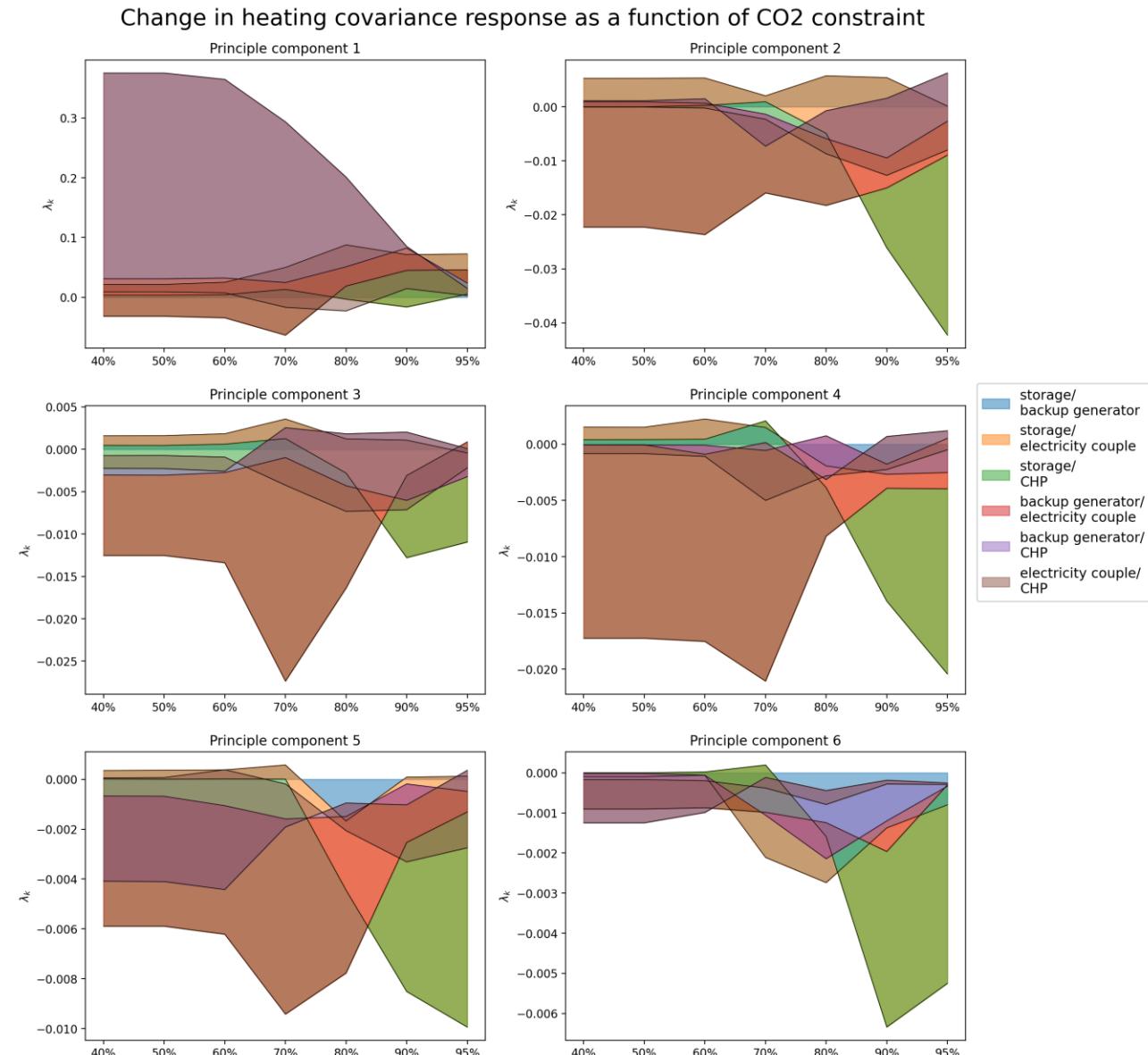
# Change in Contribution due to CO2 and Transmission Constraint



# Change in Reponse due to CO<sub>2</sub> and Transmission Constrain



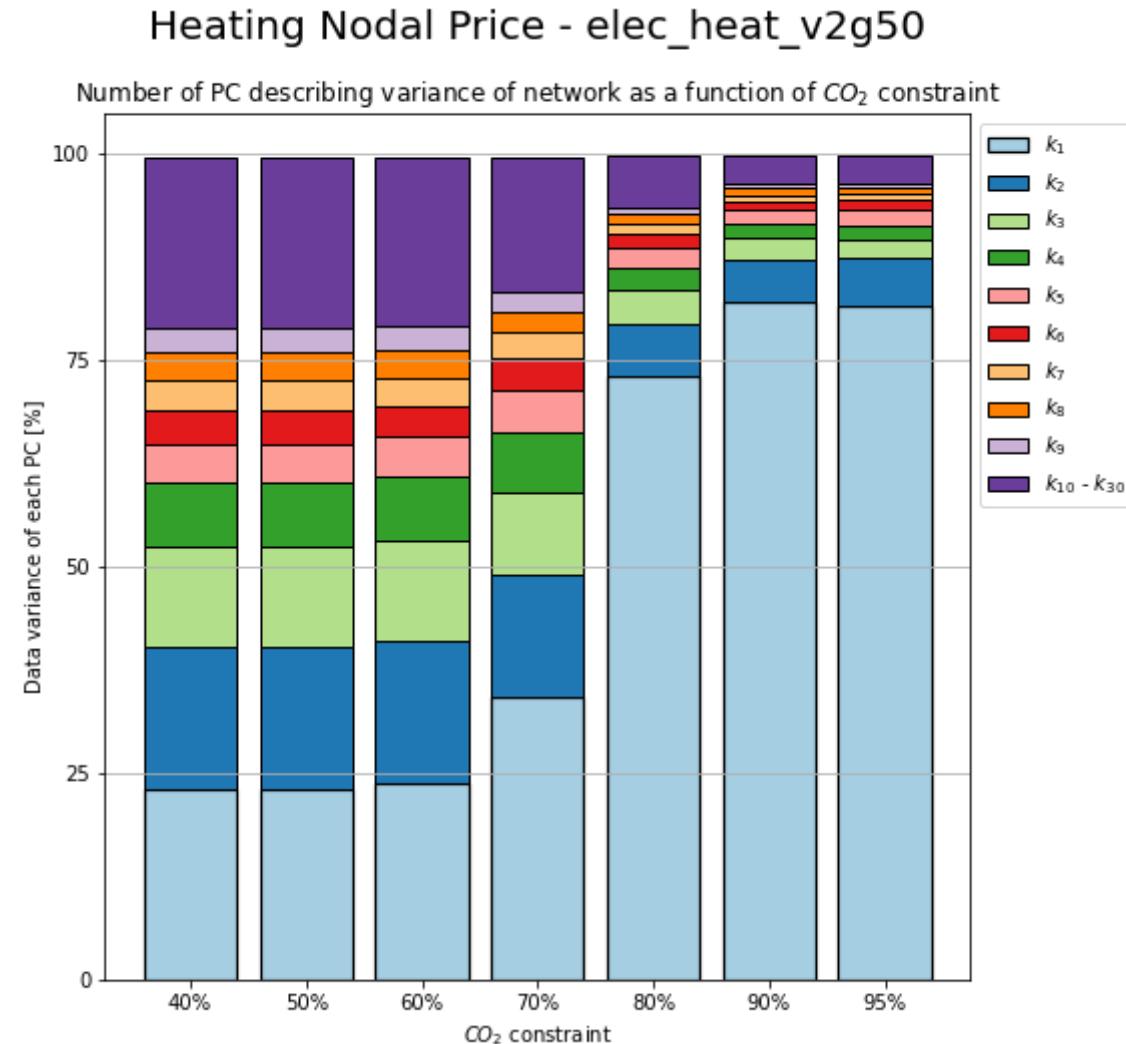
# Change in Cov Reponse due to CO2 and Transmission Constraint



# Electricity Coupled with the Heating and Transport Sector

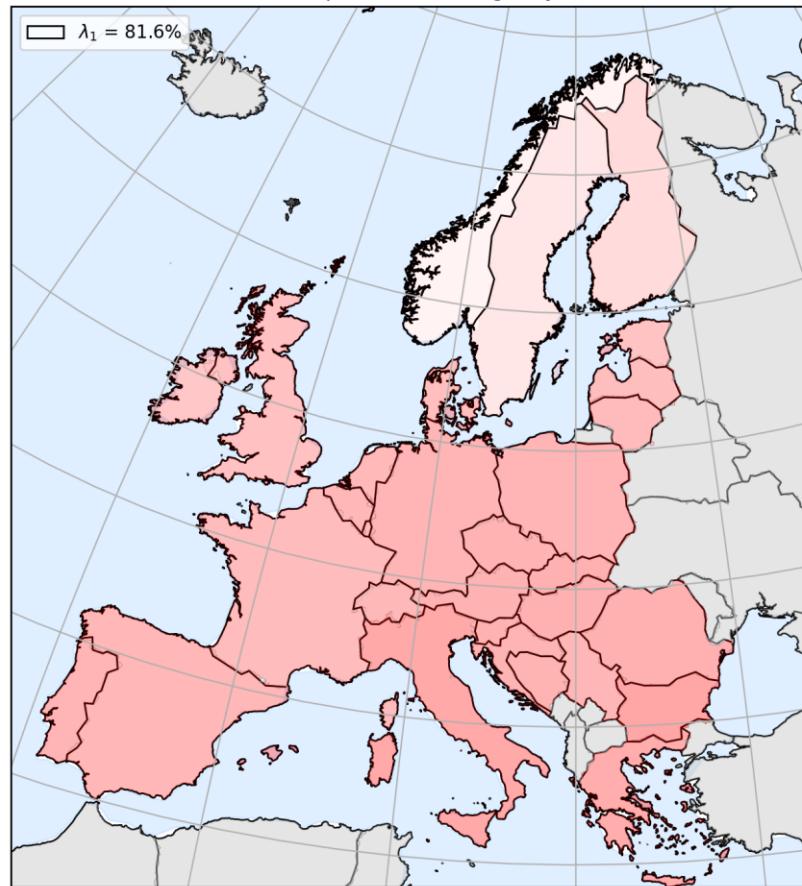
Heating NP Analysis

# Change in PC due to CO<sub>2</sub> and Transmission Constraint

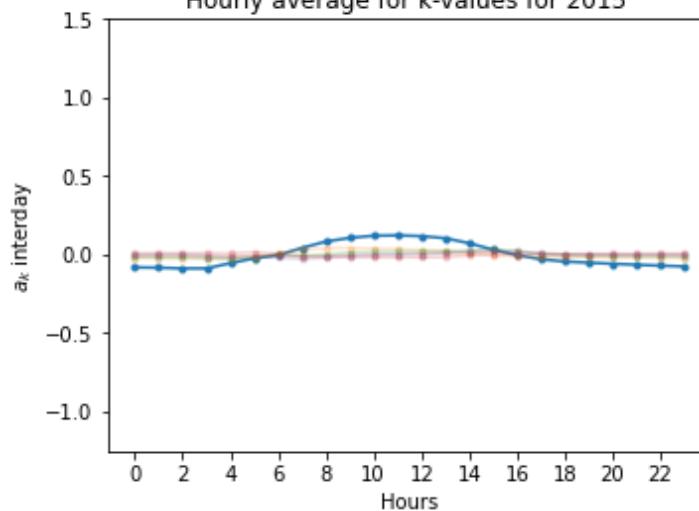


# Principle Component 1

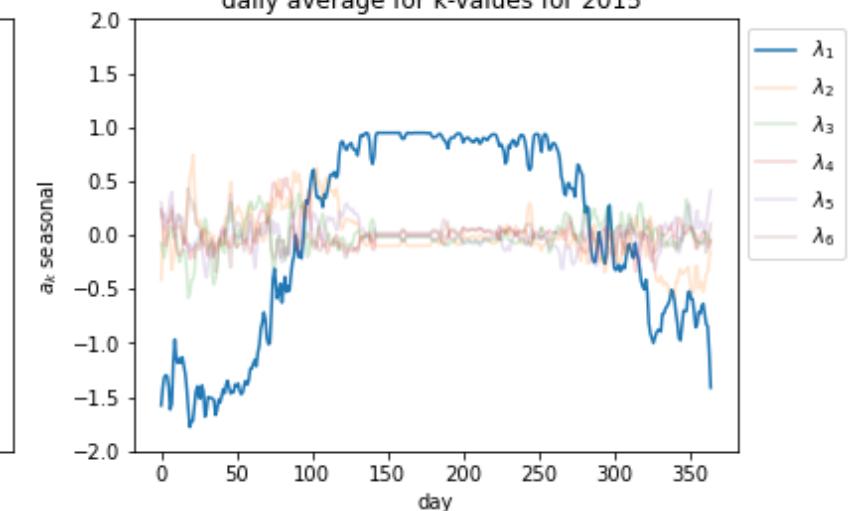
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for heating only



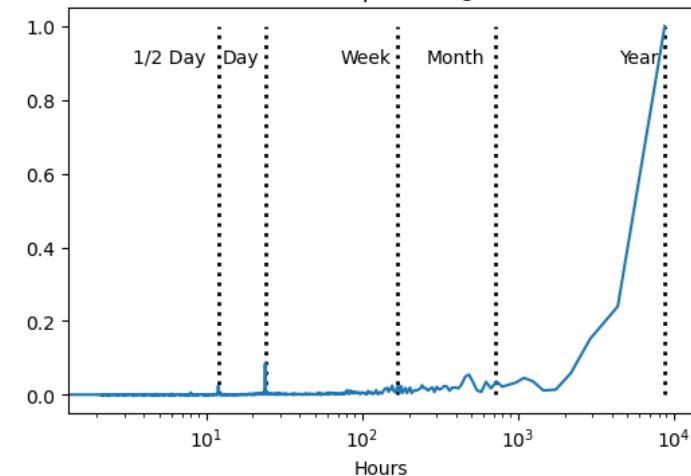
Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

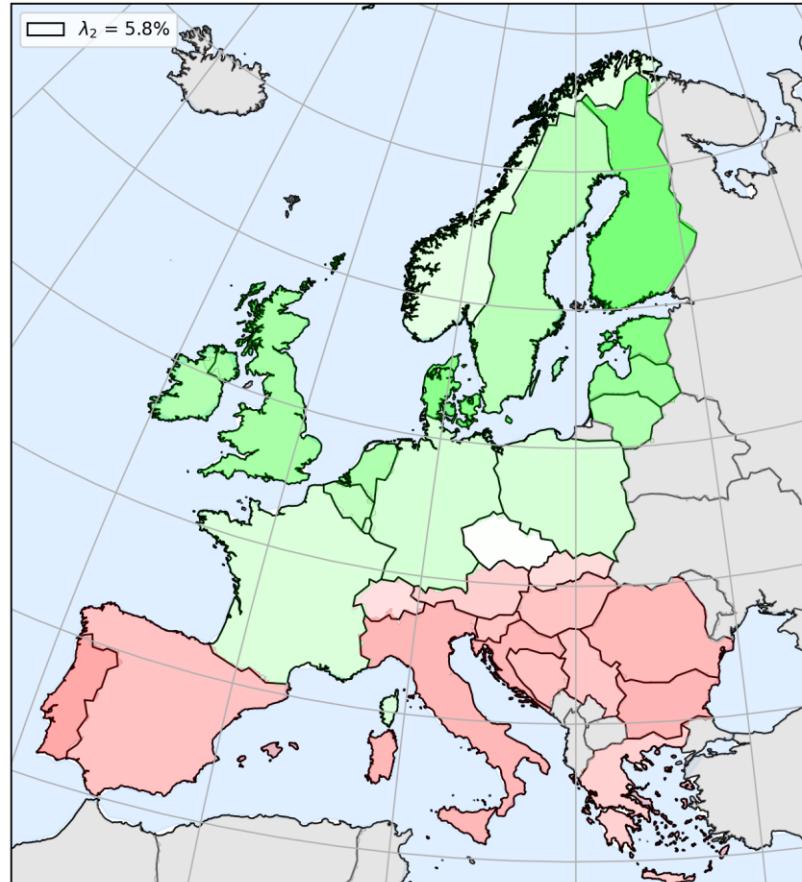


Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_1 = 81.6\%$

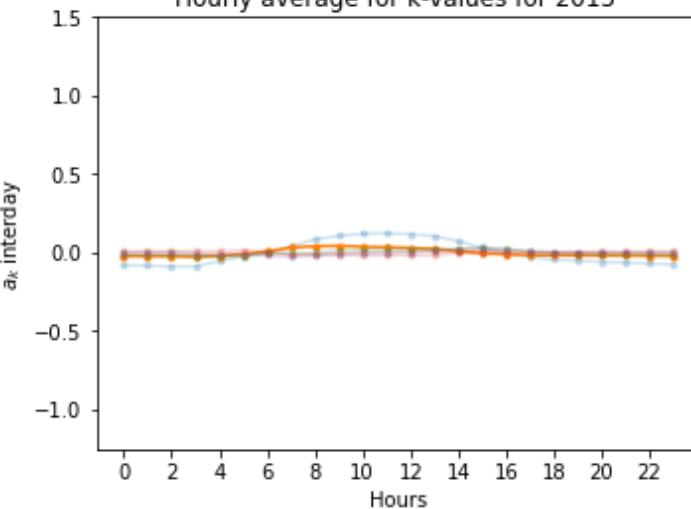


# Principle Component 2

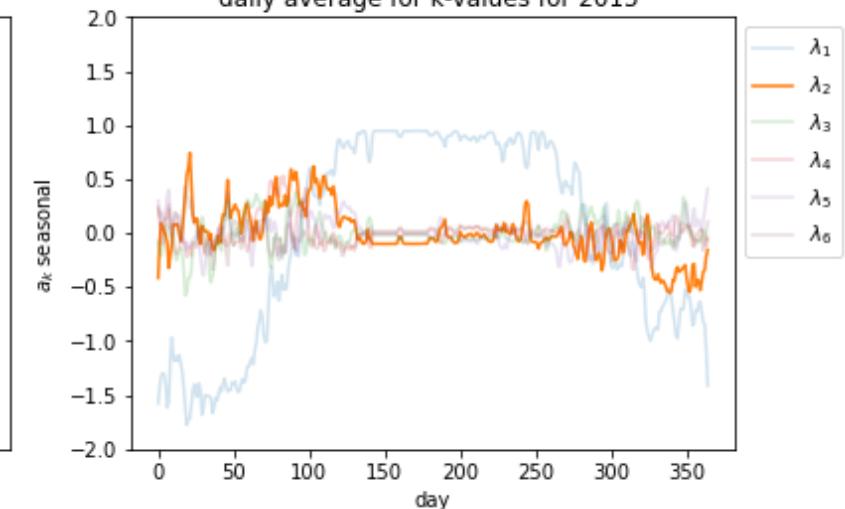
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for heating only



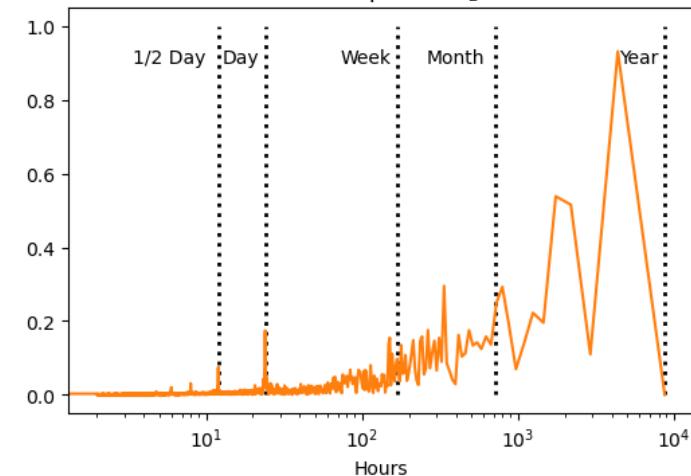
Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

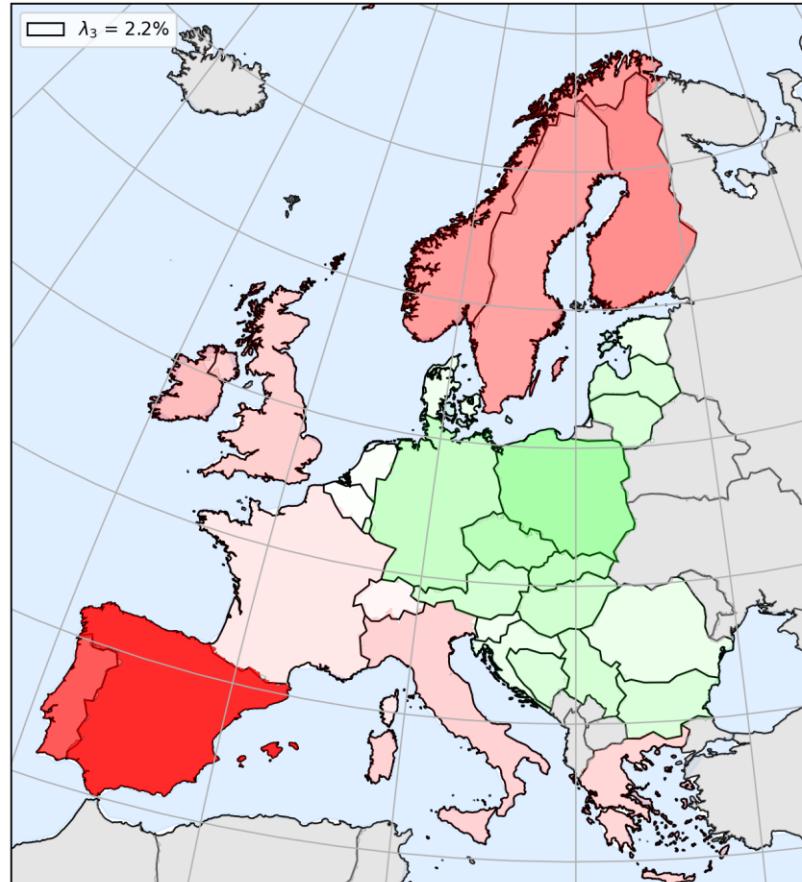


Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_2 = 5.8\%$

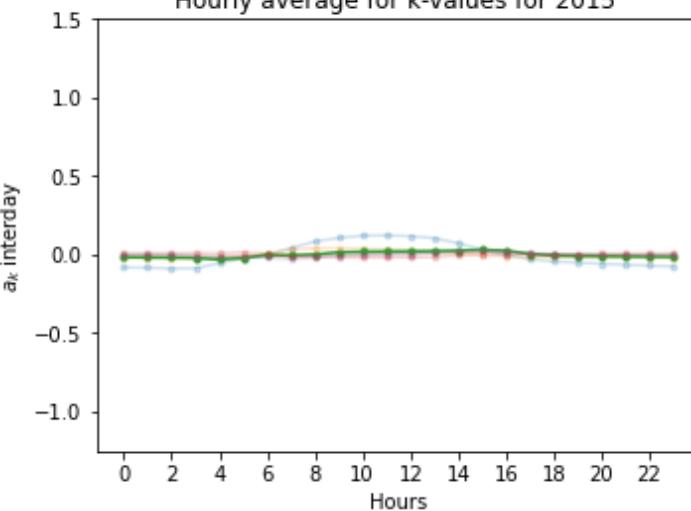


# Principle Component 3

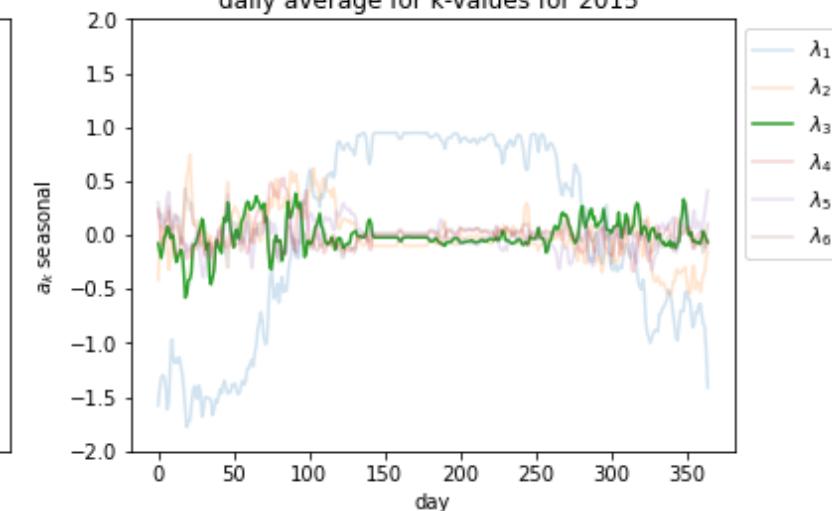
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for heating only



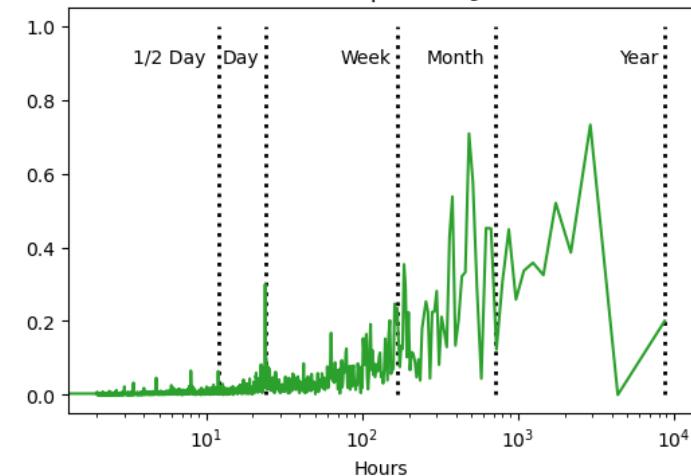
Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

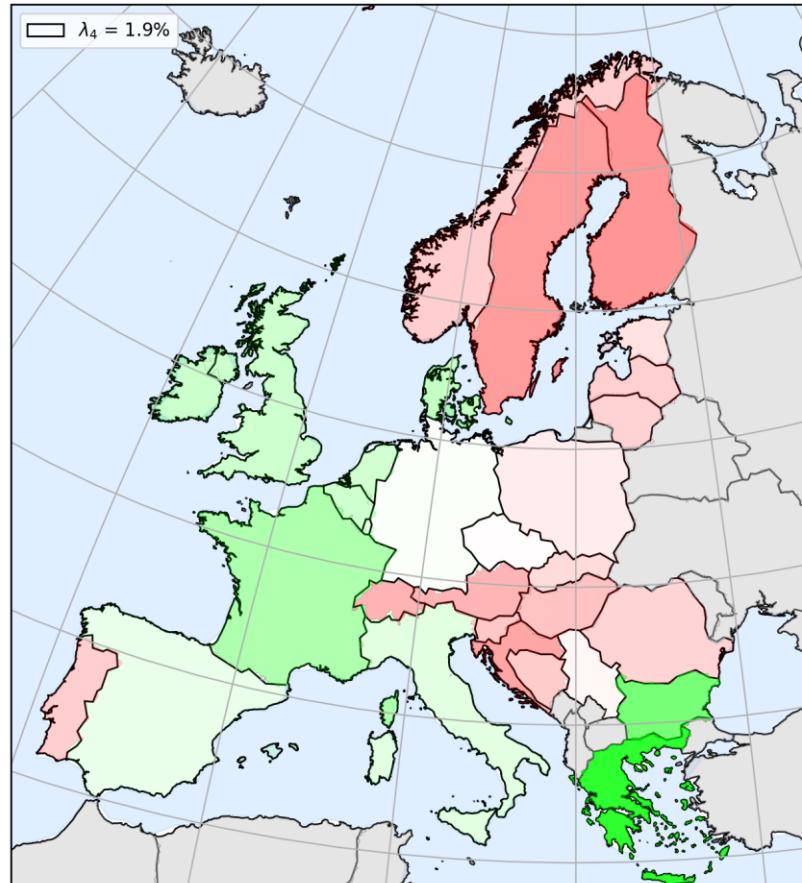


Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_3 = 2.2\%$

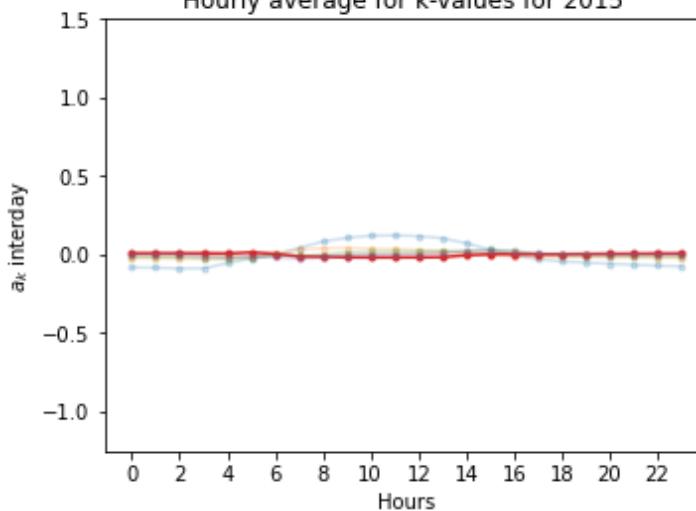


# Principle Component 4

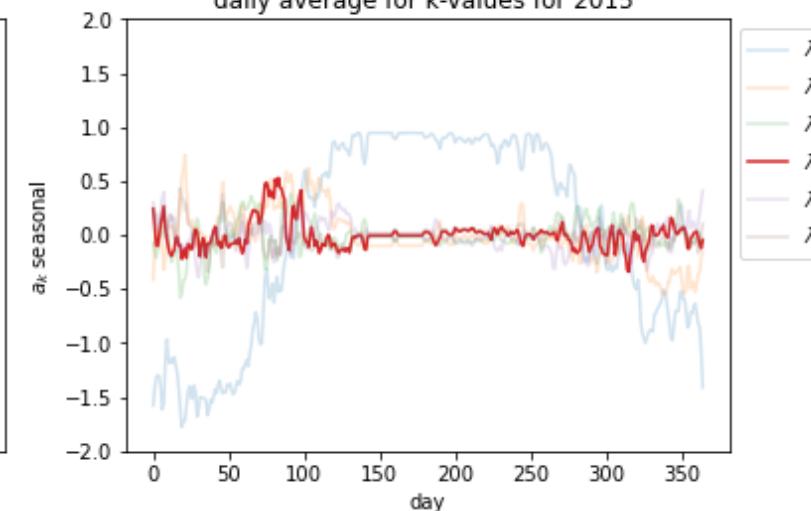
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for heating only



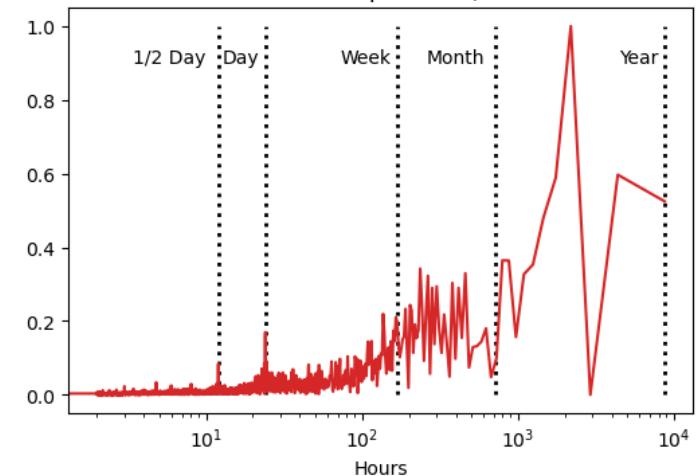
Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

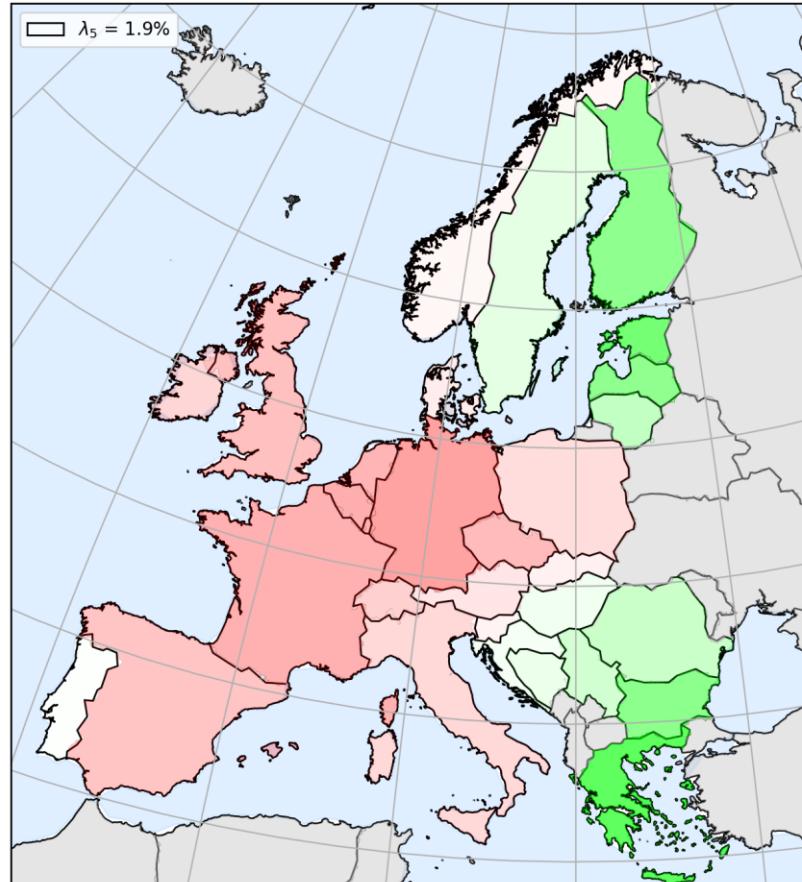


Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_4 = 1.9\%$

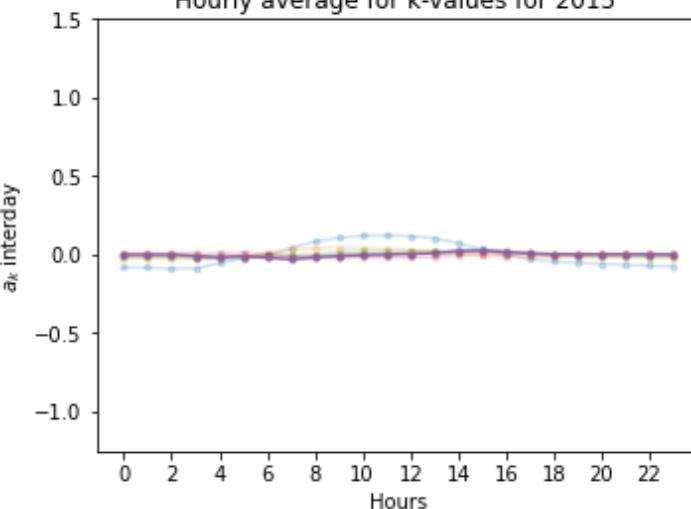


# Principle Component 5

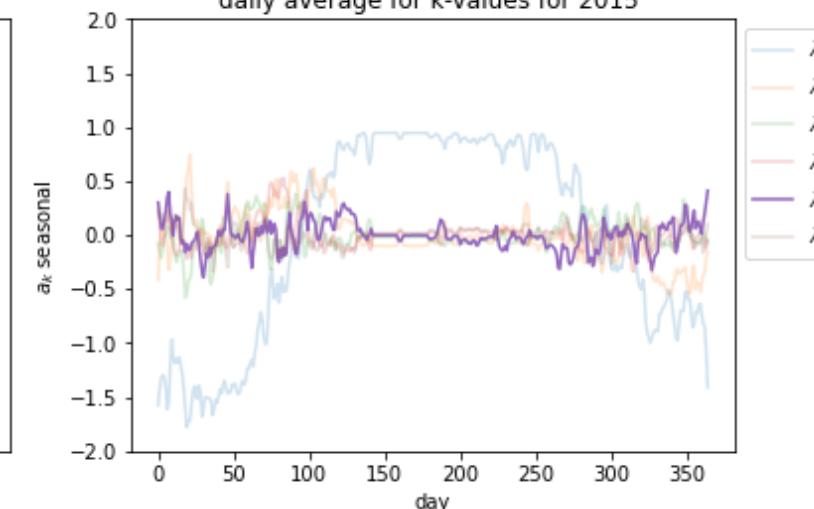
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for heating only



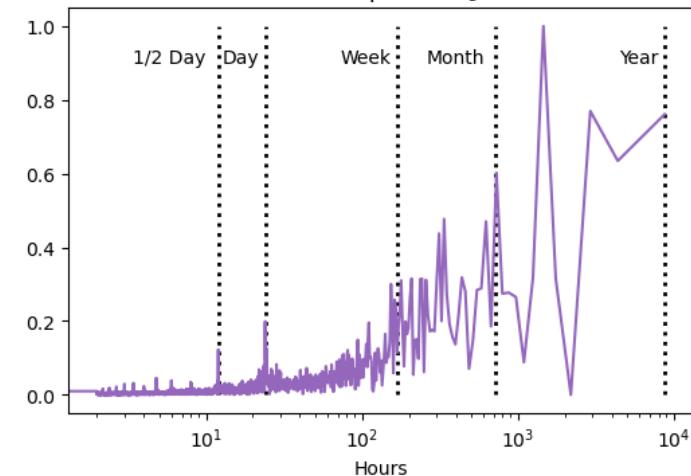
Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

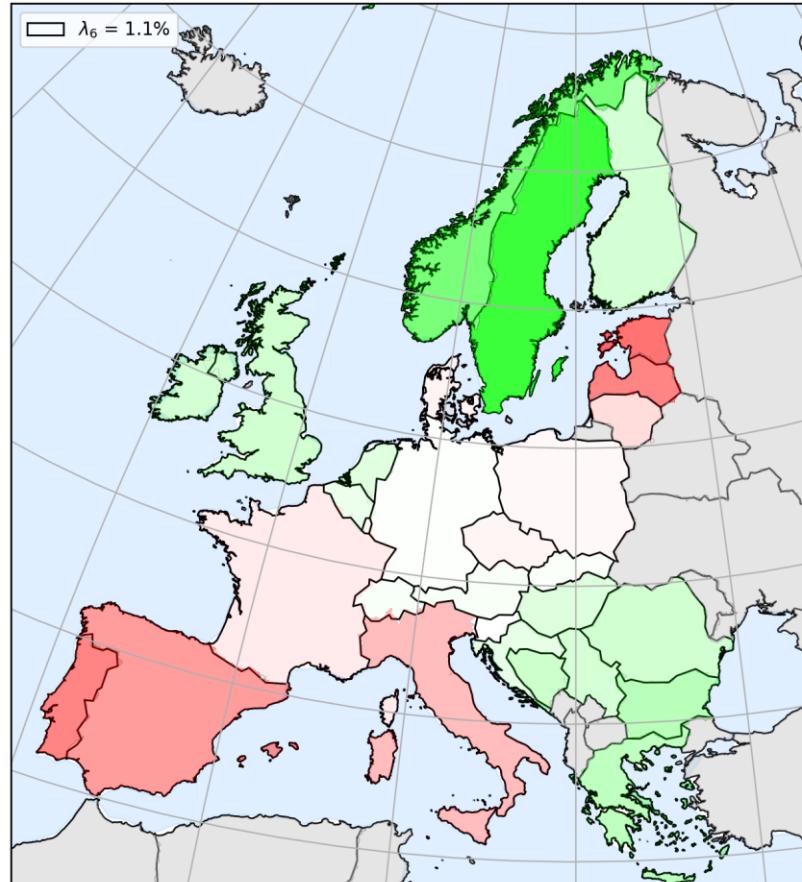


Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_5 = 1.9\%$

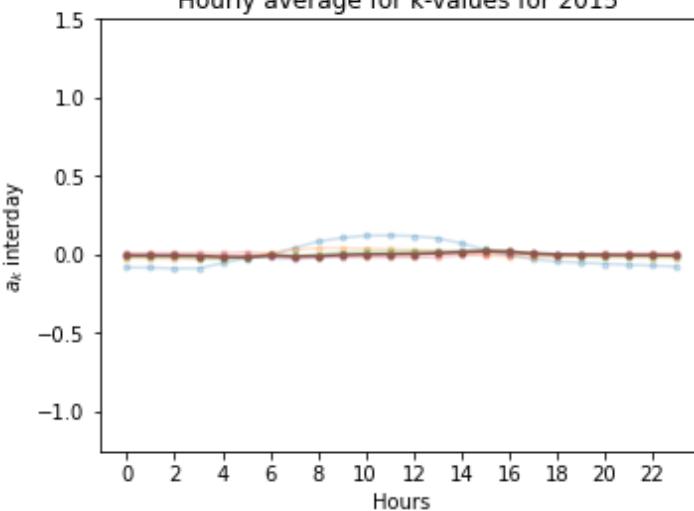


# Principle Component 6

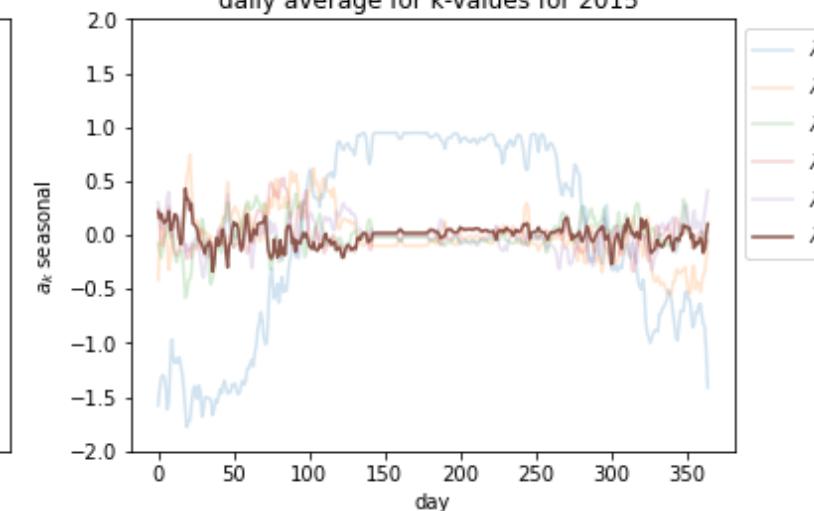
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for heating only



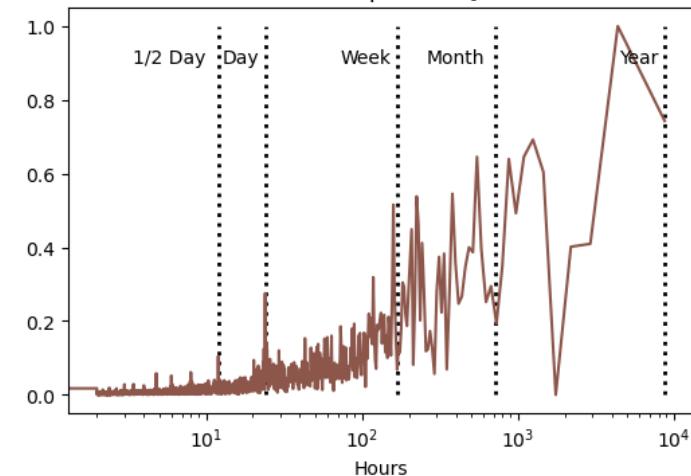
Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015



Heating Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_6 = 1.1\%$

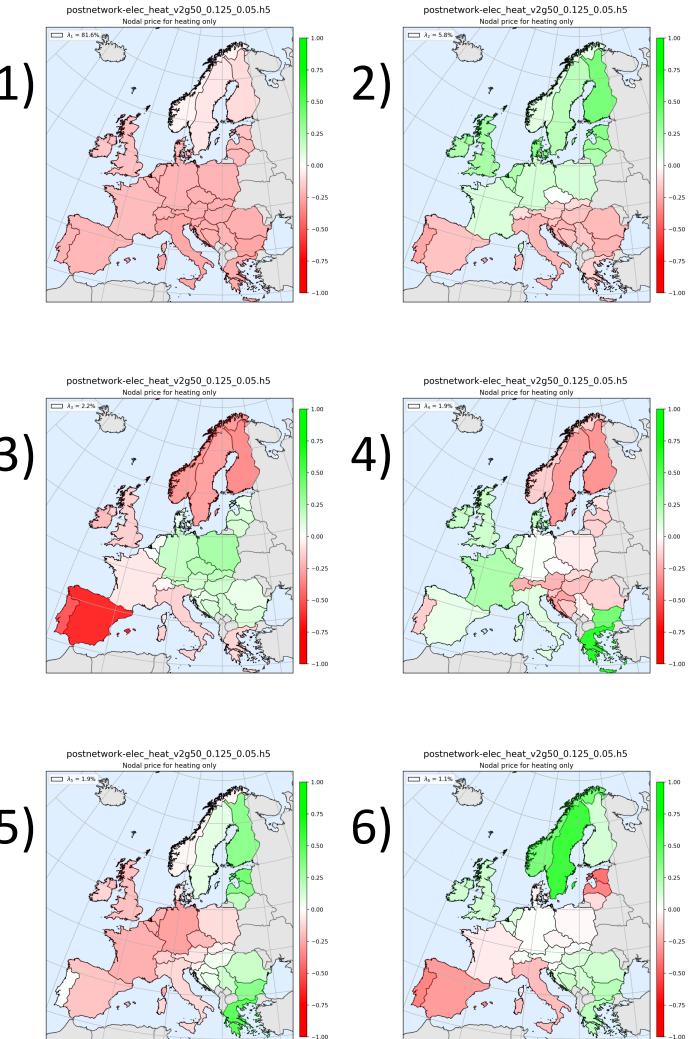


# Electricity Coupled with the Heating and Transport Sector

Heating Mismatch and NP Coherence

# Coherence Method 1

## Nodal Price

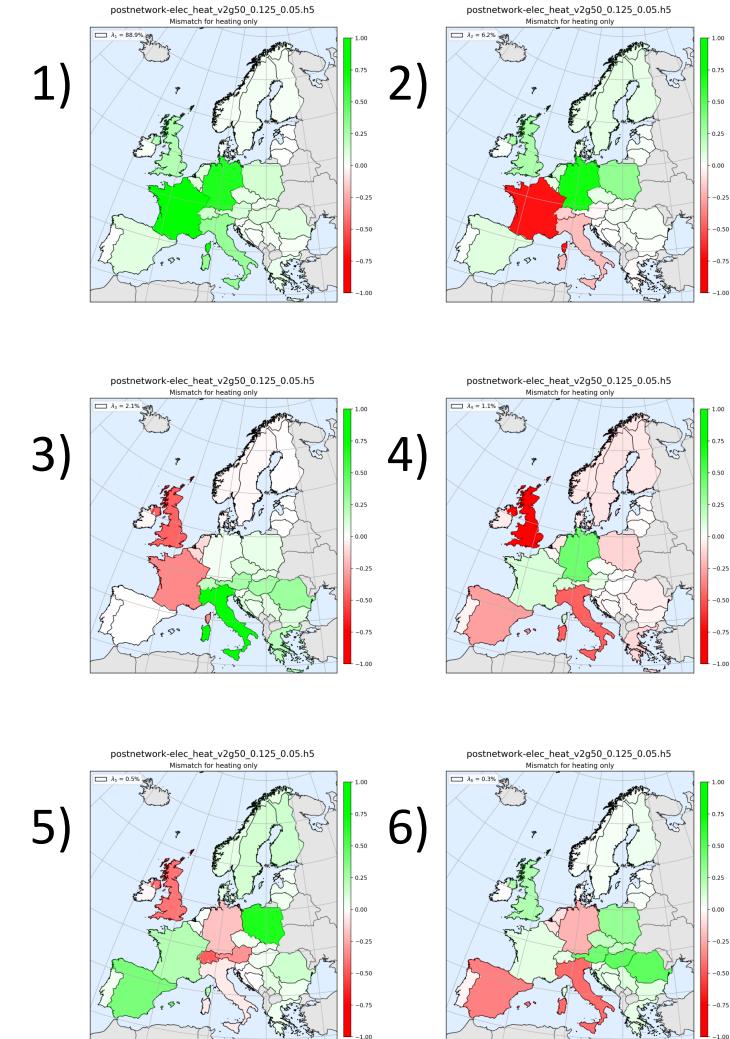


postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

Coherence 1: Heating mismatch and nodal price

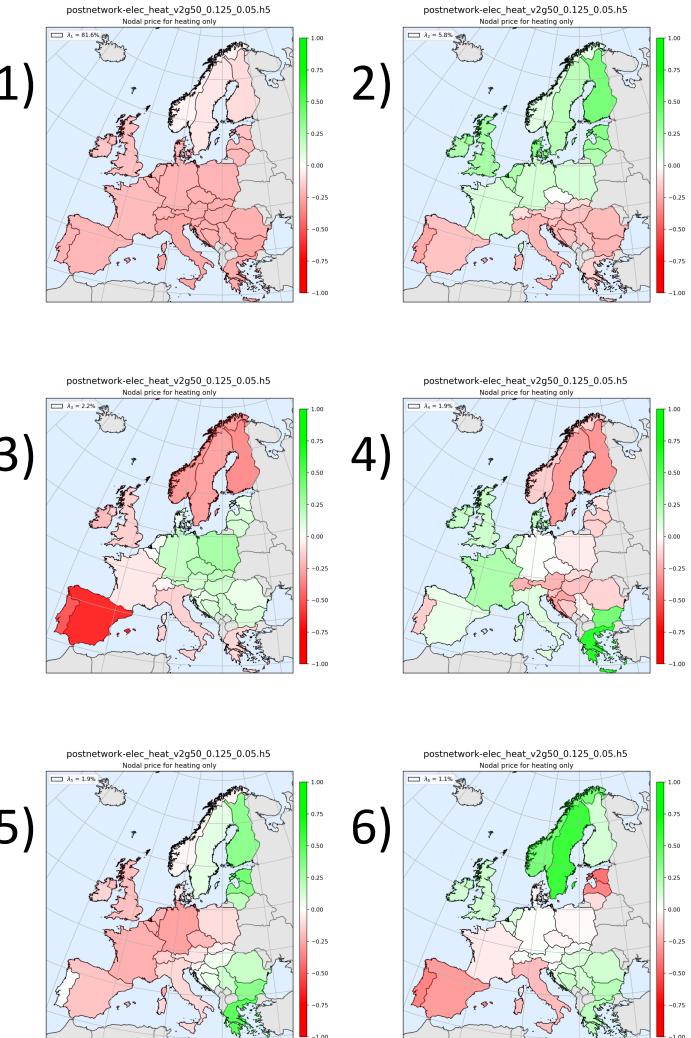
	PC1	PC2	Heat Mismatch	PC3	PC4	PC5	PC6	
PC1	0.532	0.151	0.3	0.254	0.105	0.283		1
PC2	0.107	0.207	0.484	0.068	0.065	0.069		
PC3	0.009	0.115	0.109	0.376	0.119	0.406		
PC4	0.154	0.118	0.146	0.171	0.056	0.247		
PC5	0.378	0.085	0.19	0.01	0.141	0.189		
PC6	0.01	0.125	0.065	0.039	0.062	0.312		

## Mismatch



# Coherence Method 2

## Nodal Price

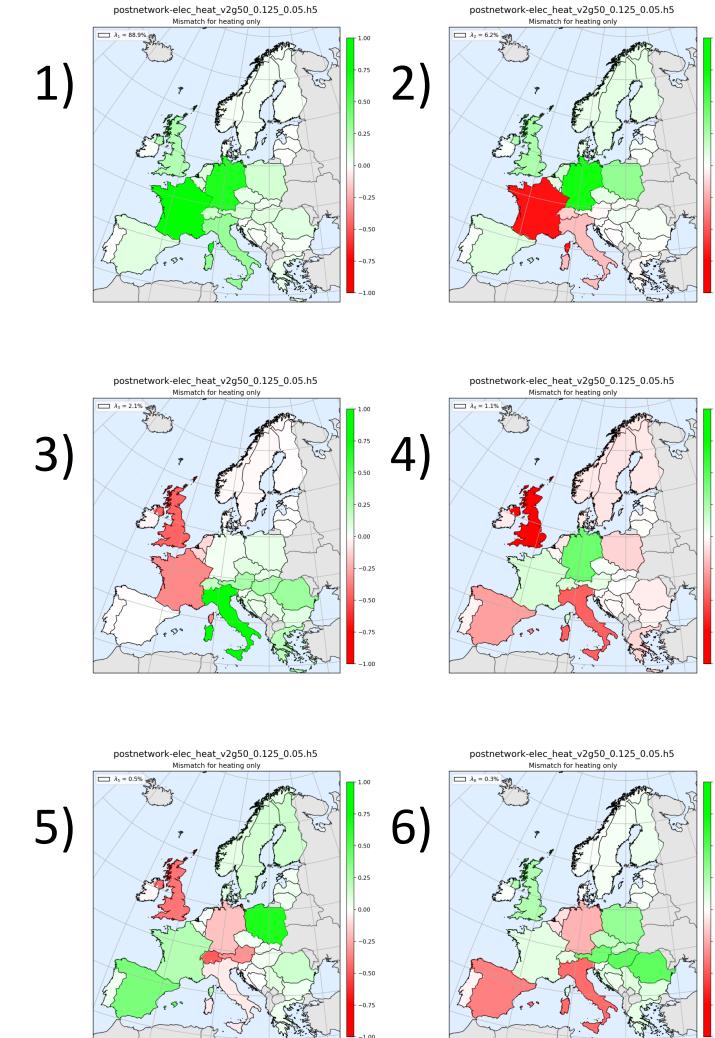


postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

Coherence 2: Heating mismatch and nodal price

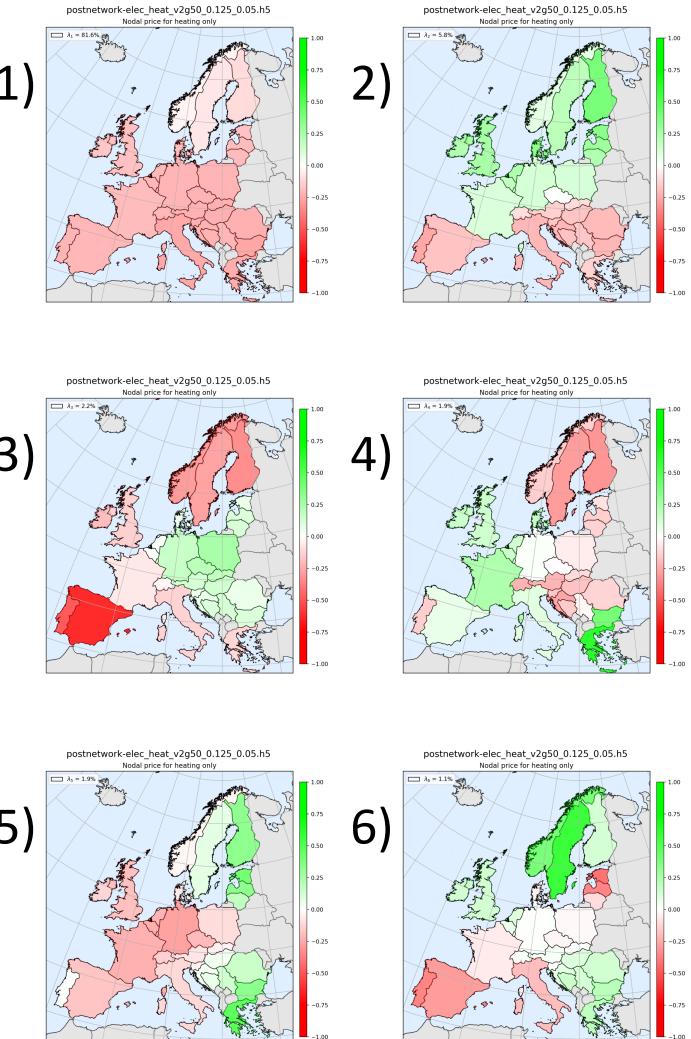
	PC1	PC2	Heat Mismatch	PC3	PC4	PC5	PC6	
PC1	0.453	0.034	0.039	0.025	0.006	0.014		1
PC2	0.024	0.012	0.017	0.002	0.001	0.001		
PC3	0.001	0.004	0.002	0.006	0.001	0.003		
PC4	0.02	0.004	0.003	0.003	0.001	0.002		
PC5	0.049	0.003	0.004	0.0	0.001	0.001		
PC6	0.001	0.003	0.001	0.0	0.0	0.002		

## Mismatch



# Coherence Method 3

## Nodal Price

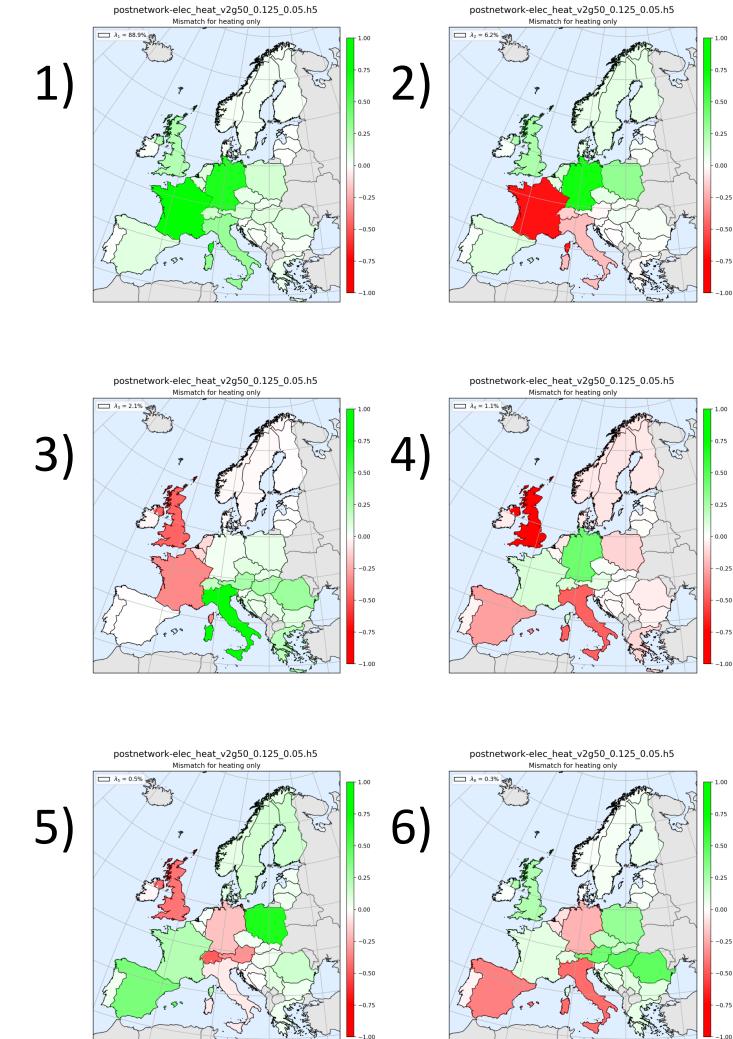


postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

Coherence 3: Heating mismatch and nodal price

	PC1	PC2	Heat Mismatch				
PC1	0.667	0.491	0.066	-0.177	0.294	-0.01	
PC2	-0.003	-0.168	0.319	0.158	0.148	0.038	
PC3	0.041	-0.137	-0.081	-0.238	0.007	-0.205	
PC4	-0.022	0.048	-0.088	0.141	-0.075	0.071	
PC5	0.068	-0.015	-0.216	0.14	-0.215	-0.189	
PC6	0.082	0.03	-0.068	-0.07	0.065	-0.089	

## Mismatch

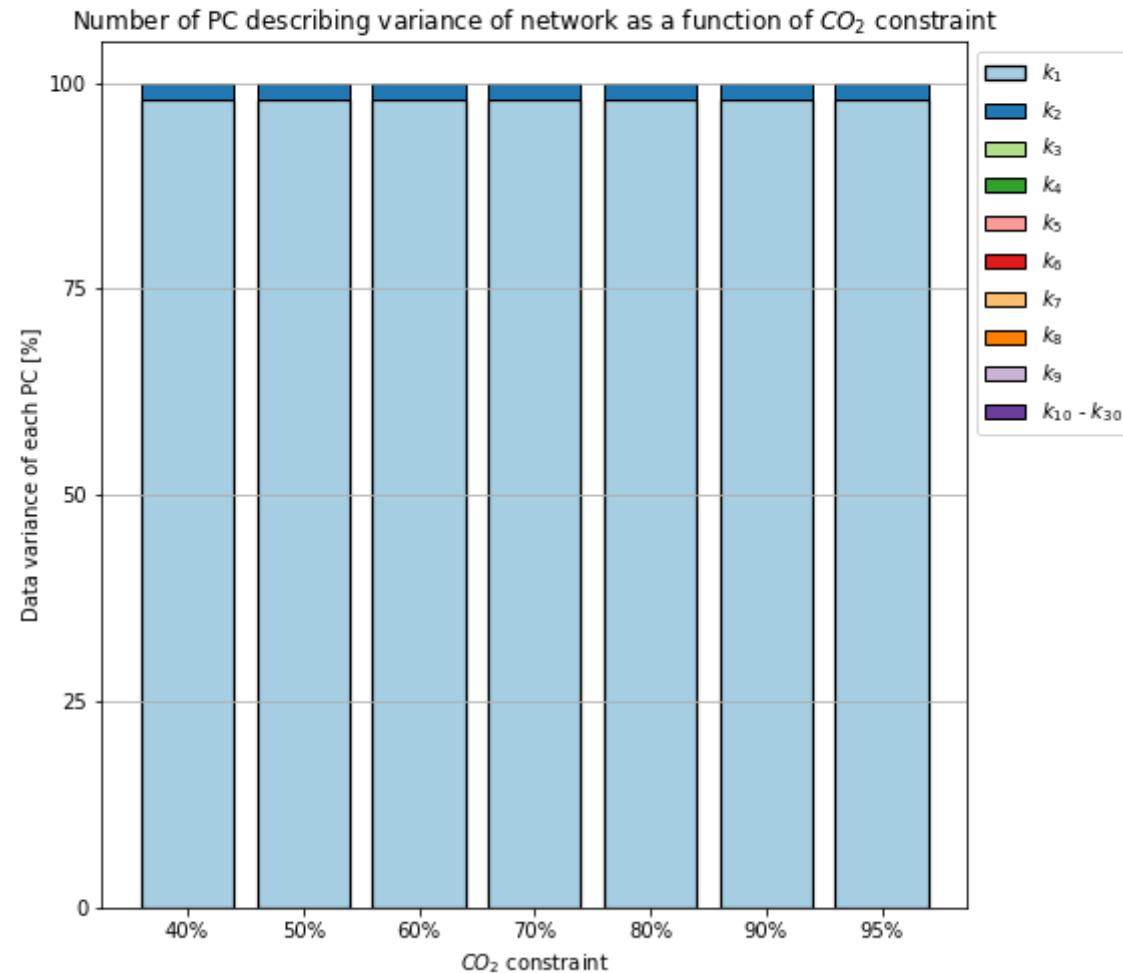


# Electricity Coupled with the Heating and Transport Sector

Transport Mismatch Analysis

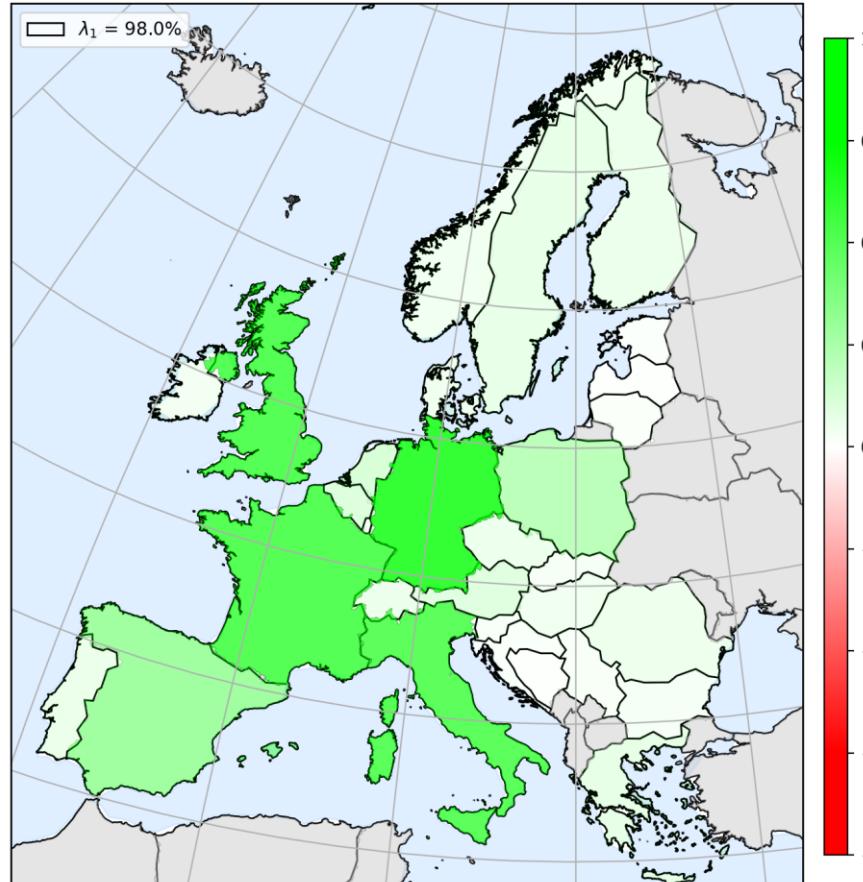
# Change in PC due to CO<sub>2</sub> Constraint

Transport Mismatch - elec\_heat\_v2g50

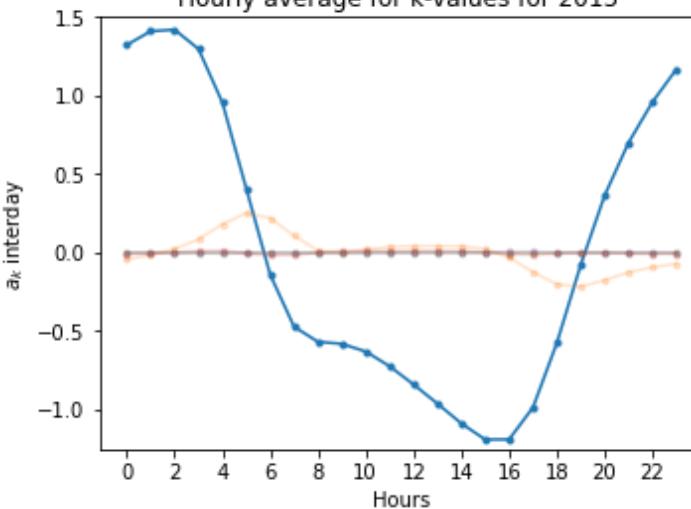


# Principle Component 1

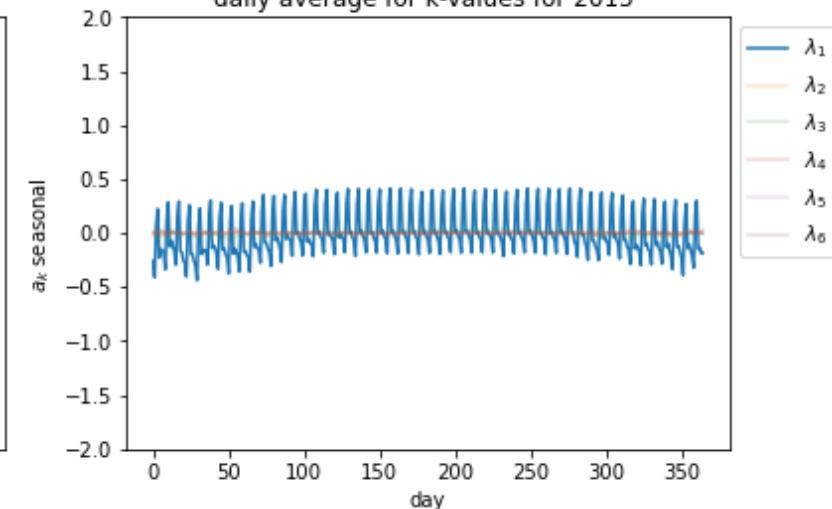
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Mismatch for transport only



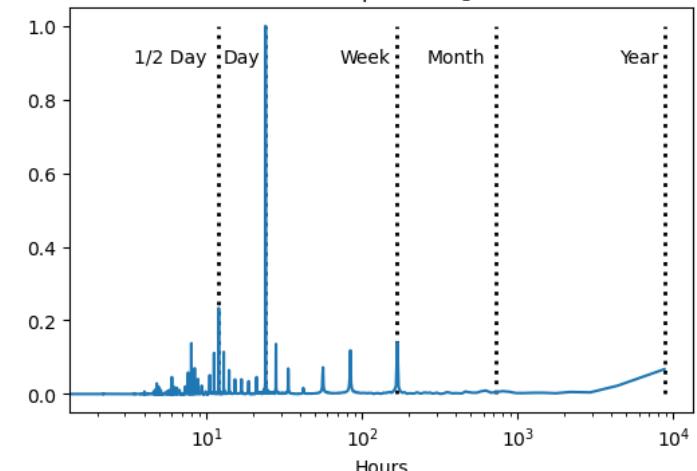
Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

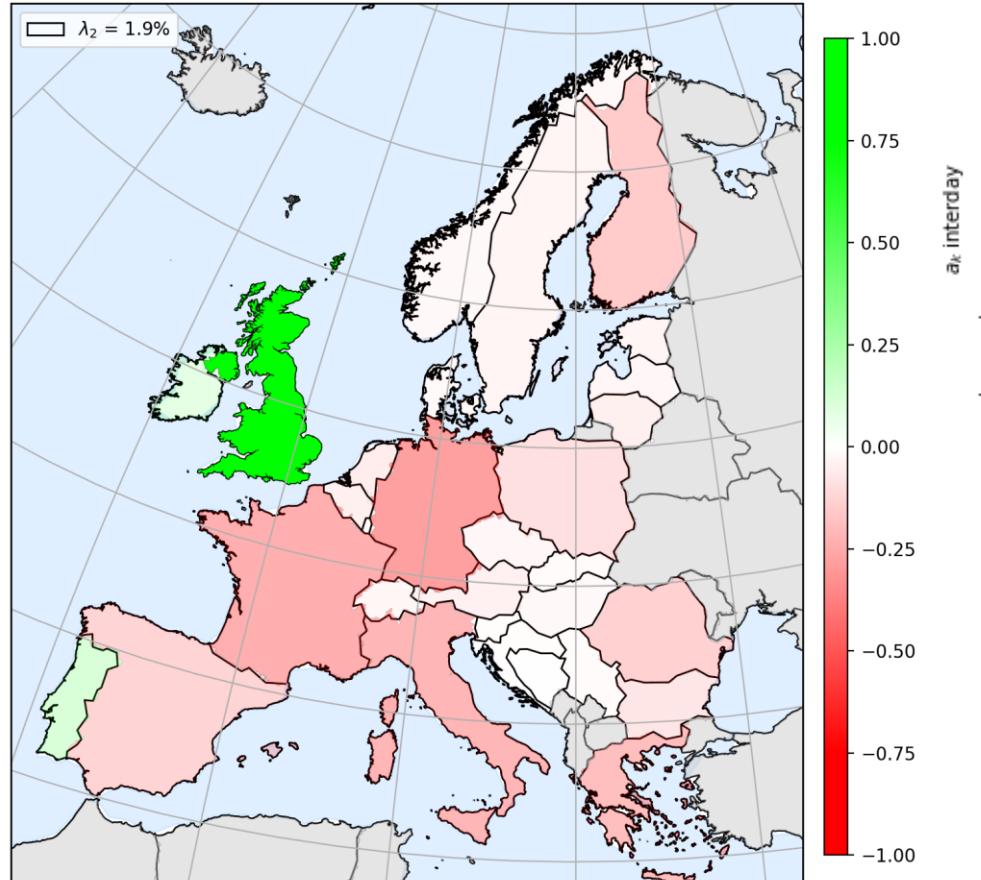


Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_1 = 98.0\%$

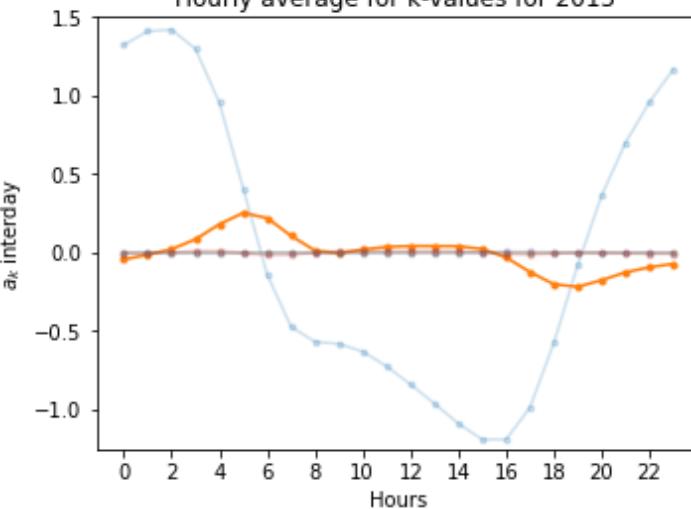


# Principle Component 2

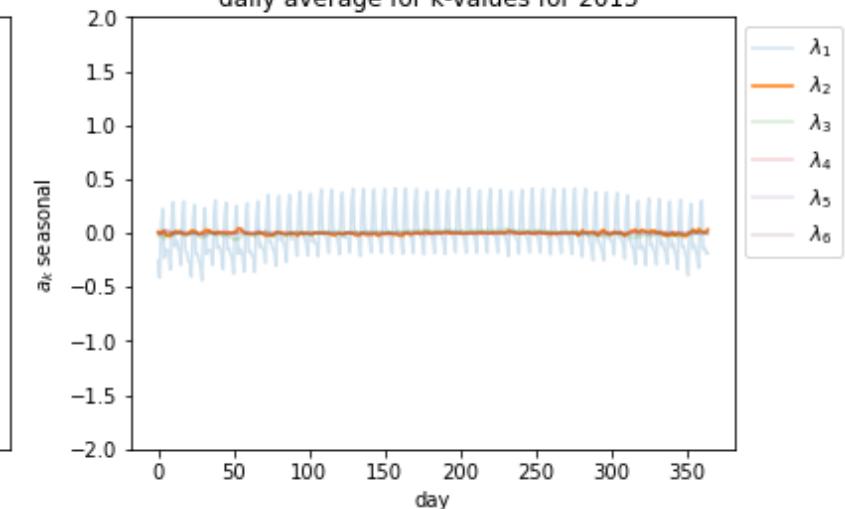
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Mismatch for transport only



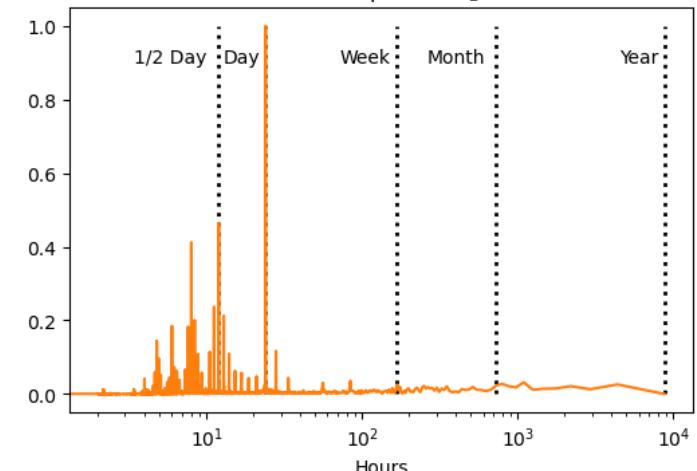
Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

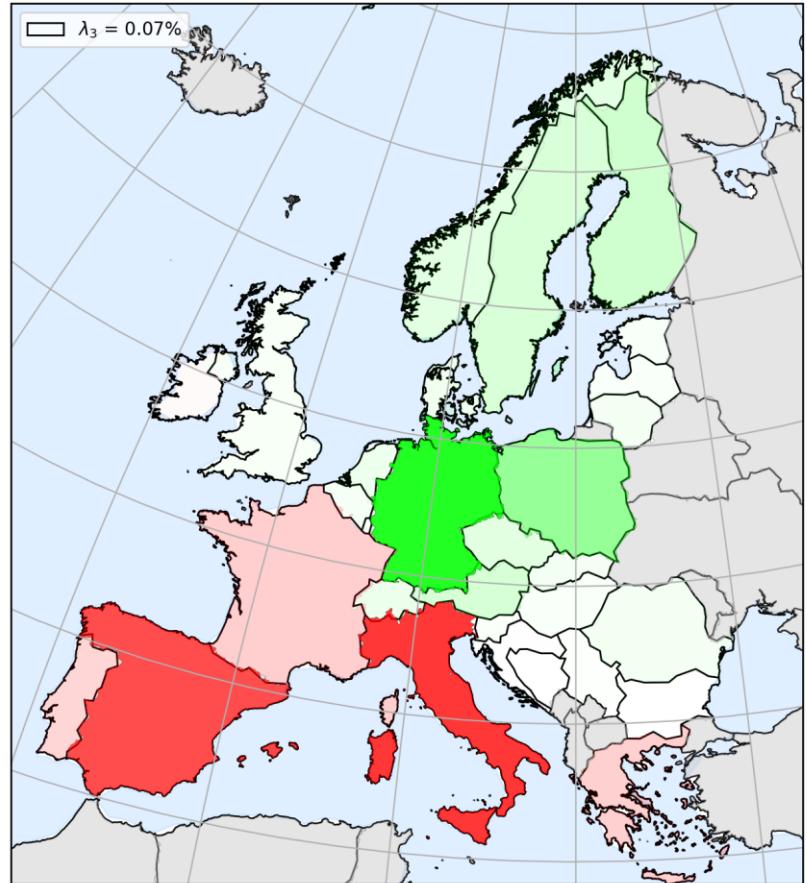


Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_2 = 1.9\%$

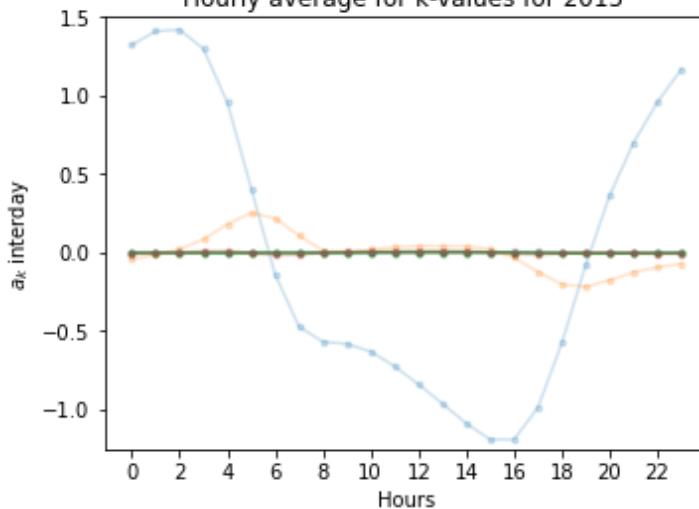


# Principle Component 3

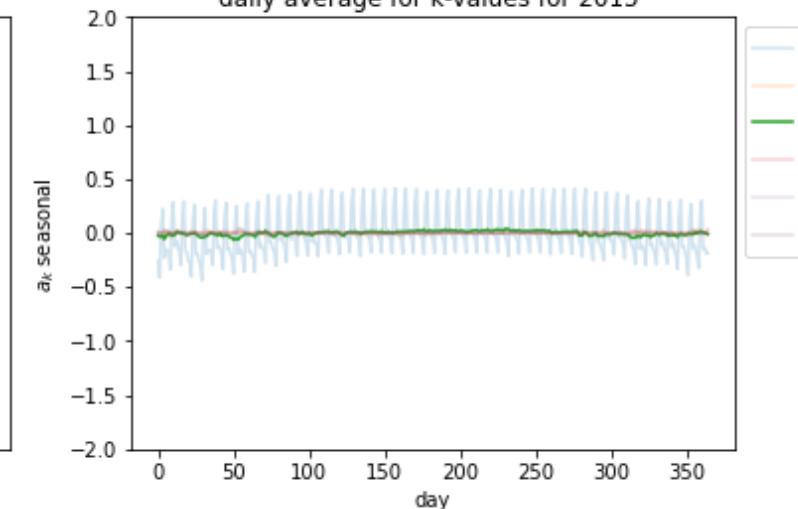
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Mismatch for transport only



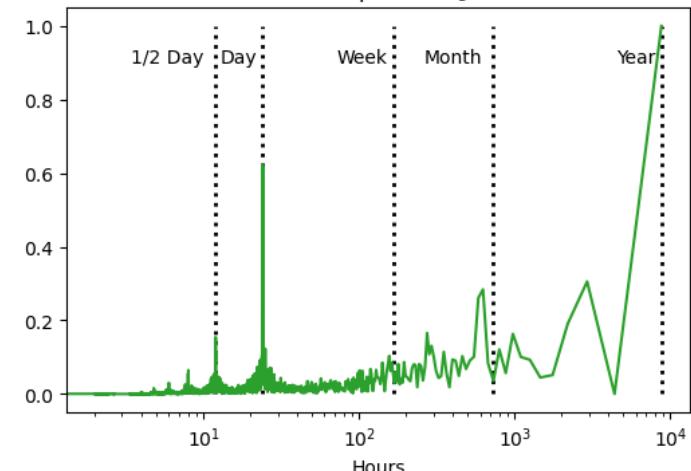
Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

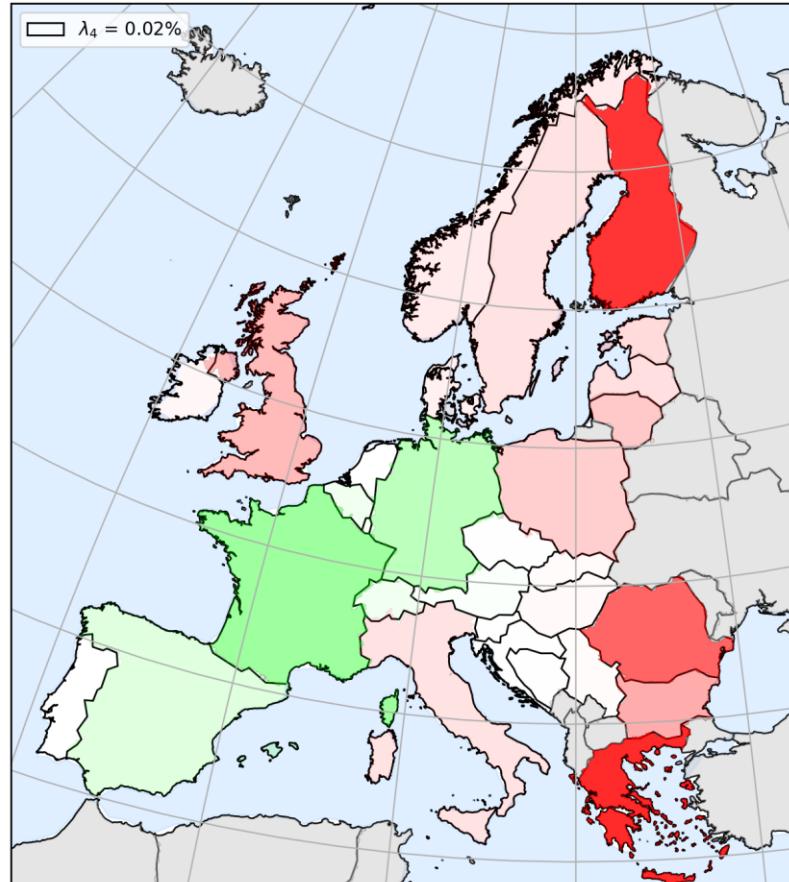


Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_3 = 0.07\%$

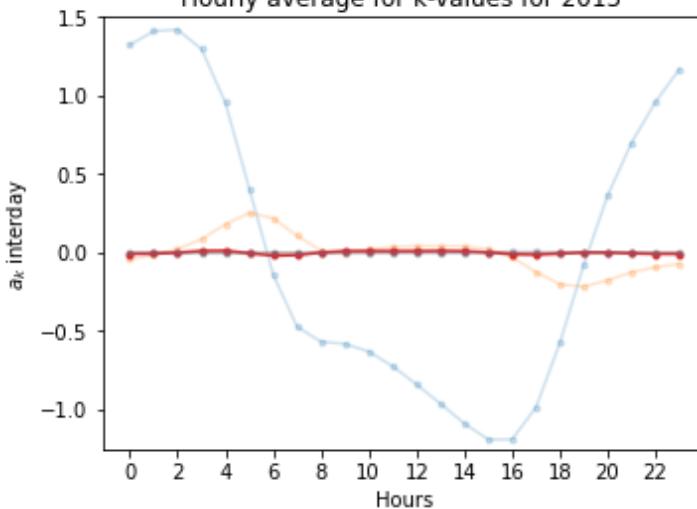


# Principle Component 4

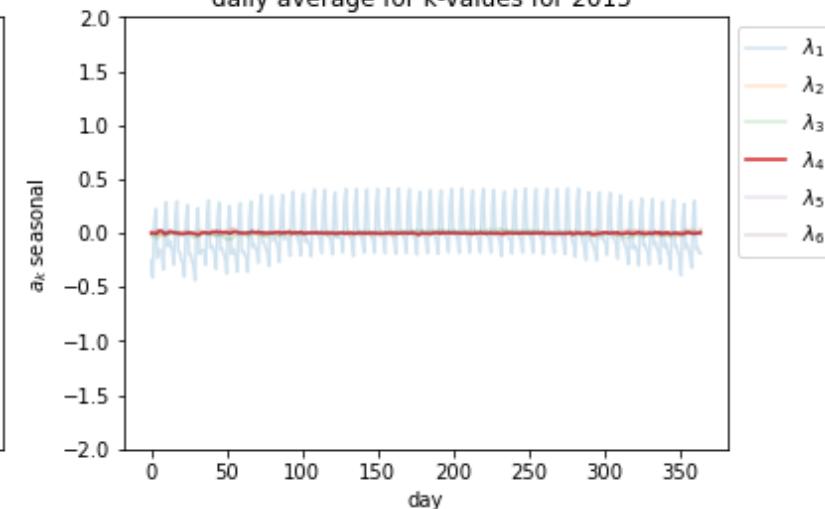
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Mismatch for transport only



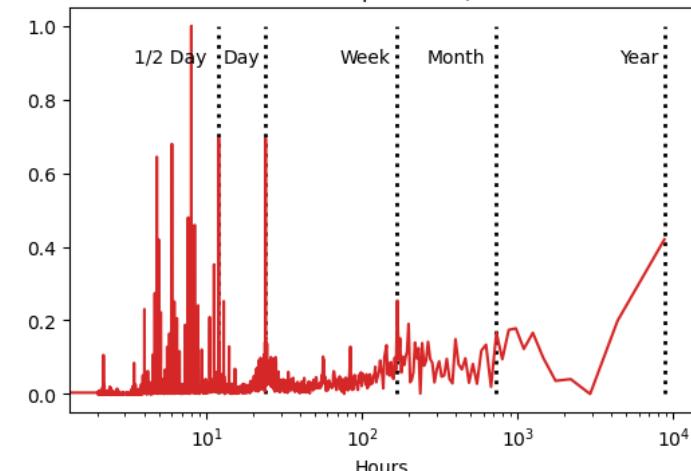
Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015



Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_4 = 0.02\%$

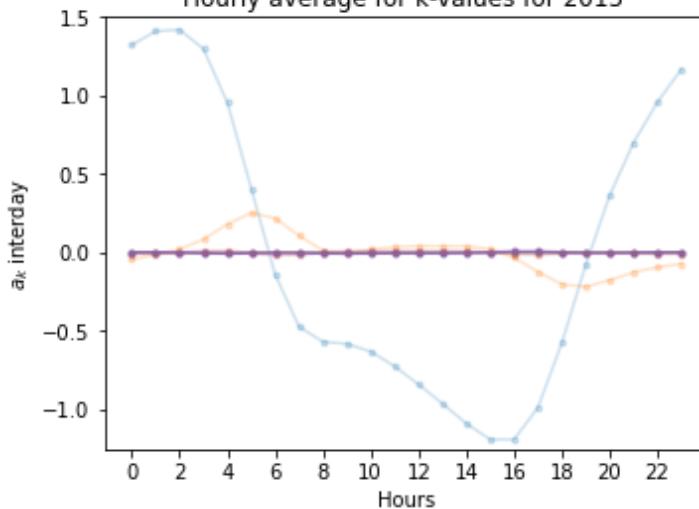


# Principle Component 5

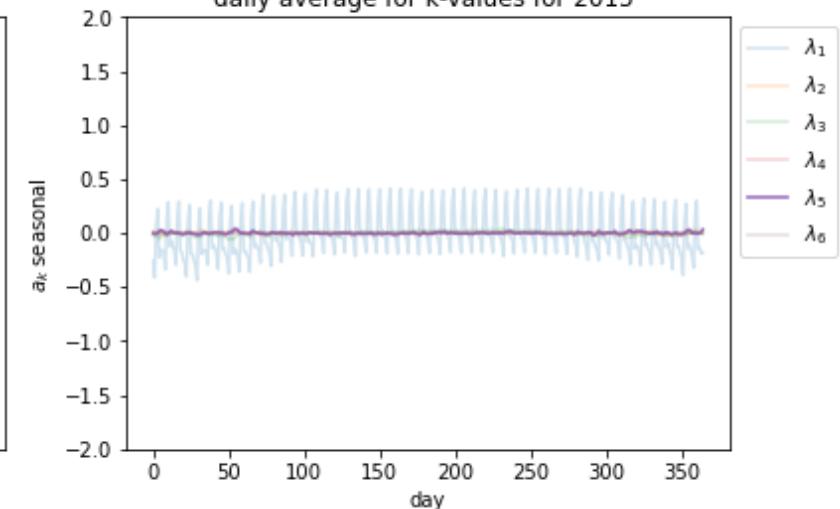
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Mismatch for transport only



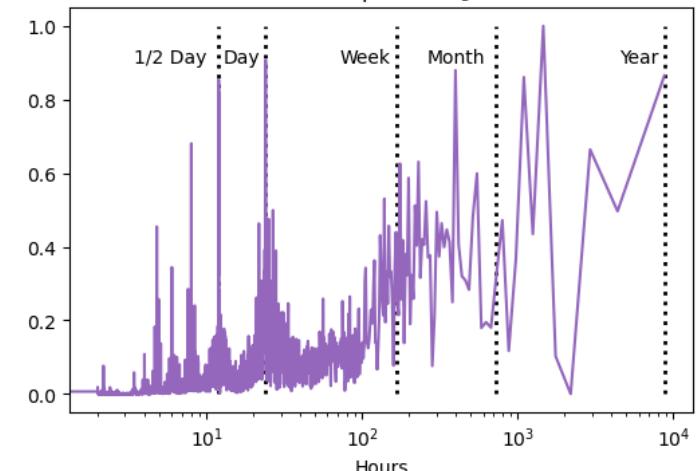
Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

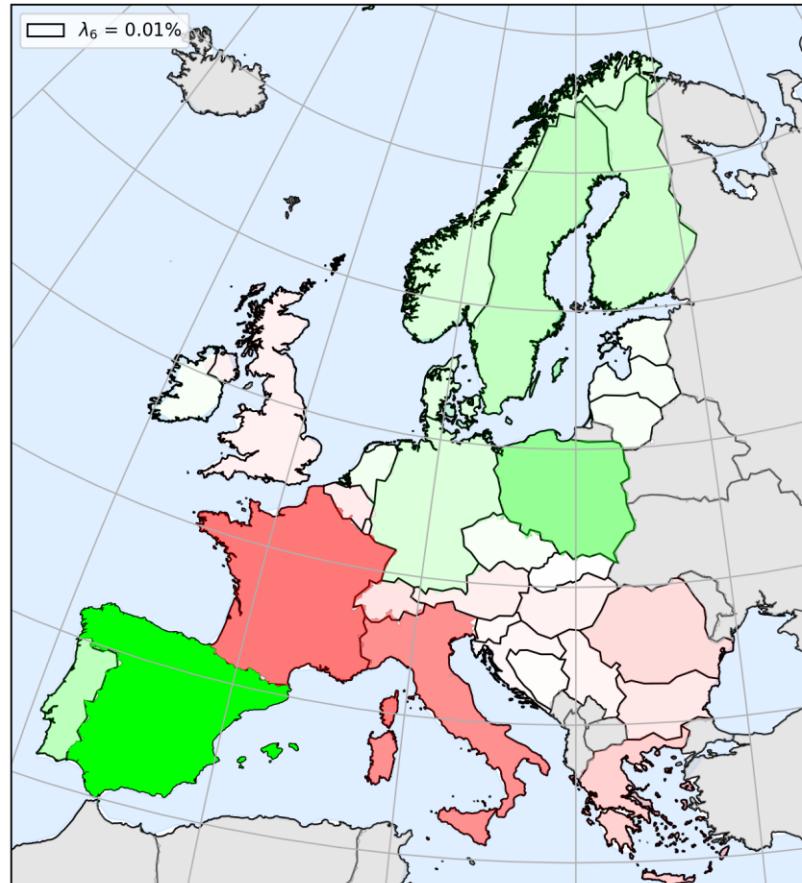


Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_5 = 0.02\%$

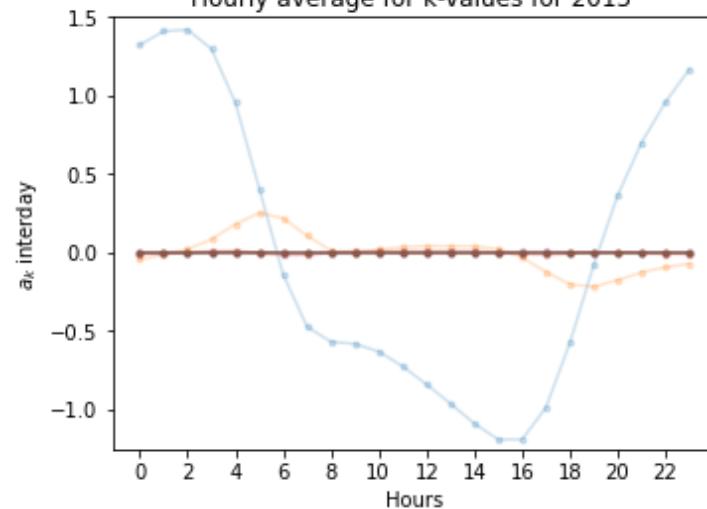


# Principle Component 6

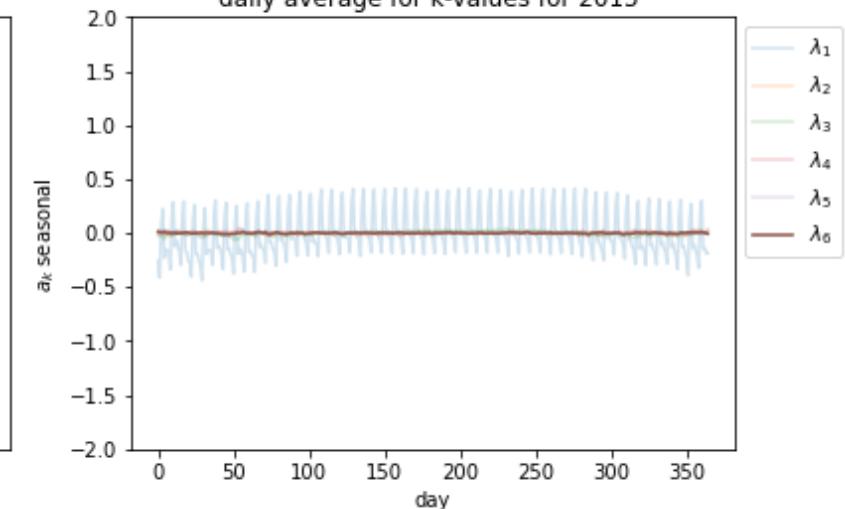
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Mismatch for transport only



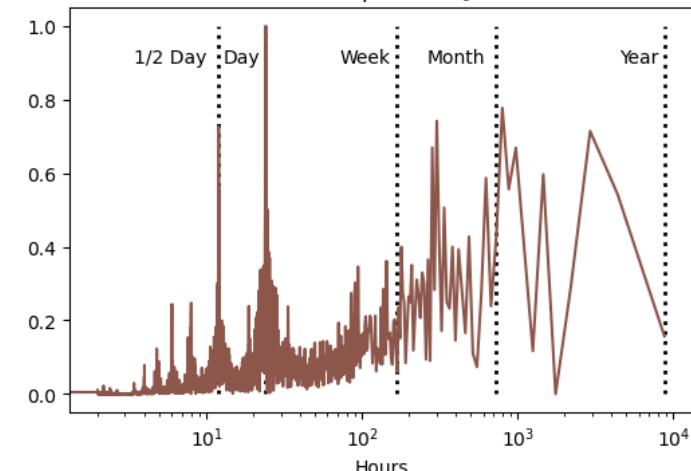
Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015



Transport mismatch - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_6 = 0.01\%$

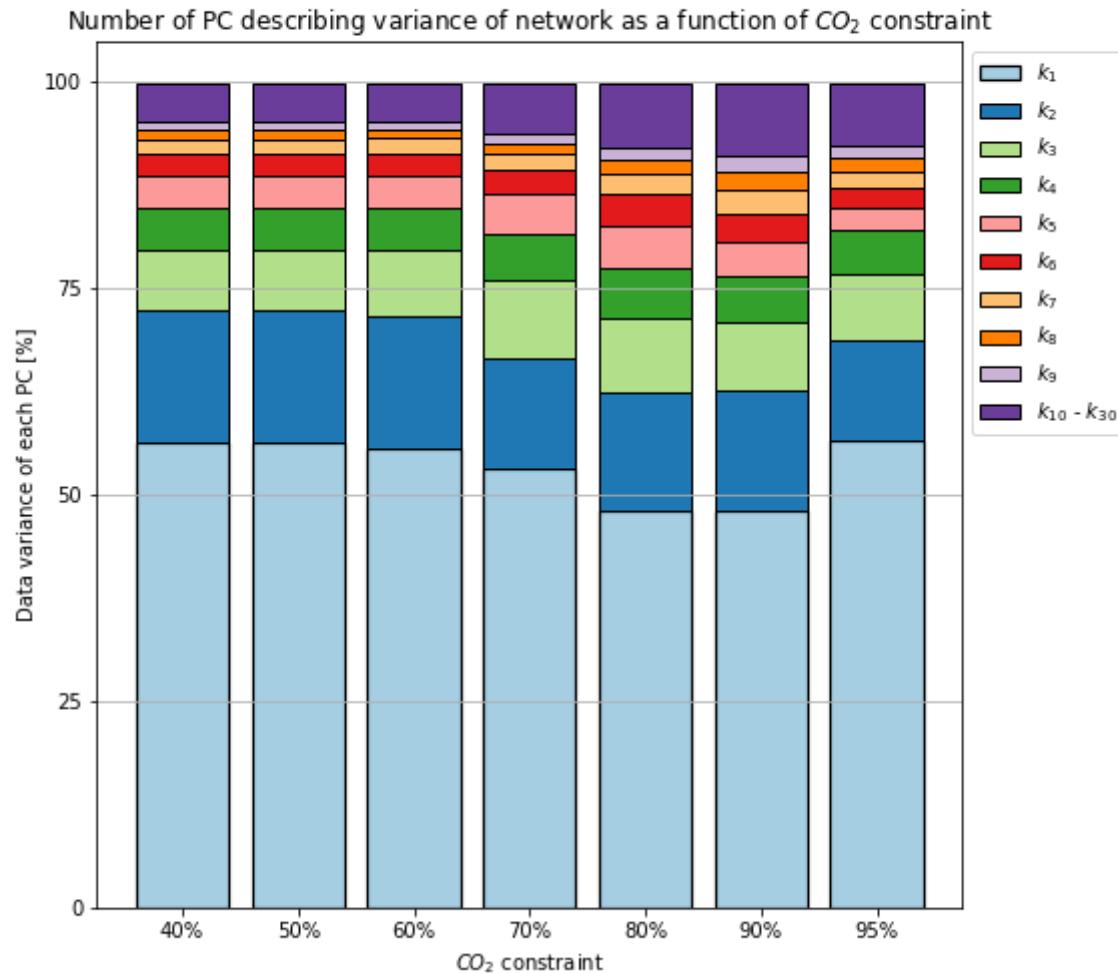


# Electricity Coupled with the Heating and Transport Sector

Transport NP Analysis

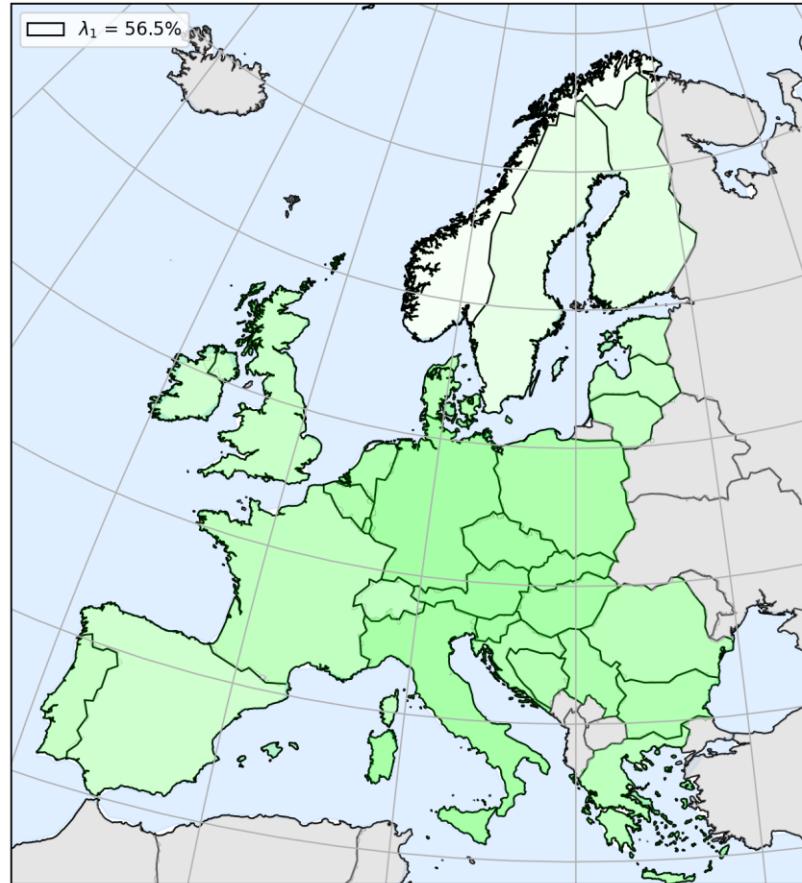
# Change in PC due to CO<sub>2</sub> Constrain

Transport Nodal Price - elec\_heat\_v2g50

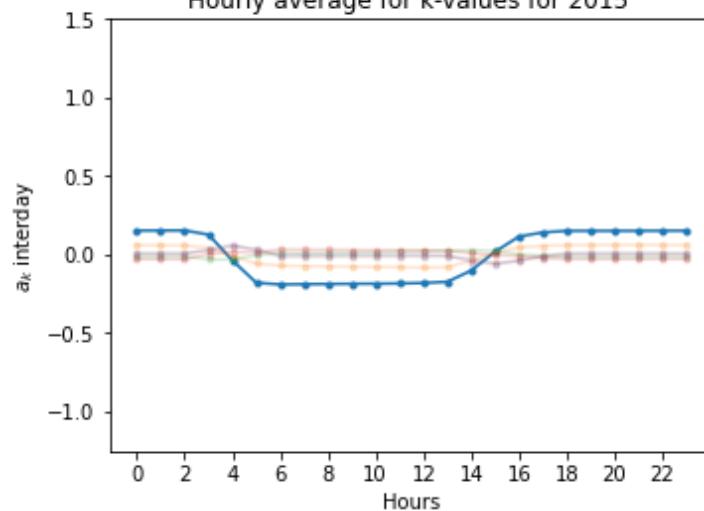


# Principle Component 1

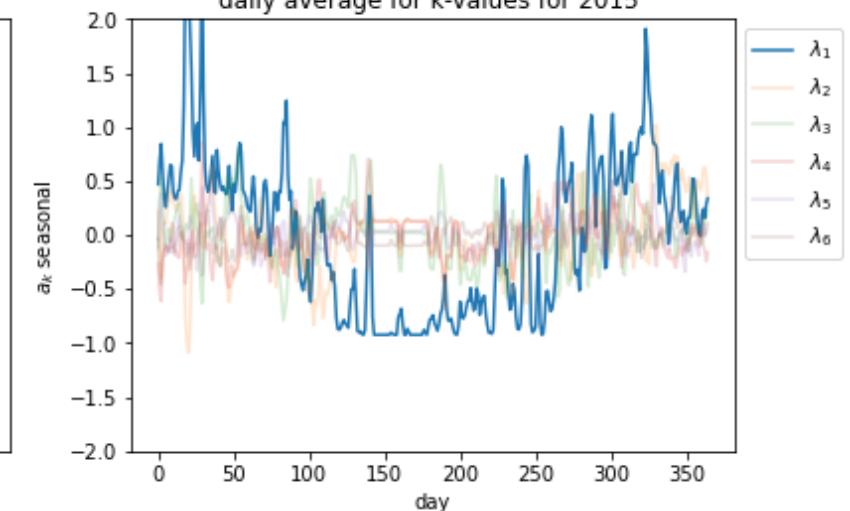
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for transport only



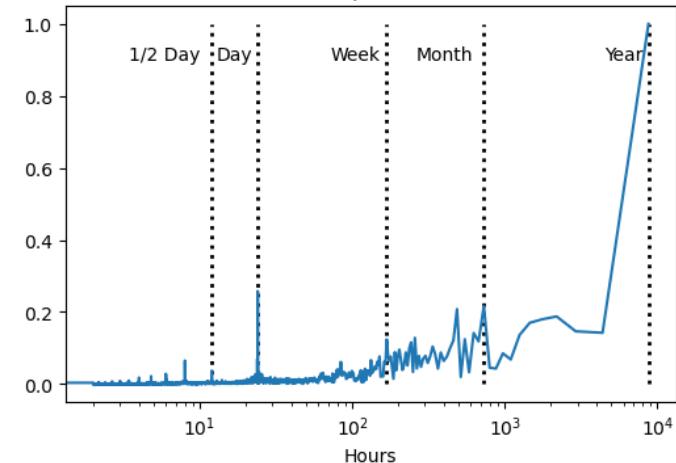
Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

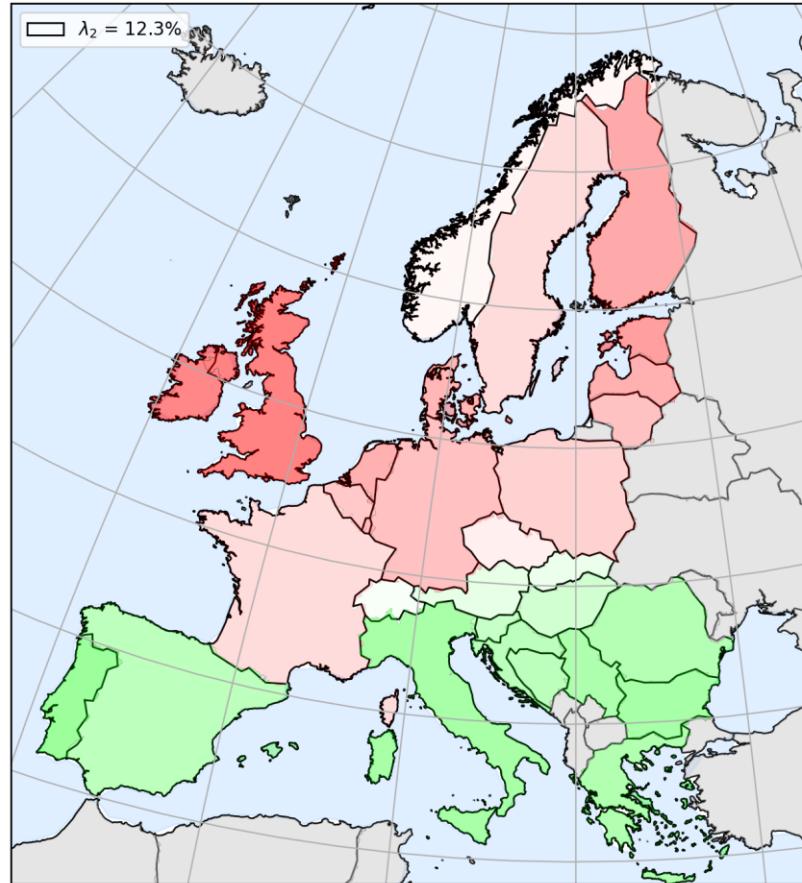


Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_1 = 56.5\%$

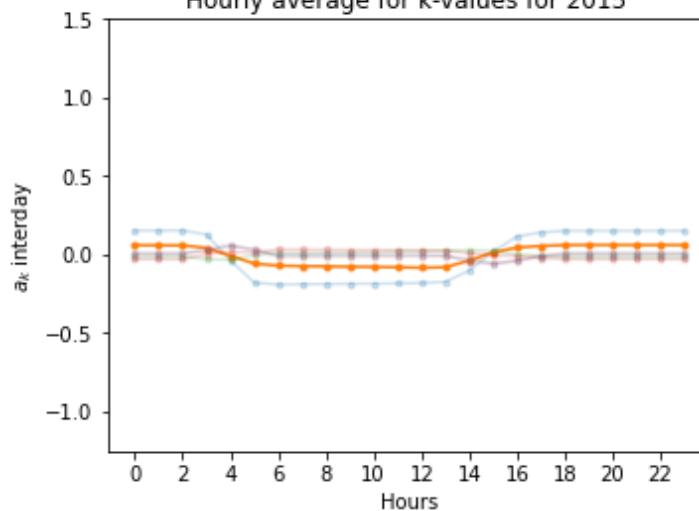


# Principle Component 2

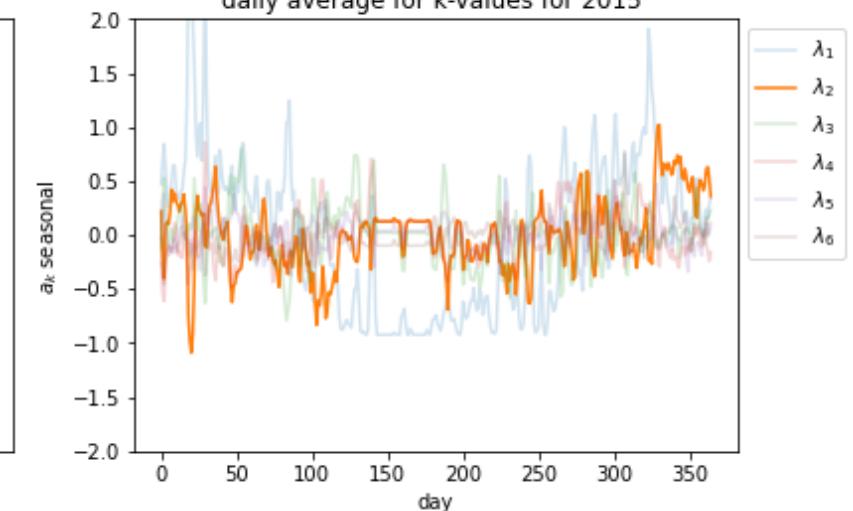
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for transport only



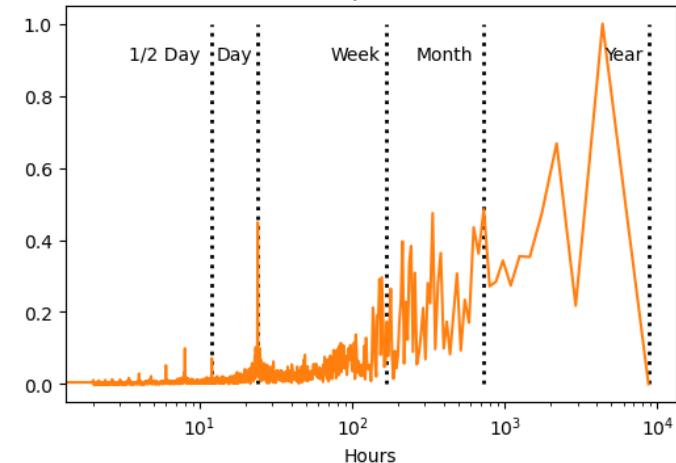
Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

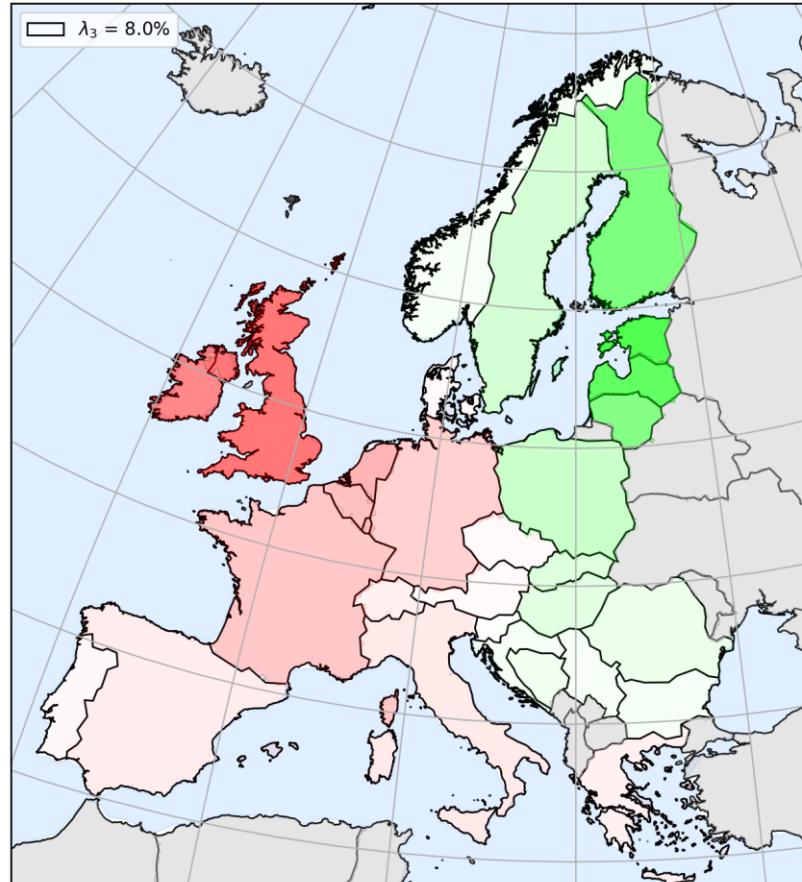


Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_2 = 12.3\%$

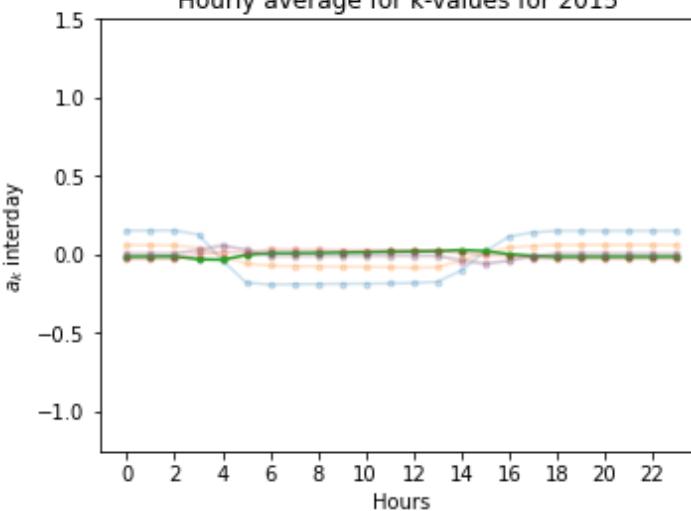


# Principle Component 3

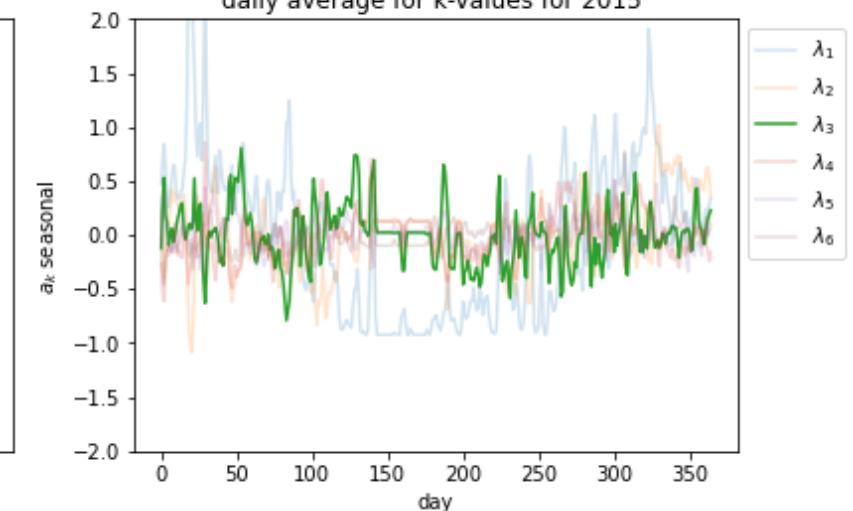
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for transport only



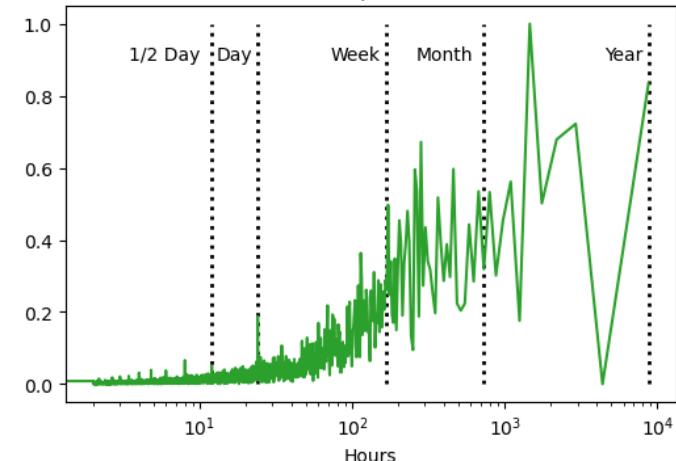
Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

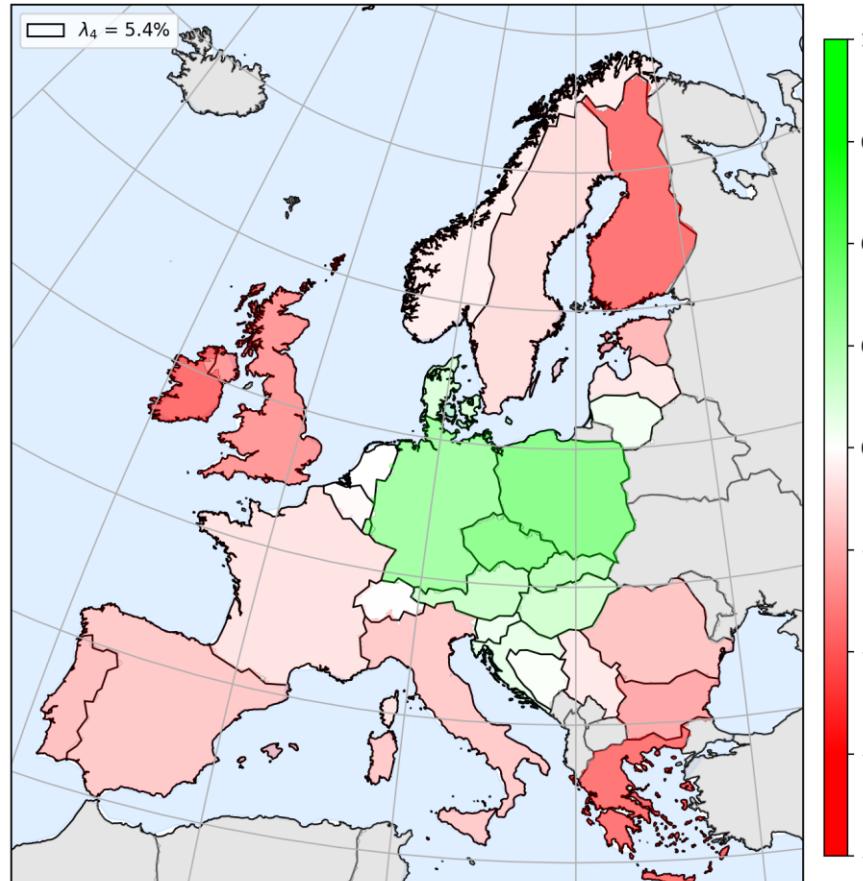


Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_3 = 8.0\%$

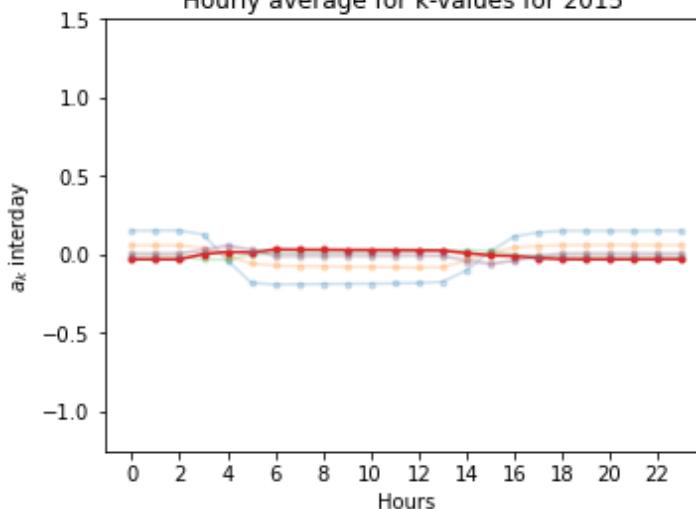


# Principle Component 4

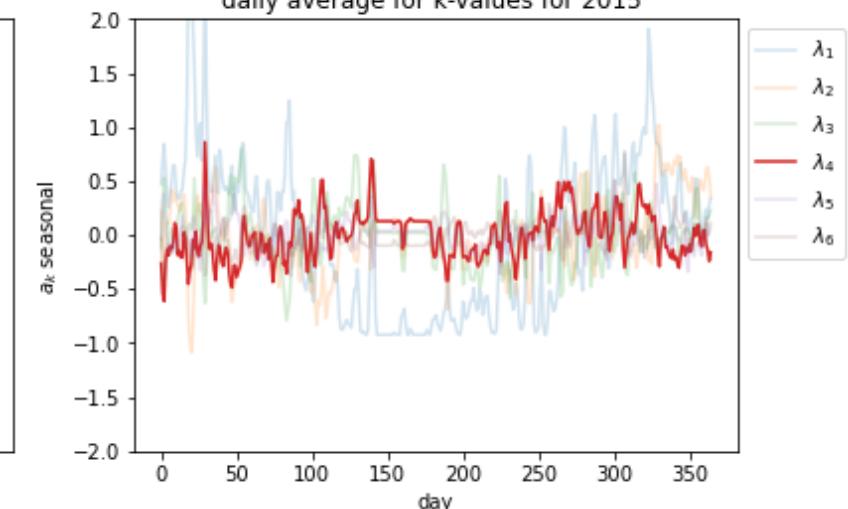
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for transport only



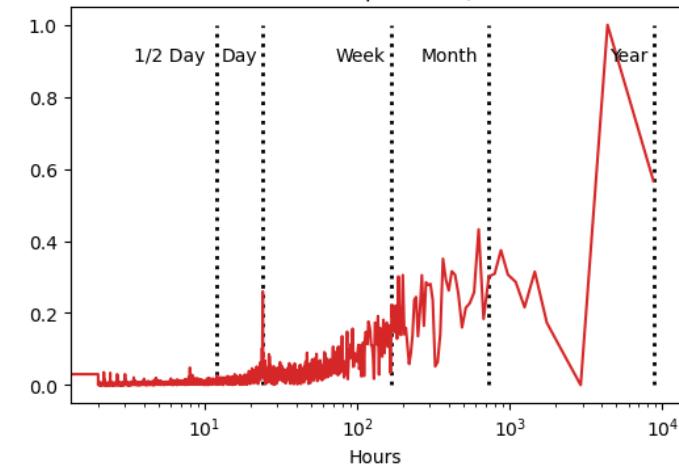
Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

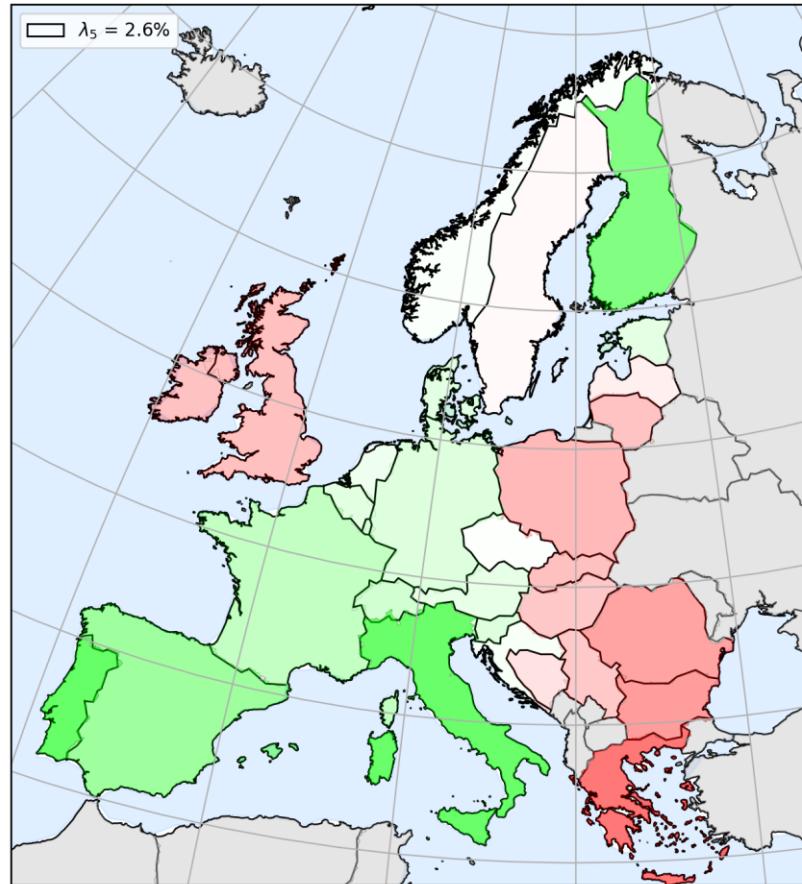


Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_4 = 5.4\%$

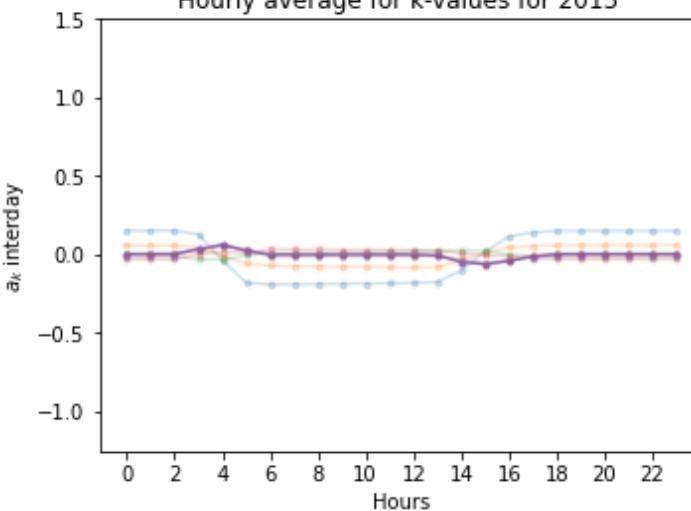


# Principle Component 5

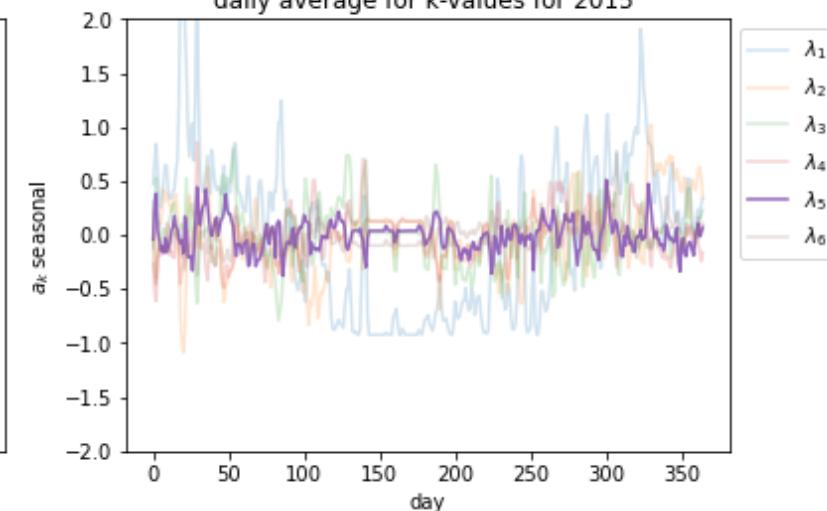
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for transport only



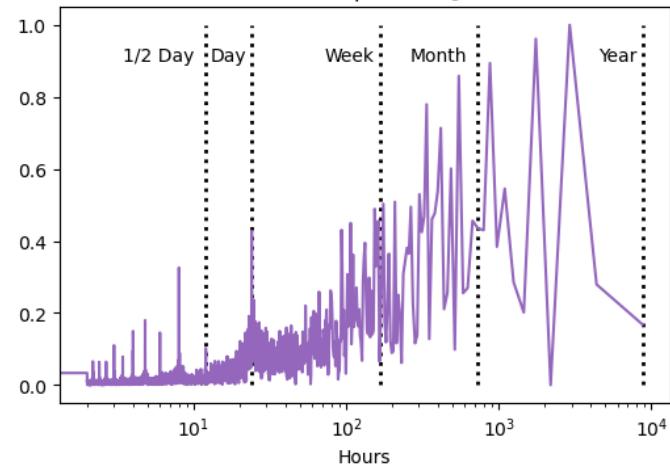
Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015

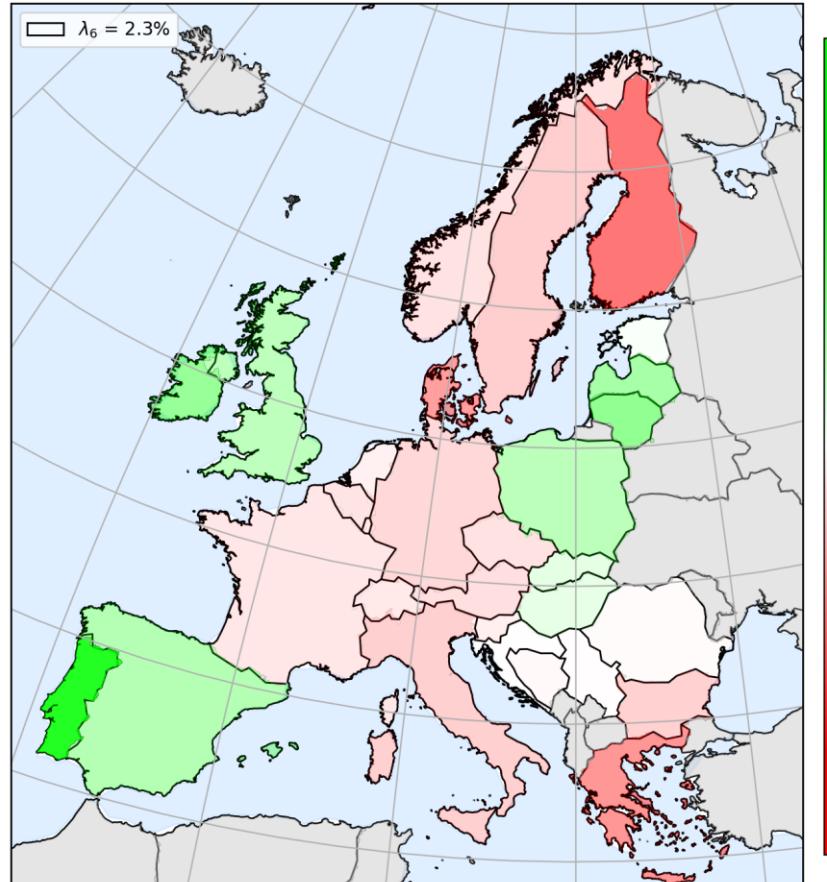


Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_5 = 2.6\%$

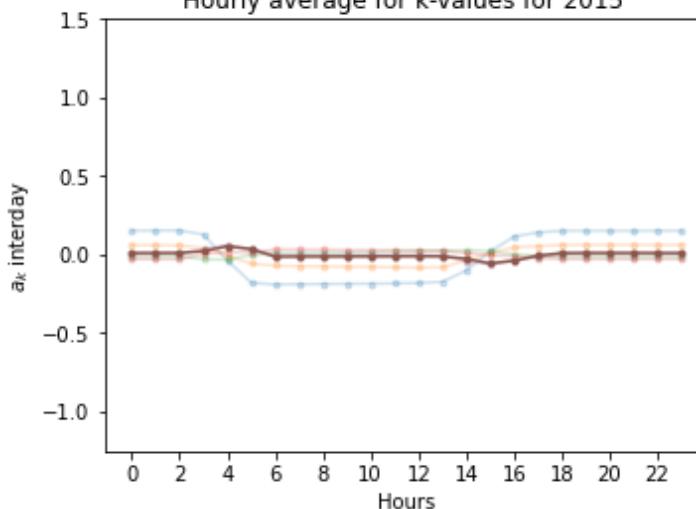


# Principle Component 6

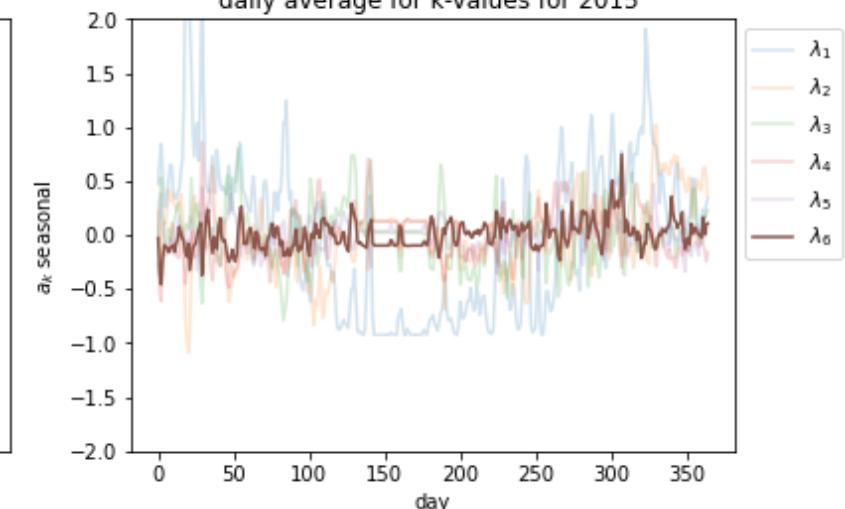
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Nodal price for transport only



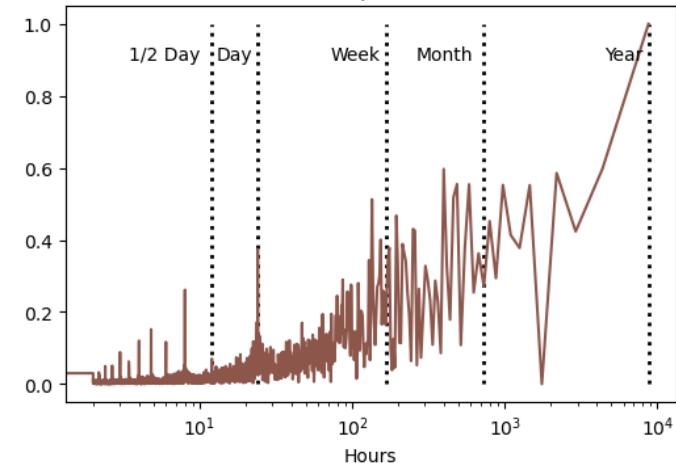
Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Hourly average for k-values for 2015



daily average for k-values for 2015



Transport Nodal Price - postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5  
Fourier Power Spectra:  $\lambda_6 = 2.3\%$

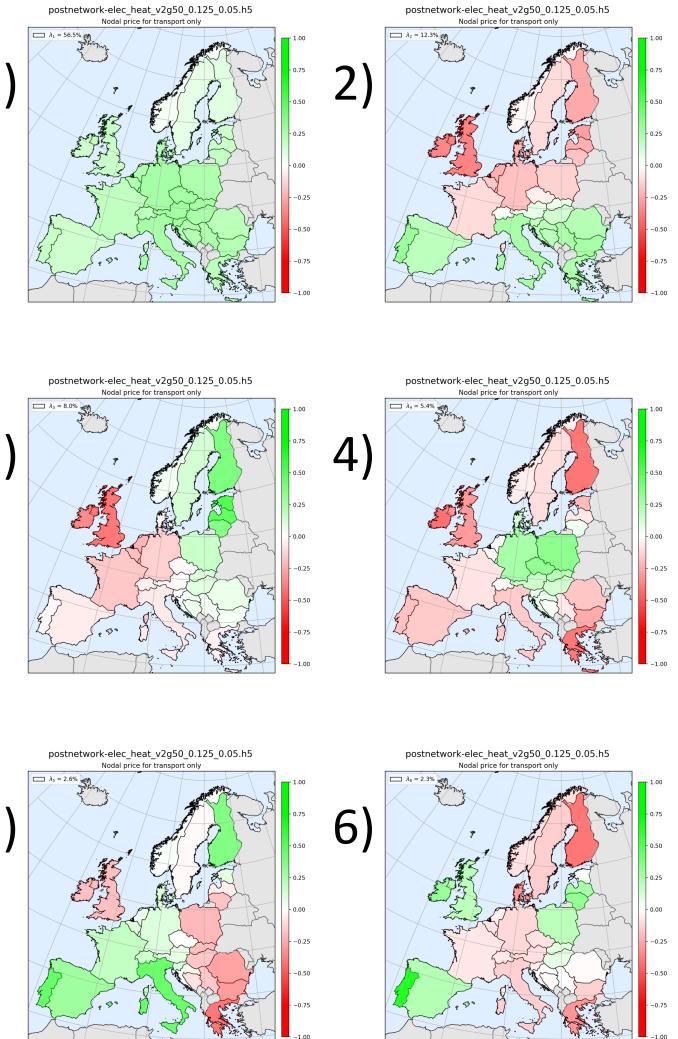


# Electricity Coupled with the Heating and Transport Sector

Transport Mismatch and NP Coherence

# Coherence Method 1

## Nodal Price

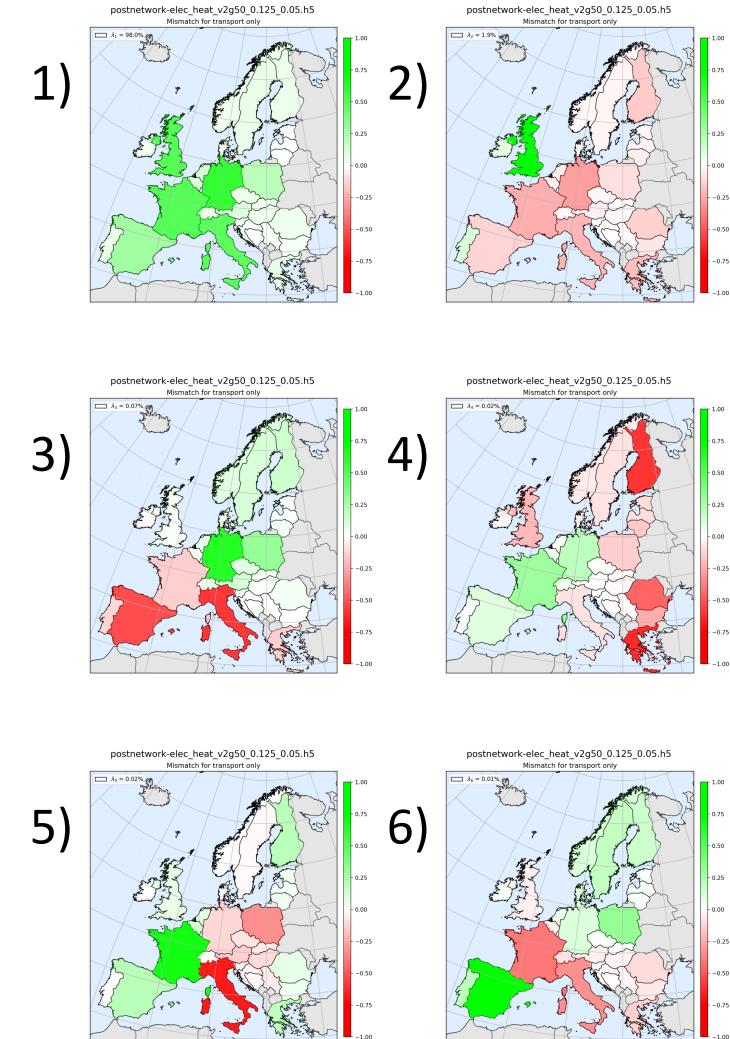


postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

Coherence 1: Transport mismatch and nodal price

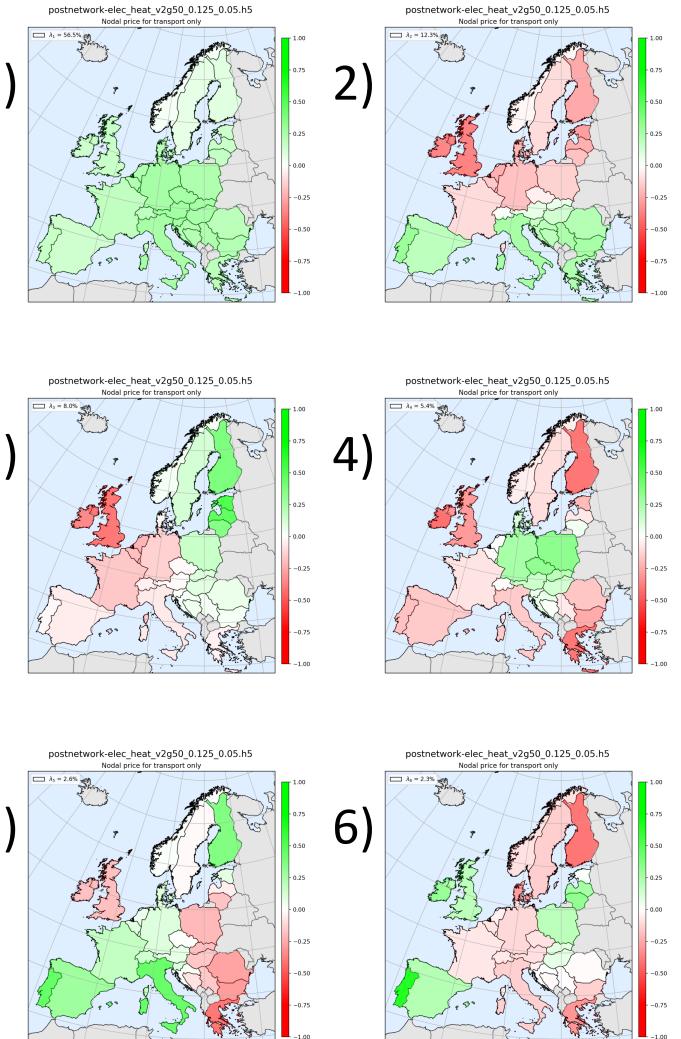
		Transport Mismatch						
		PC1	PC2	PC3	PC4	PC5	PC6	
Transport Nodal Prices	PC1	0.587	0.162	0.085	0.279	0.085	0.021	
	PC2	0.169	0.279	0.425	0.03	0.212	0.047	
	PC3	0.306	0.334	0.105	0.332	0.068	0.149	
	PC4	0.104	0.163	0.402	0.553	0.313	0.036	
	PC5	0.248	0.197	0.297	0.311	0.061	0.167	
	PC6	0.013	0.355	0.136	0.259	0.065	0.309	

## Mismatch



# Coherence Method 2

## Nodal Price

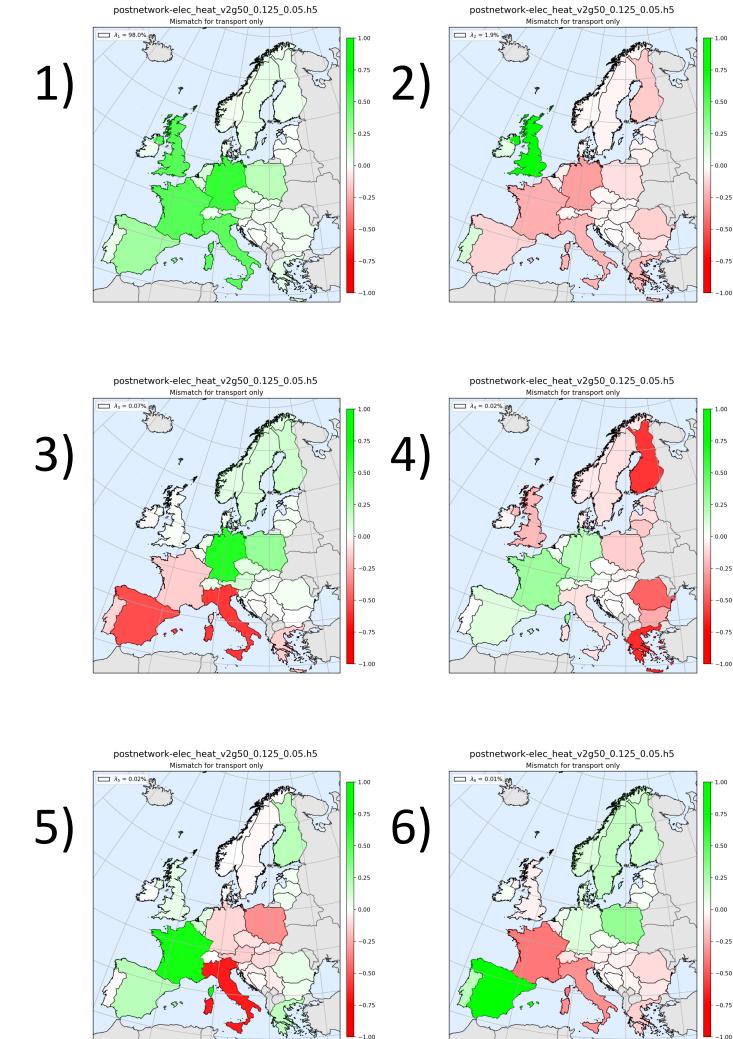


postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

Coherence 2: Transport mismatch and nodal price

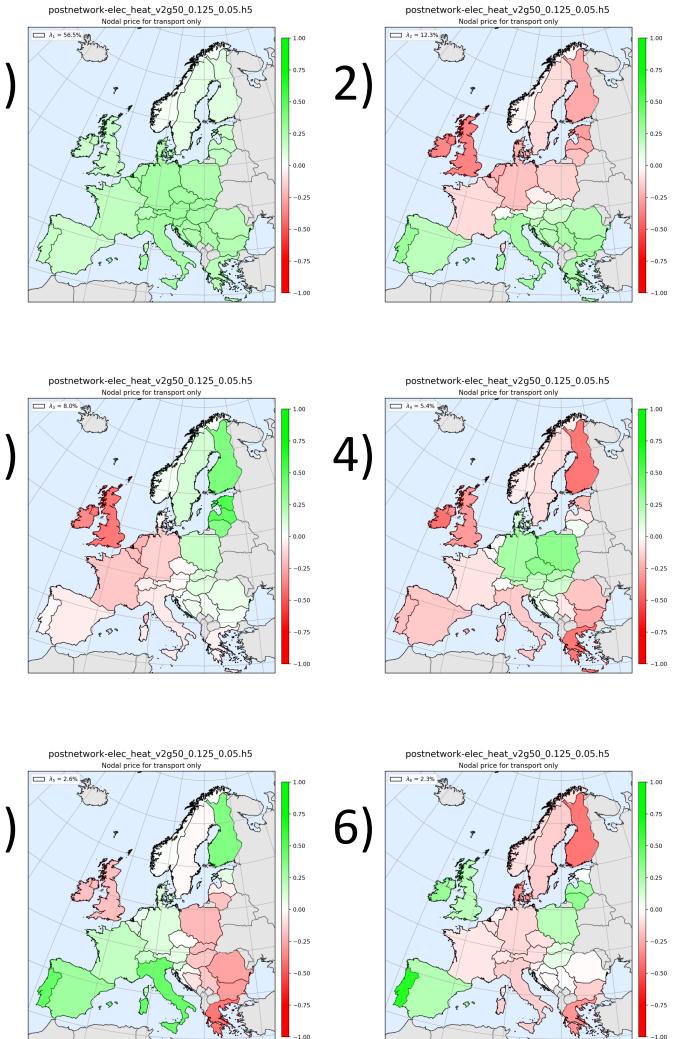
		Transport Mismatch						
		PC1	PC2	PC3	PC4	PC5	PC6	
Transport Nodal Prices	PC1	0.437	0.017	0.002	0.003	0.001	0.0	1
	PC2	0.059	0.013	0.004	0.0	0.001	0.0	
	PC3	0.086	0.013	0.001	0.001	0.0	0.0	
	PC4	0.024	0.005	0.002	0.002	0.001	0.0	
	PC5	0.04	0.004	0.001	0.001	0.0	0.0	
	PC6	0.002	0.007	0.001	0.001	0.0	0.0	

## Mismatch



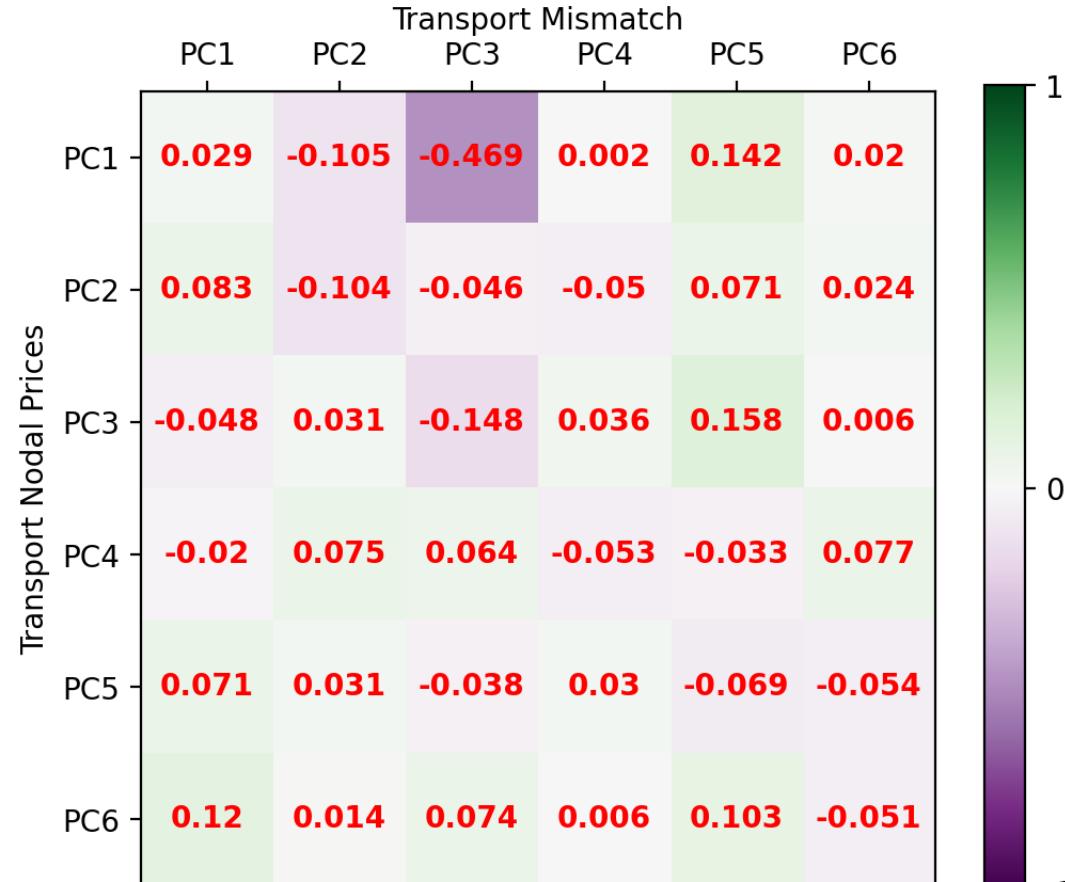
# Coherence Method 3

## Nodal Price

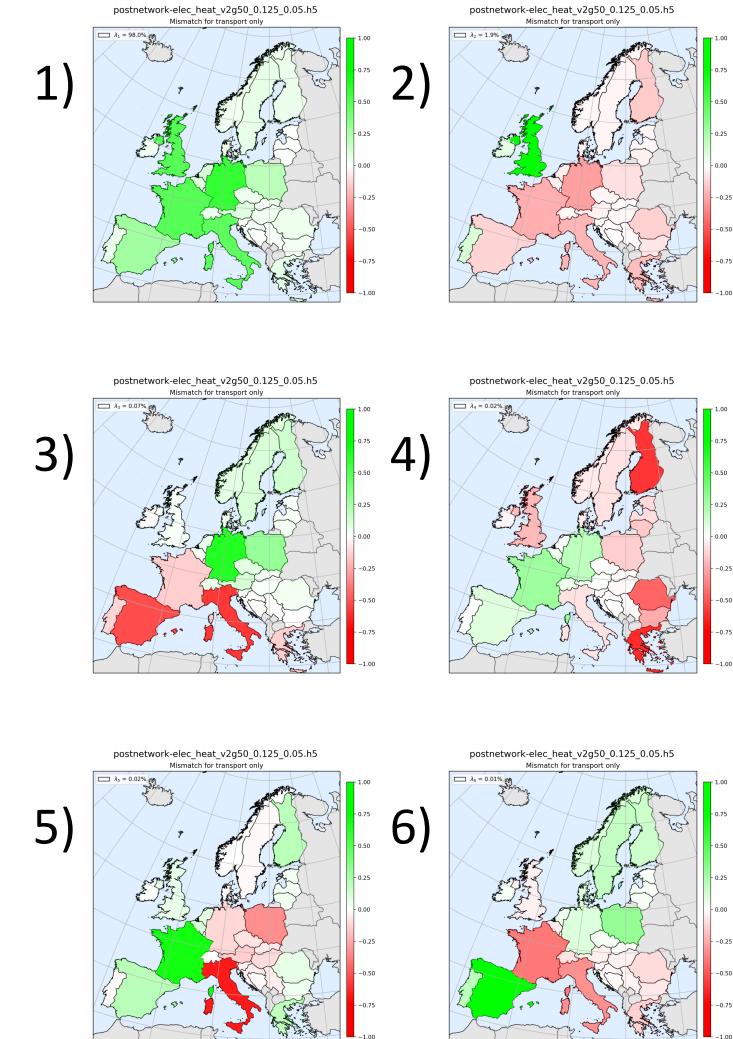


postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

Coherence 3: Transport mismatch and nodal price



## Mismatch



# Electricity Coupled with the Heating and Transport Sector

Electricity NP and Heating NP Coherence

# Coherence Method 1

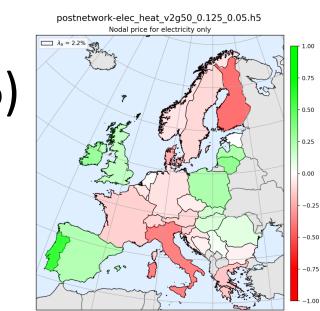
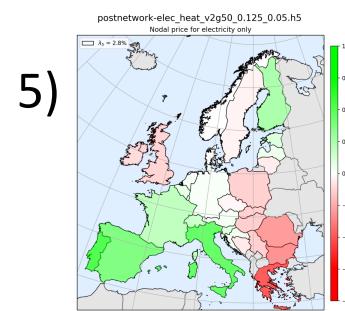
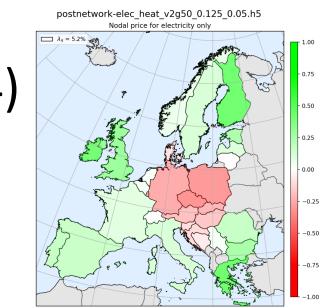
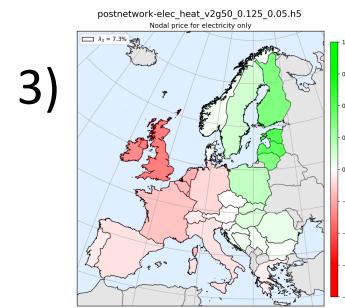
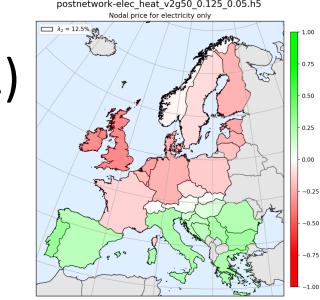
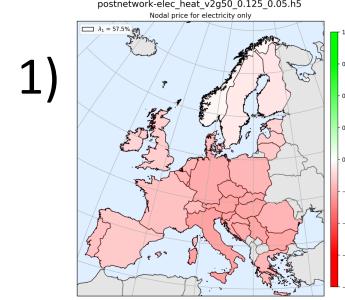
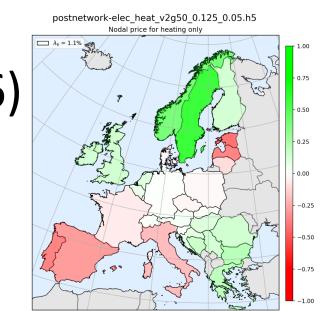
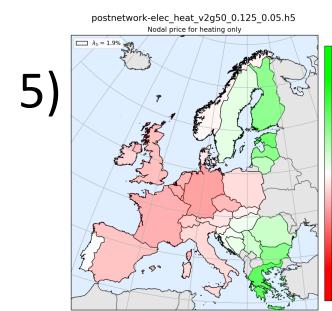
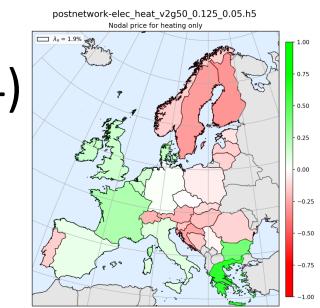
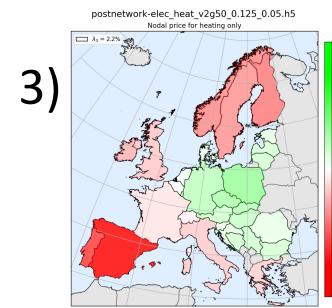
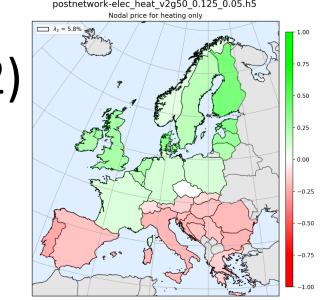
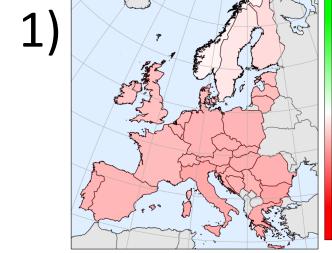
**HNP**

postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

**ENP**

Coherence 1: Electricity and heating nodal prices

		Electricity Nodal Prices						1	
		PC1	PC2	PC3	PC4	PC5	PC6		
		PC1	0.99	0.035	0.036	0.099	0.018	0.055	1
		PC2	0.056	0.932	0.21	0.184	0.021	0.079	
		PC3	0.079	0.126	0.179	0.623	0.525	0.107	1
		PC4	0.02	0.009	0.478	0.303	0.353	0.076	
		PC5	0.054	0.261	0.702	0.508	0.342	0.035	1
		PC6	0.04	0.003	0.245	0.087	0.537	0.339	



# Coherence Method 2

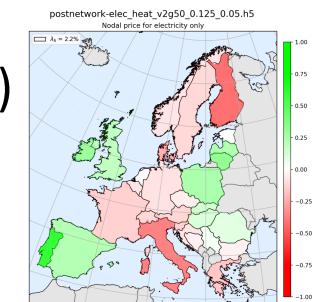
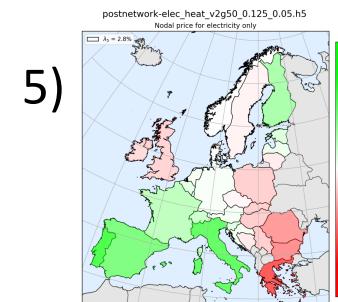
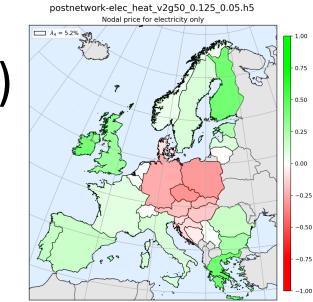
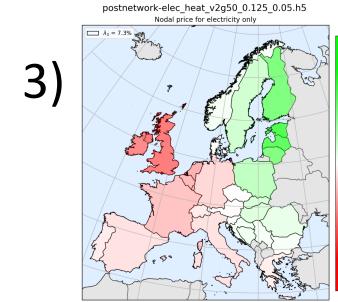
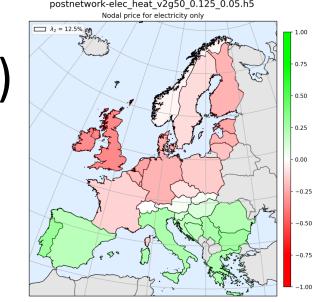
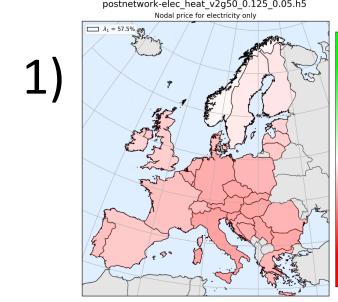
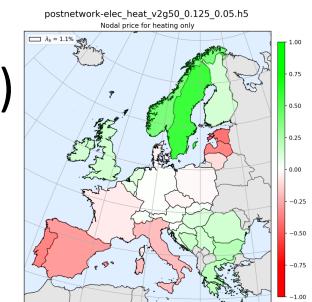
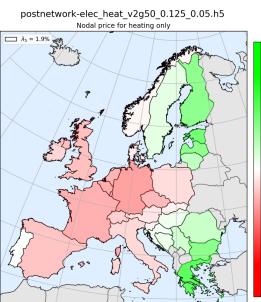
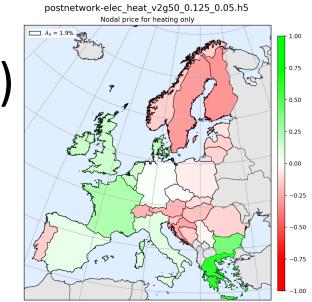
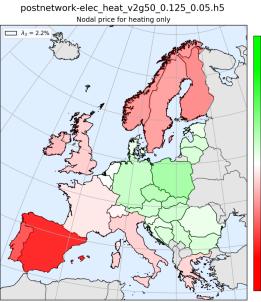
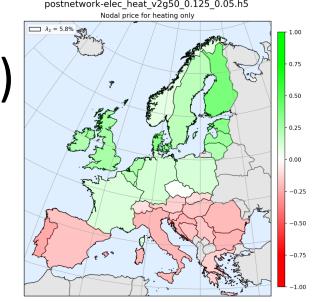
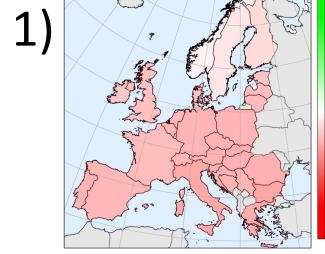
**HNP**

postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

**ENP**

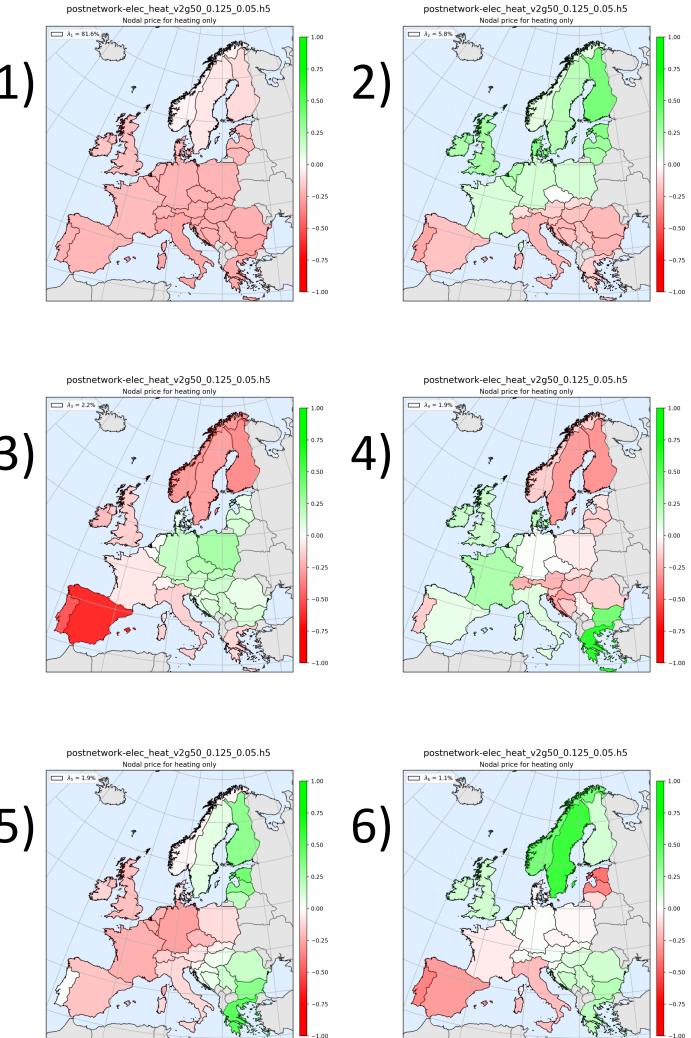
Coherence 2: Electricity and heating nodal prices

		Electricity Nodal Prices						1	
		PC1	PC2	PC3	PC4	PC5	PC6		
		PC1	0.678	0.011	0.009	0.02	0.003	0.007	1
		PC2	0.01	0.079	0.014	0.01	0.001	0.003	
		PC3	0.009	0.007	0.007	0.021	0.013	0.002	1
		PC4	0.002	0.0	0.018	0.009	0.008	0.002	
		PC5	0.006	0.013	0.026	0.016	0.008	0.001	1
		PC6	0.003	0.0	0.007	0.002	0.009	0.005	



# Coherence Method 3

**HNP**

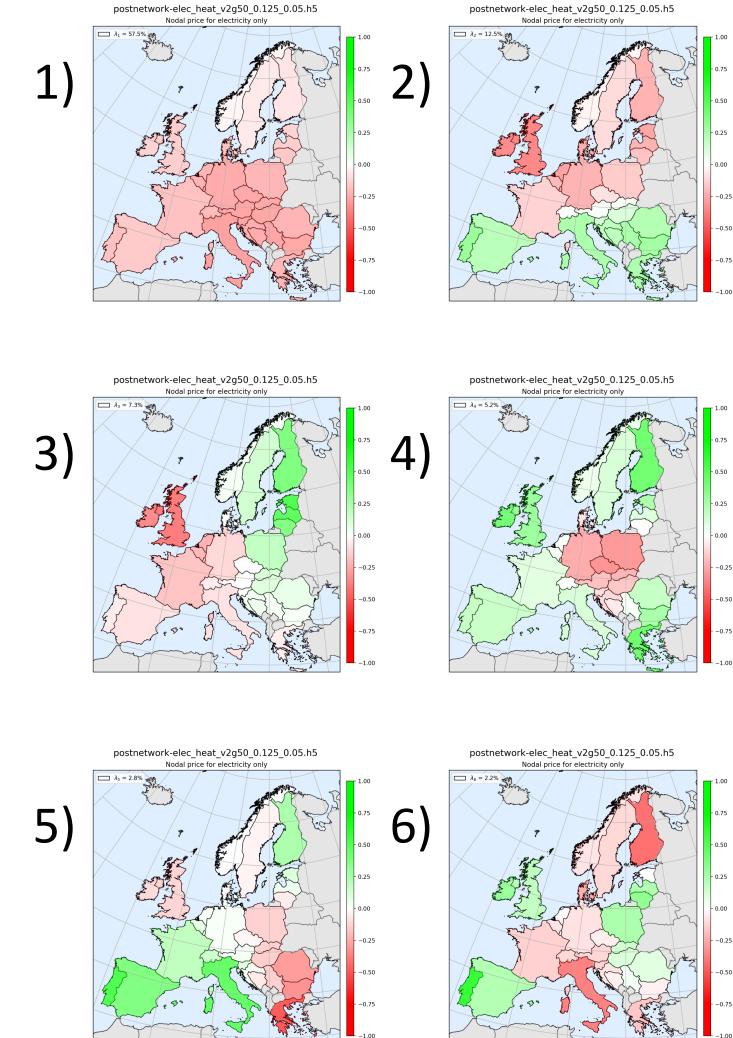


postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

Coherence 3: Electricity and heating nodal prices

		Electricity Nodal Prices					
		PC1	PC2	PC3	PC4	PC5	PC6
Heating Nodal Prices	PC1	0.786	-0.163	-0.121	-0.256	-0.029	0.083
	PC2	-0.057	-0.797	0.152	0.083	-0.033	-0.145
	PC3	-0.048	0.004	0.057	-0.449	-0.311	0.05
	PC4	0.048	-0.005	-0.561	0.194	-0.182	-0.066
	PC5	0.214	0.125	0.496	0.322	-0.189	0.037
	PC6	-0.07	-0.109	-0.081	0.101	-0.373	-0.229

**ENP**



# Electricity Coupled with the Heating and Transport Sector

Electricity NP and Transport NP Coherence

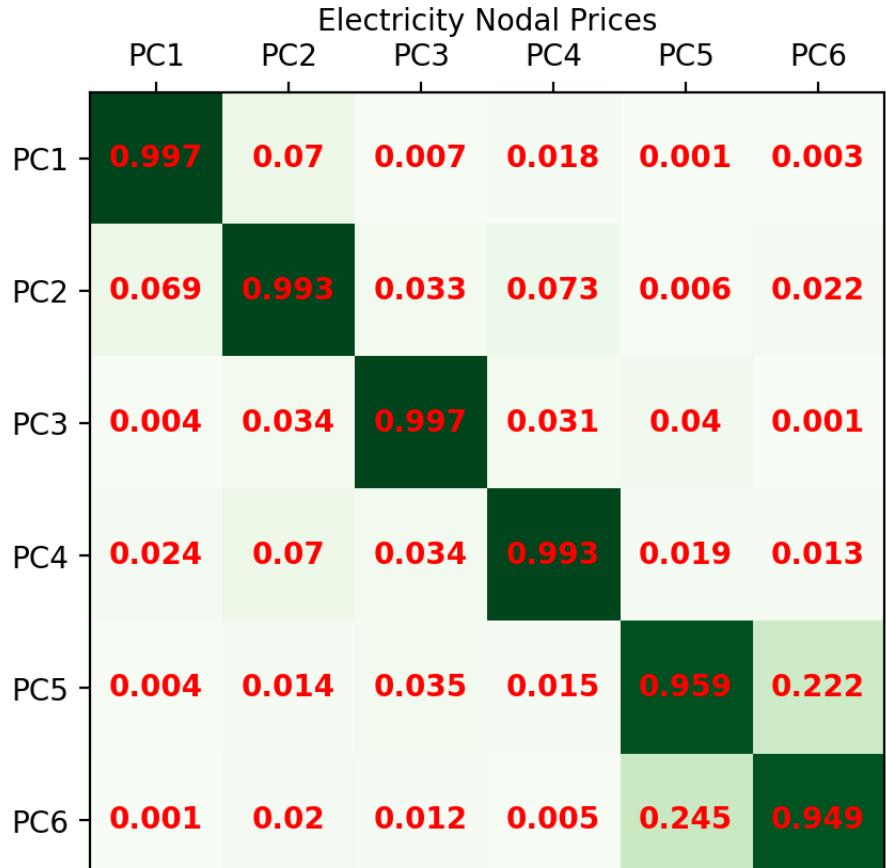
# Coherence Method 1

TNP

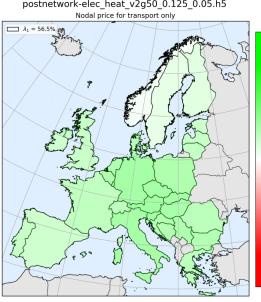
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

ENP

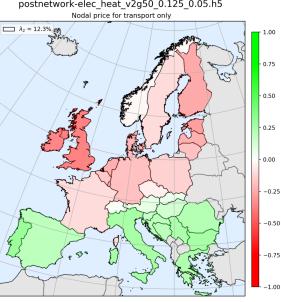
Coherence 1: Electricity and transport nodal prices



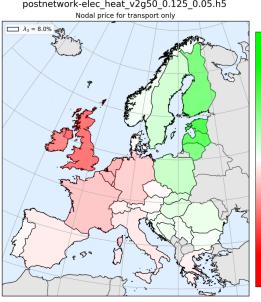
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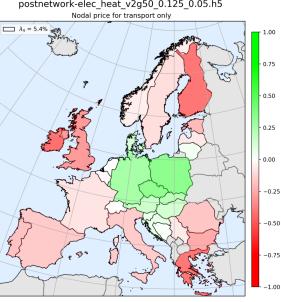
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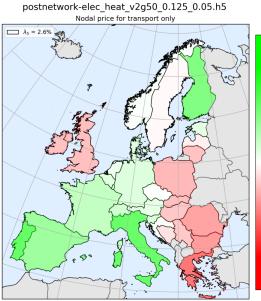
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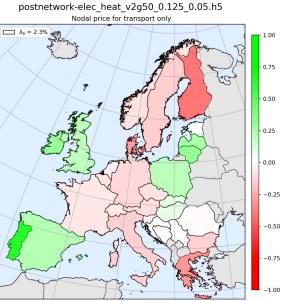
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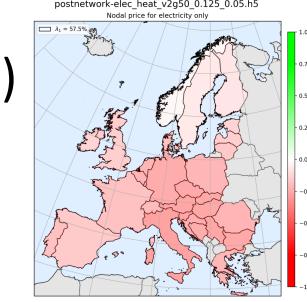
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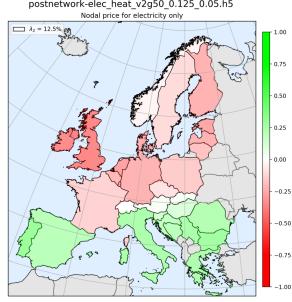
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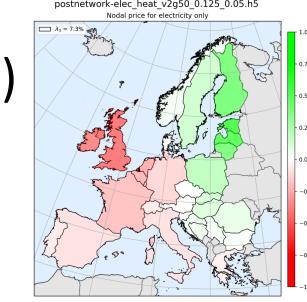
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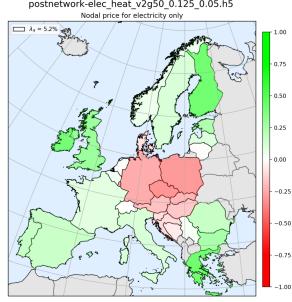
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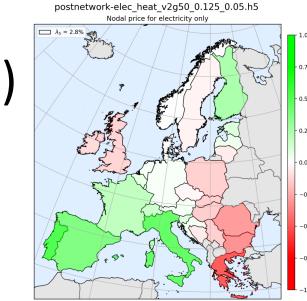
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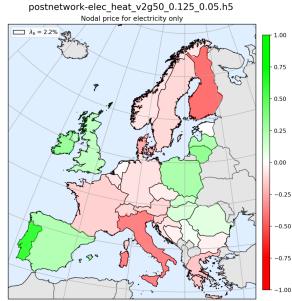
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5)



6)



# Coherence Method 2

TNP

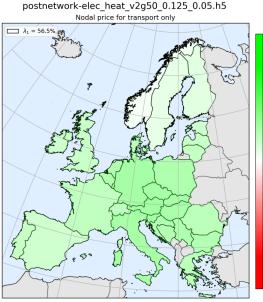
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

ENP

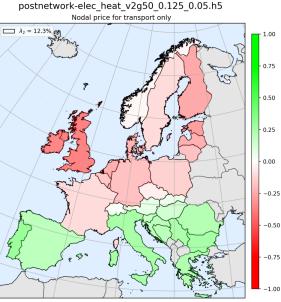
Coherence 2: Electricity and transport nodal prices

	PC1	PC2	PC3	PC4	PC5	PC6	
PC1	0.568	0.019	0.001	0.003	0.0	0.0	1
PC2	0.018	0.123	0.003	0.006	0.0	0.001	
PC3	0.001	0.003	0.076	0.002	0.002	0.0	
PC4	0.004	0.006	0.002	0.052	0.001	0.0	
PC5	0.0	0.001	0.002	0.001	0.026	0.005	
PC6	0.0	0.001	0.0	0.0	0.006	0.021	

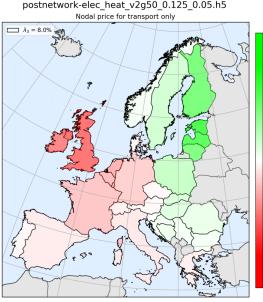
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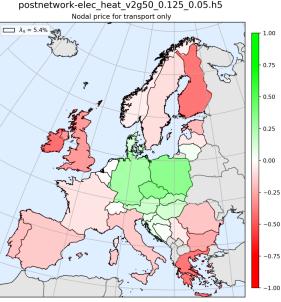
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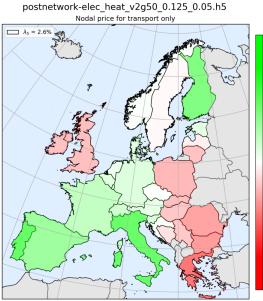
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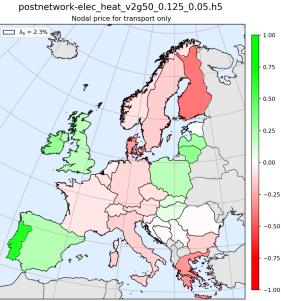
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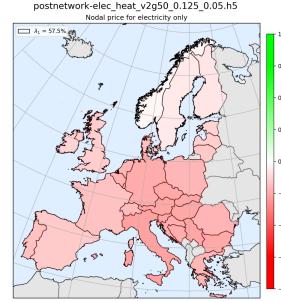
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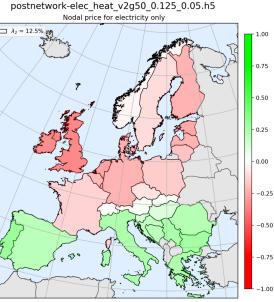
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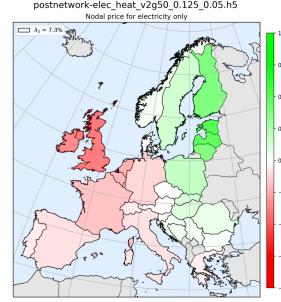
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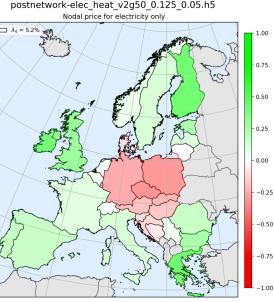
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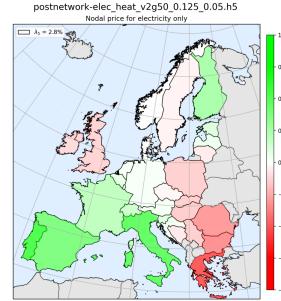
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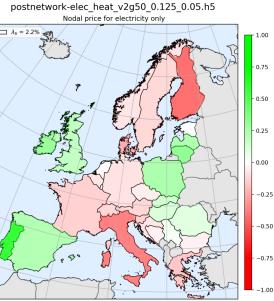
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5)



6)



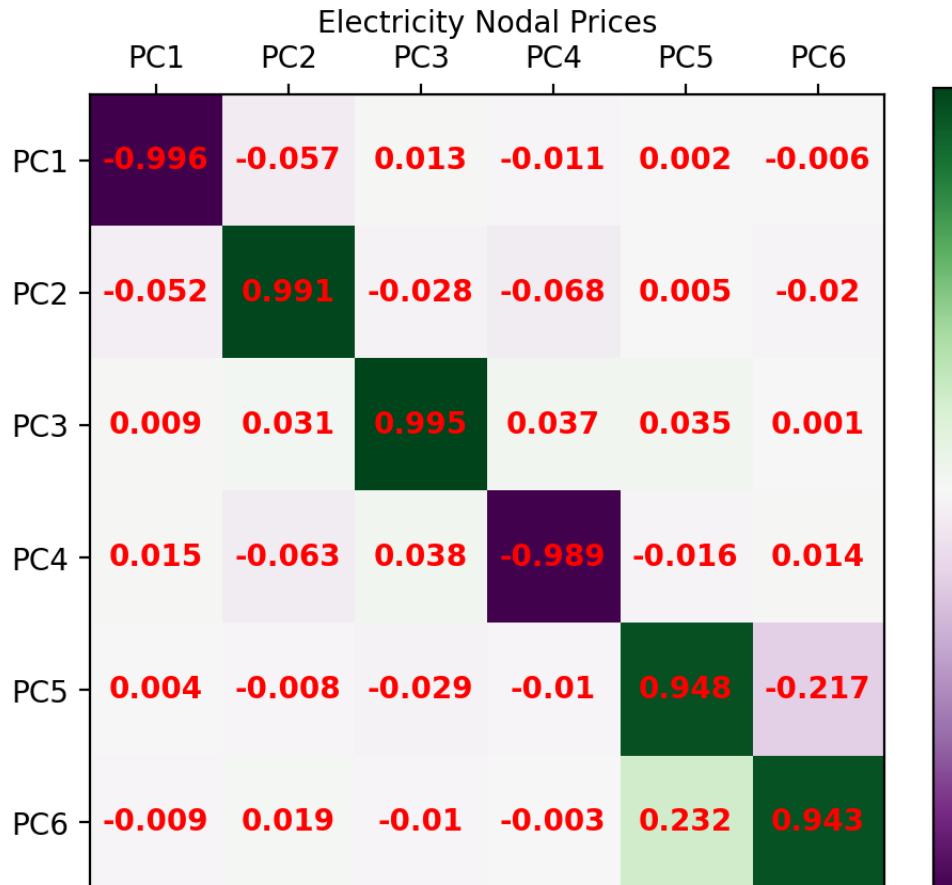
# Coherence Method 3

TNP

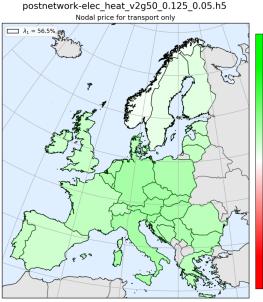
postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

ENP

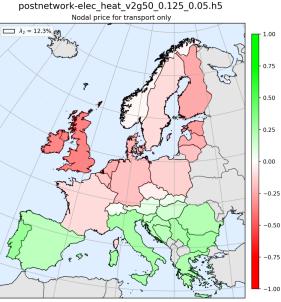
Coherence 3: Electricity and transport nodal prices



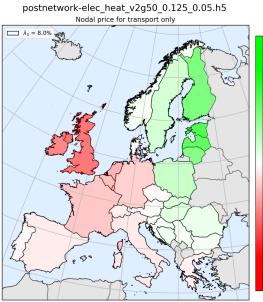
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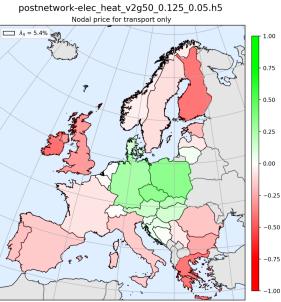
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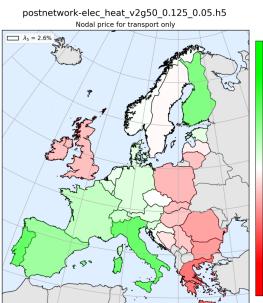
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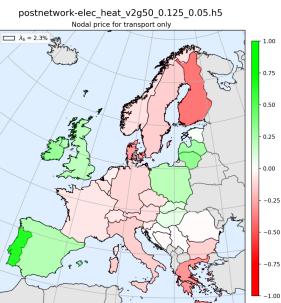
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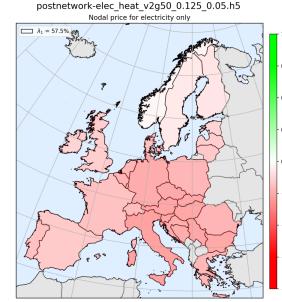
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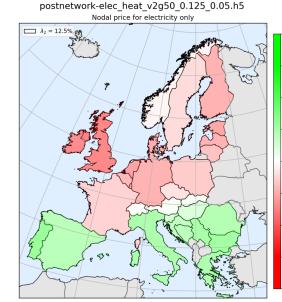
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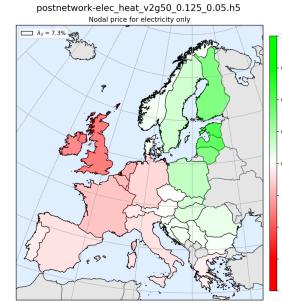
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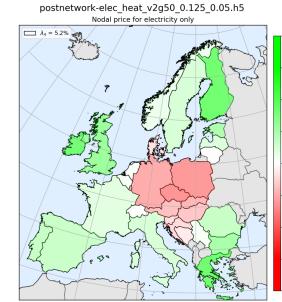
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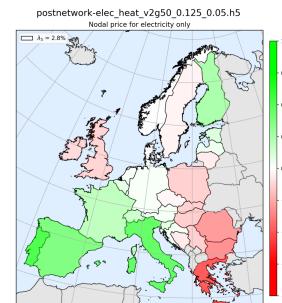
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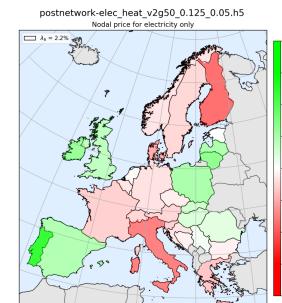
4)



5)



6)



# Electricity Coupled with the Heating and Transport Sector

Heating NP and Transport NP Coherence

# Coherence Method 1

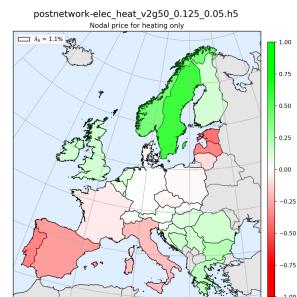
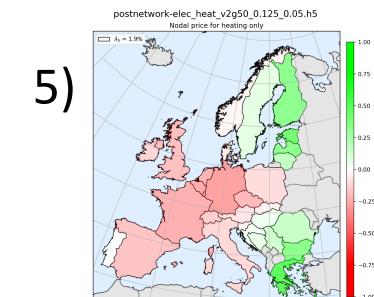
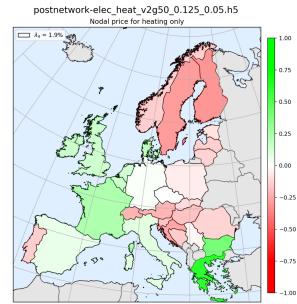
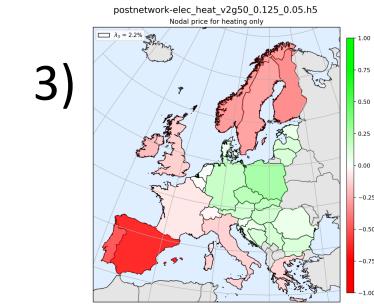
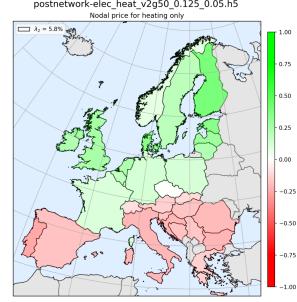
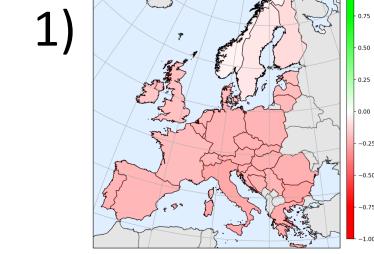
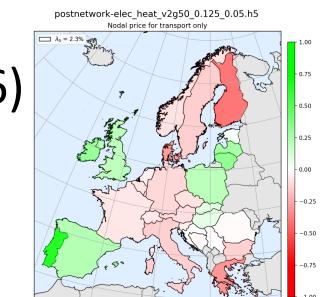
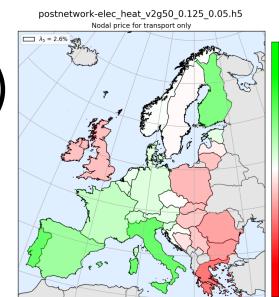
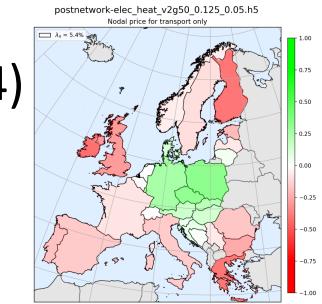
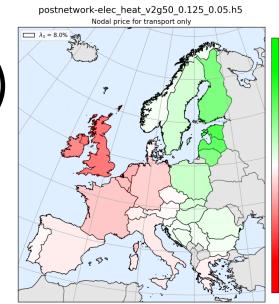
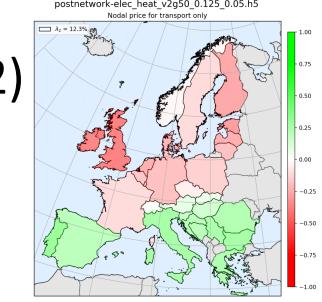
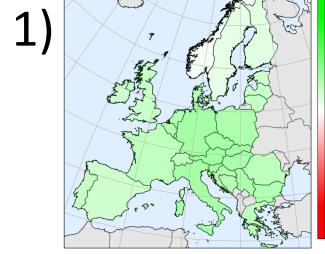
TNP

postnetwork-elec\_heat\_v2g50\_0.125\_0.05.h5

HNP

Coherence 1: Heating and transport nodal prices

	Heating Nodal Prices						
	PC1	PC2	PC3	PC4	PC5	PC6	
PC1	0.988	0.007	0.095	0.026	0.075	0.032	1
PC2	0.024	0.949	0.083	0.002	0.194	0.013	
PC3	0.035	0.184	0.139	0.476	0.711	0.268	
PC4	0.115	0.102	0.628	0.271	0.492	0.102	
PC5	0.002	0.05	0.497	0.299	0.338	0.432	
PC6	0.051	0.109	0.173	0.185	0.121	0.463	



# Coherence Method 2

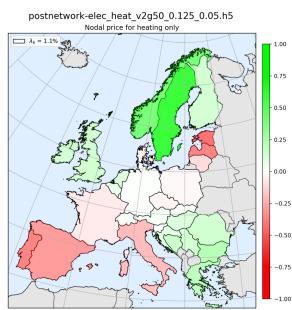
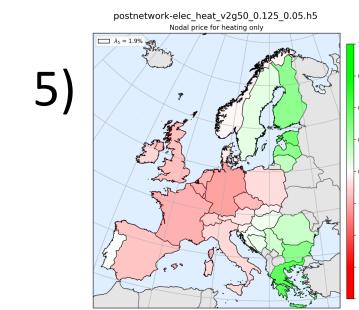
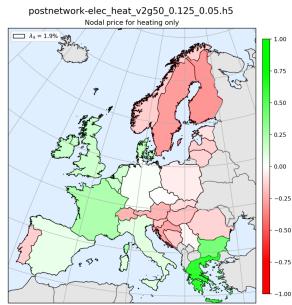
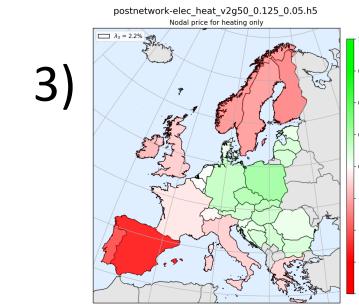
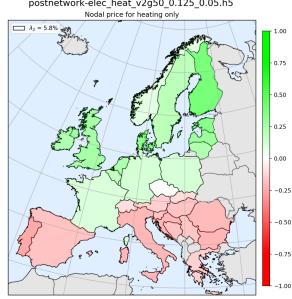
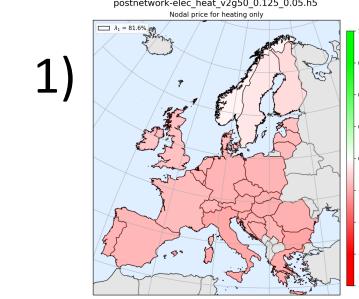
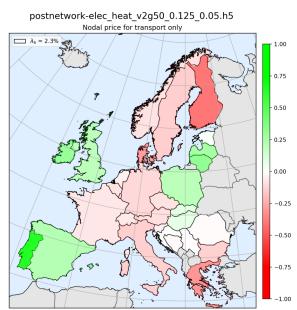
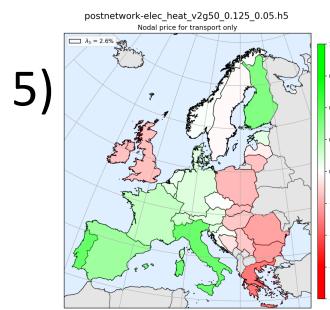
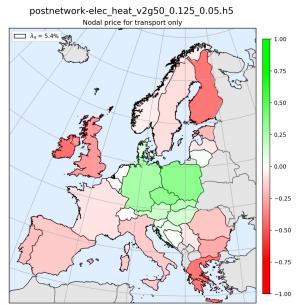
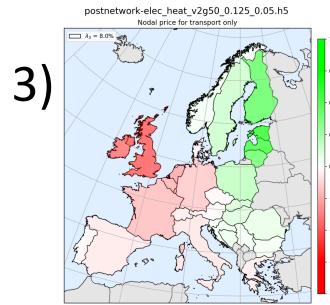
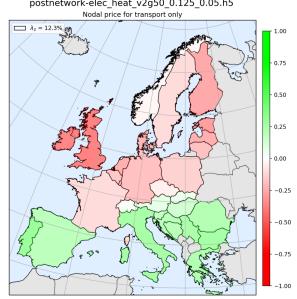
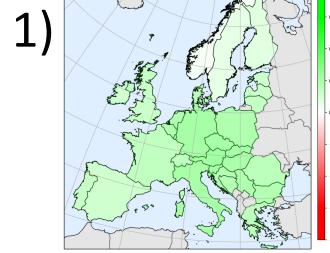
TNP

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HNP

Coherence 2: Heating and transport nodal prices

	Heating Nodal Prices					
	PC1	PC2	PC3	PC4	PC5	PC6
Transport Nodal Prices	0.671	0.001	0.011	0.003	0.008	0.003
PC1	0.007	0.08	0.004	0.0	0.009	0.0
PC2	0.009	0.012	0.006	0.018	0.028	0.008
PC3	0.024	0.006	0.022	0.009	0.016	0.002
PC4	0.0	0.002	0.012	0.007	0.008	0.007
PC5	0.007	0.004	0.004	0.004	0.003	0.007
PC6	1					



# Coherence Method 3

TNP

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HNP

Coherence 3: Heating and transport nodal prices

	Heating Nodal Prices					
	PC1	PC2	PC3	PC4	PC5	PC6
Transport Nodal Prices	-0.783	0.098	0.049	-0.065	-0.225	0.078
PC1	-0.2	-0.795	0.032	-0.006	0.075	-0.111
PC2	-0.121	0.128	0.03	-0.553	0.505	-0.094
PC3	0.274	-0.032	0.442	-0.203	-0.299	-0.087
PC4	-0.041	0.003	-0.309	-0.149	-0.179	-0.308
PC5	0.092	-0.162	-0.006	-0.121	-0.018	-0.326
PC6						

