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The Market Value of increased Solar Power Production in Winter

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Introduction

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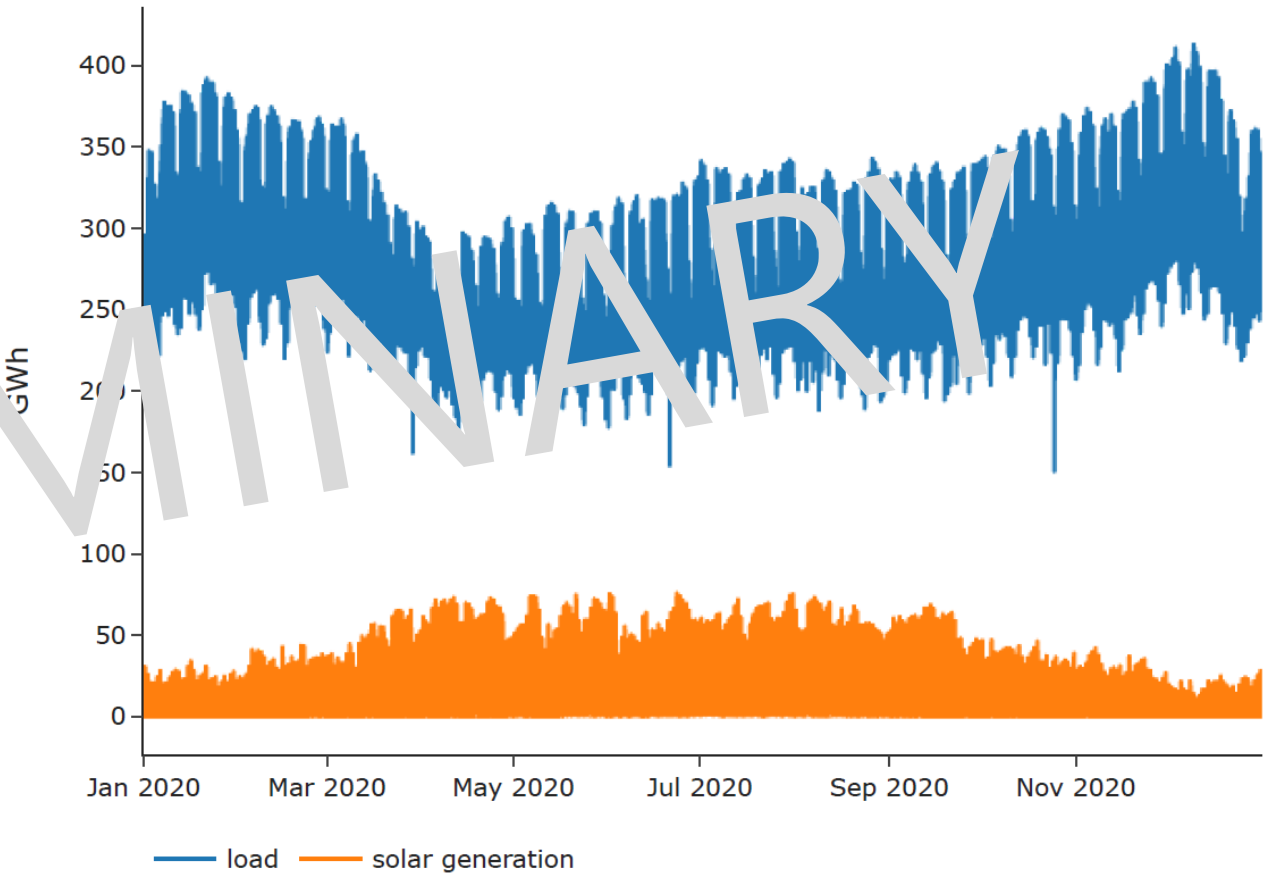
Discussion

Electricity will be essential for decarbonization

- Decarbonization of the energy system by 2050 following Paris agreement or the European Clean Energy Package
- Electricity sector will play a leading role
  - expansion of renewable generation capacities
  - electrification of other sectors
- Solar PV expected to be one of the major drivers of the global expansion of renewable capacities in the coming decades
  - investment costs for solar PV panels have been falling rapidly and are expected to decrease further
  - solar power now cheaper than coal and gas in most countries
- However, at high levels of solar penetration, there is a mismatch between electricity demand and production, within the day and between seasons

There is a mismatch between solar generation and electricity demand

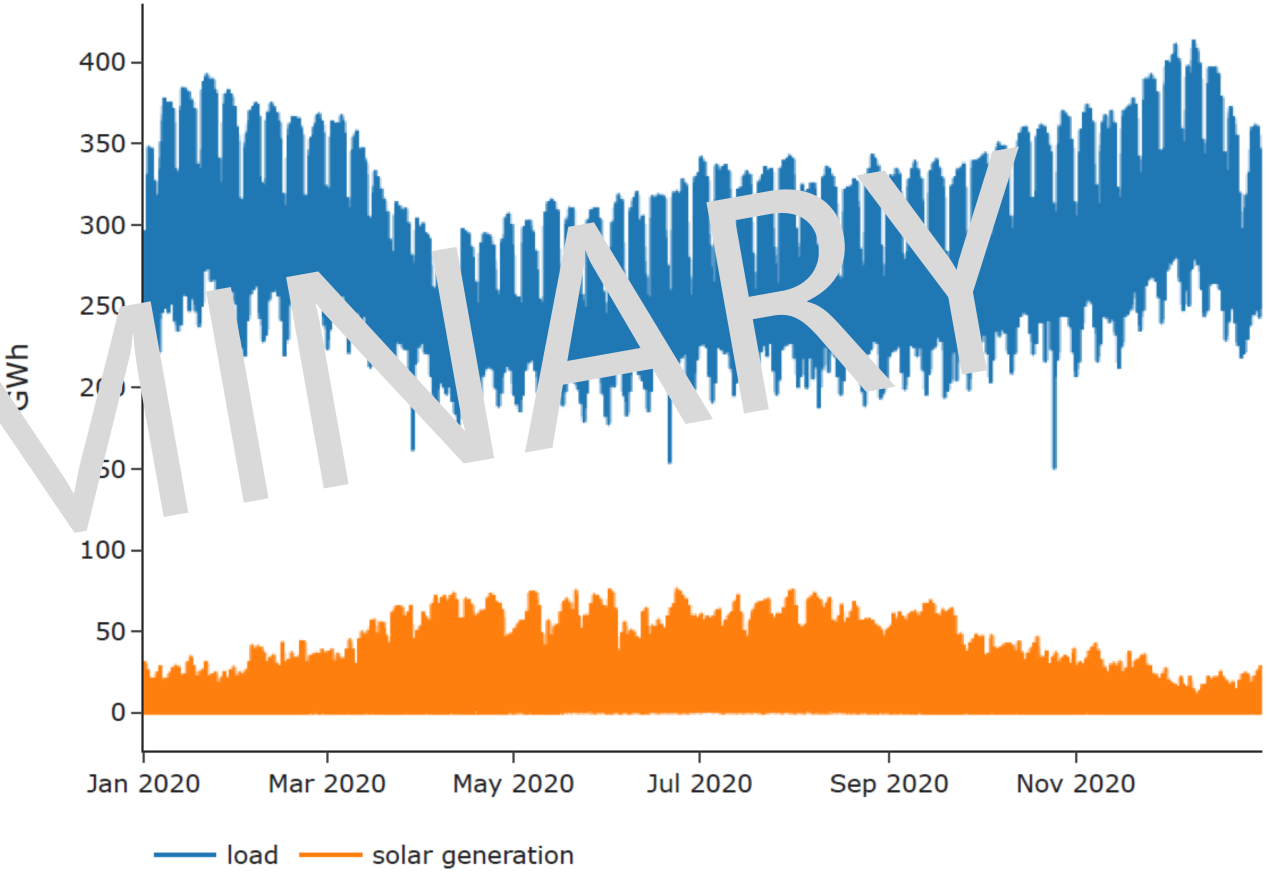
- Seasonal mismatches between high demand in the colder and darker winter months and high solar generation in summer
- Seasonal storage options, grid expansions or additional wind power capacity



There is a mismatch between solar generation and electricity demand

- Seasonal mismatches between high demand in the colder and darker winter months and high solar generation in summer
- Seasonal storage options, grid expansions or additional wind power capacity

- **Or placing solar PV in locations that have a different seasonal profile with a much higher level of winter production**




PRELIMINARY

Market value approach

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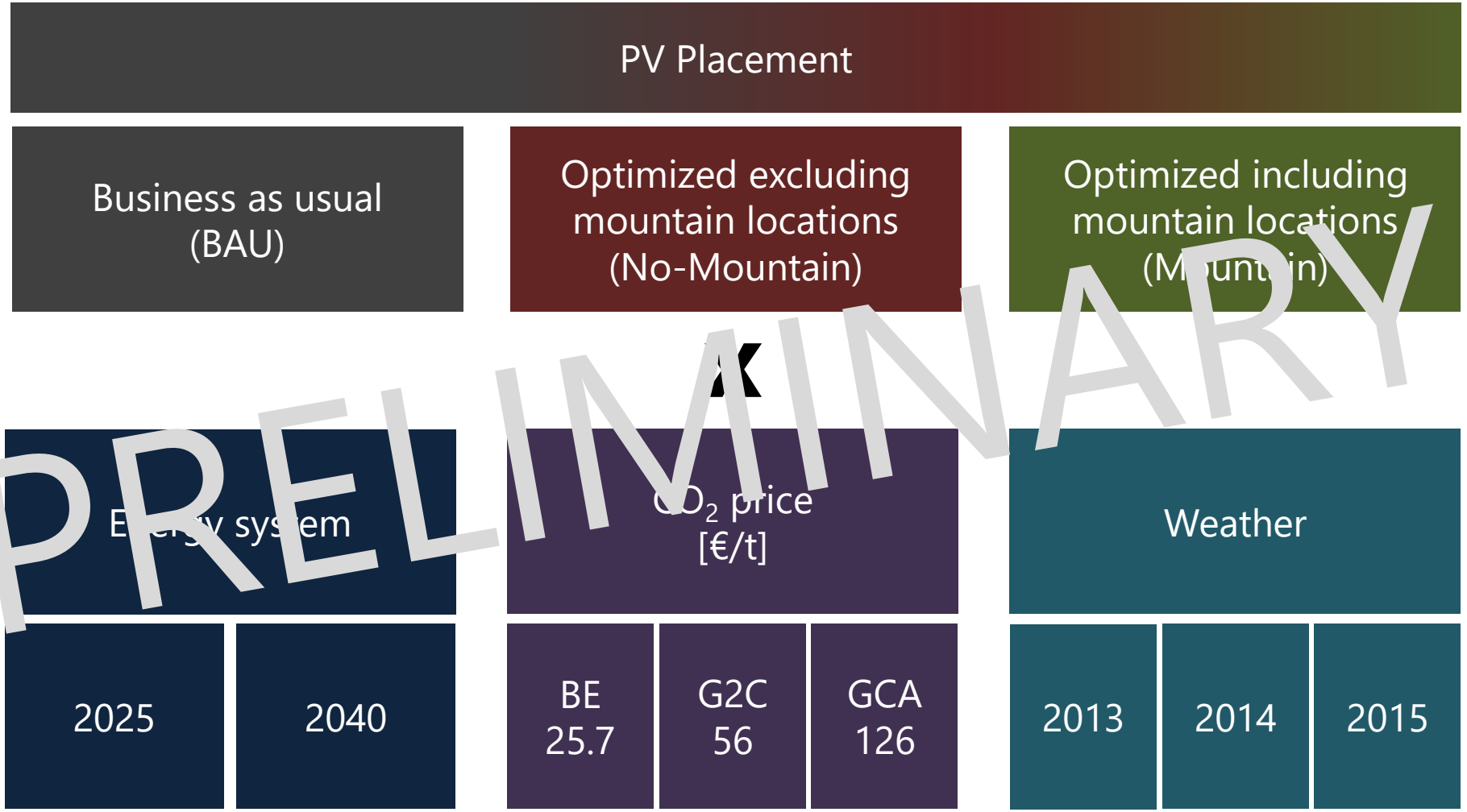
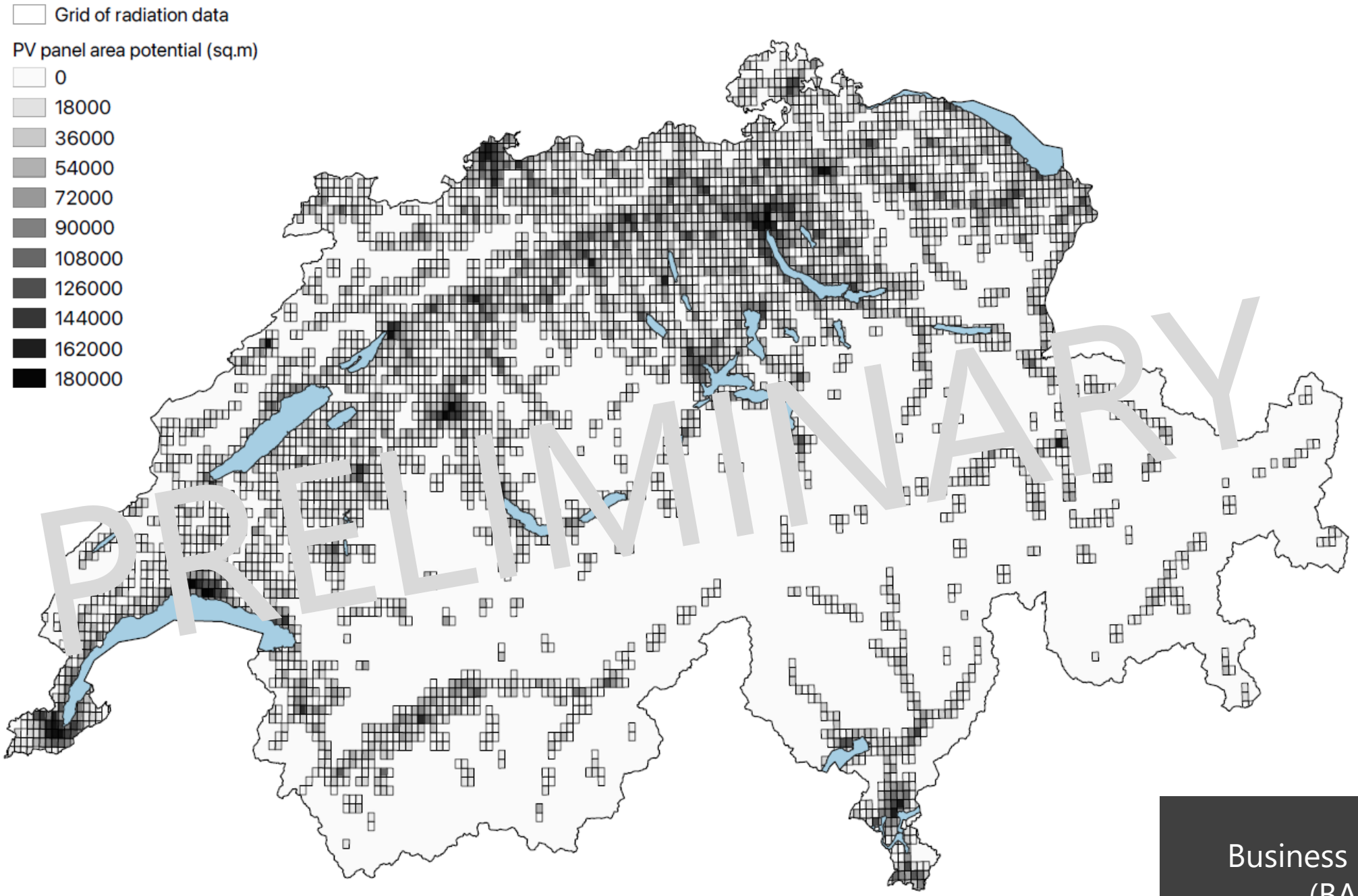
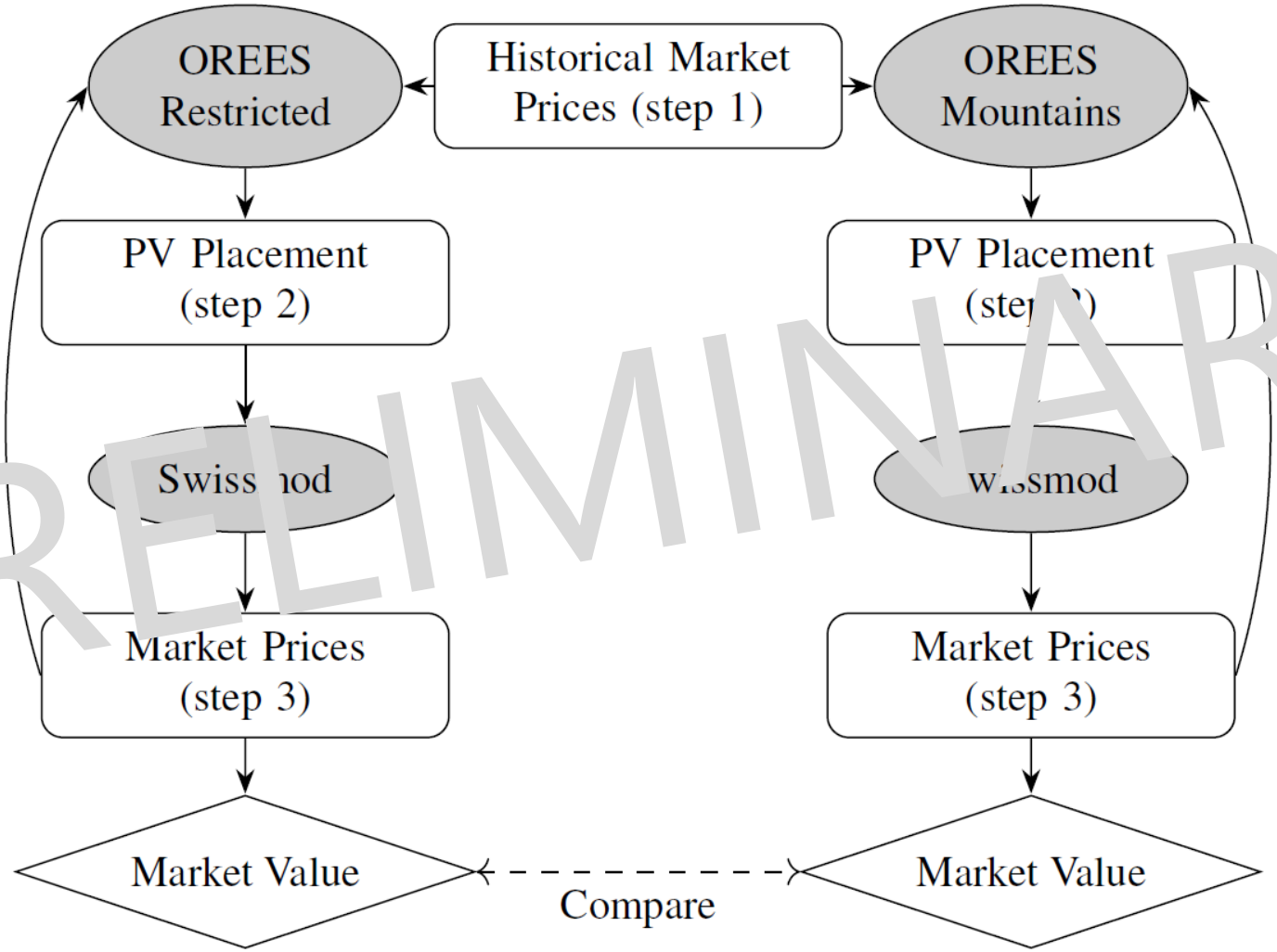




Business as usual (BAU)

Model framework



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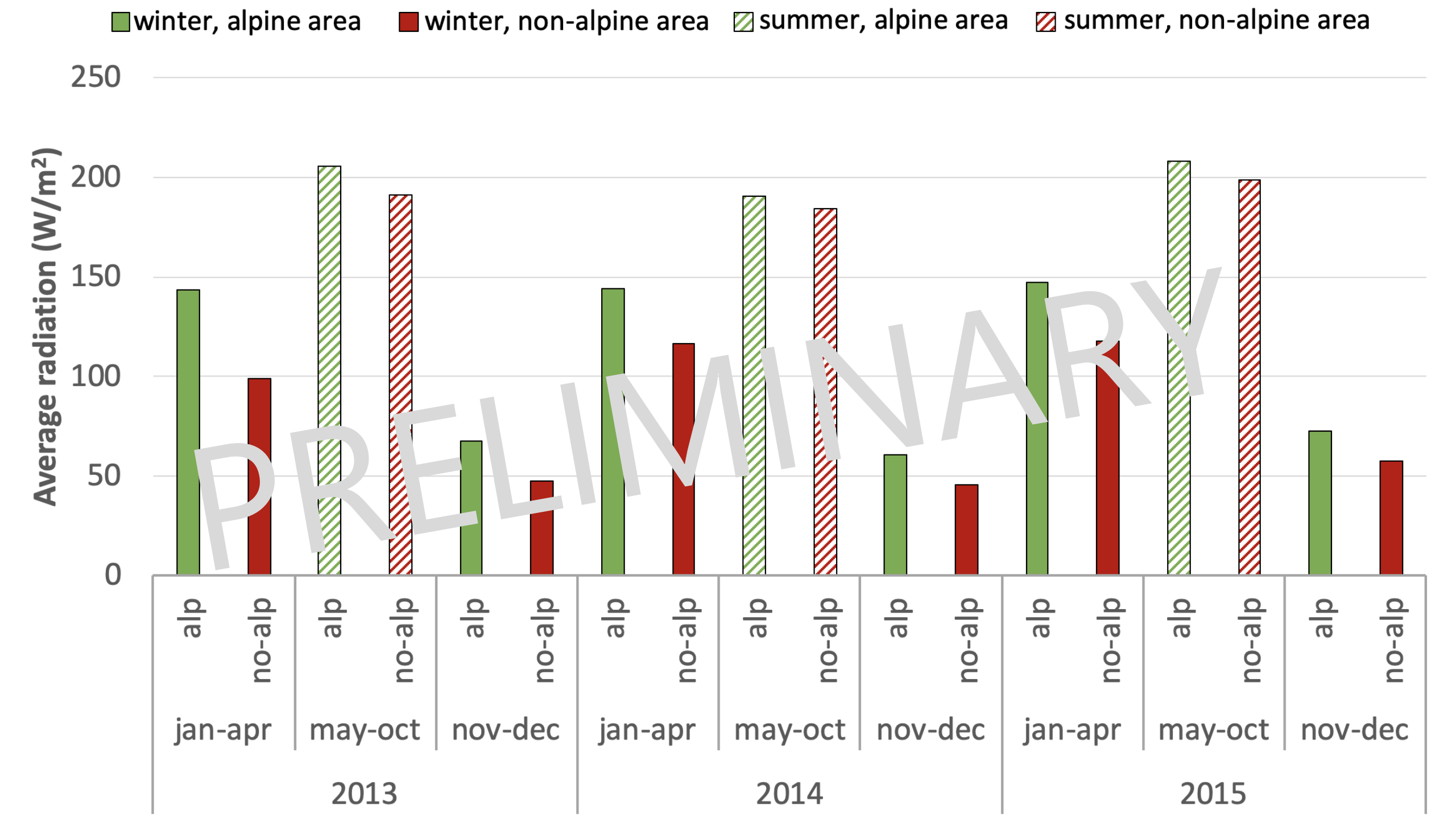
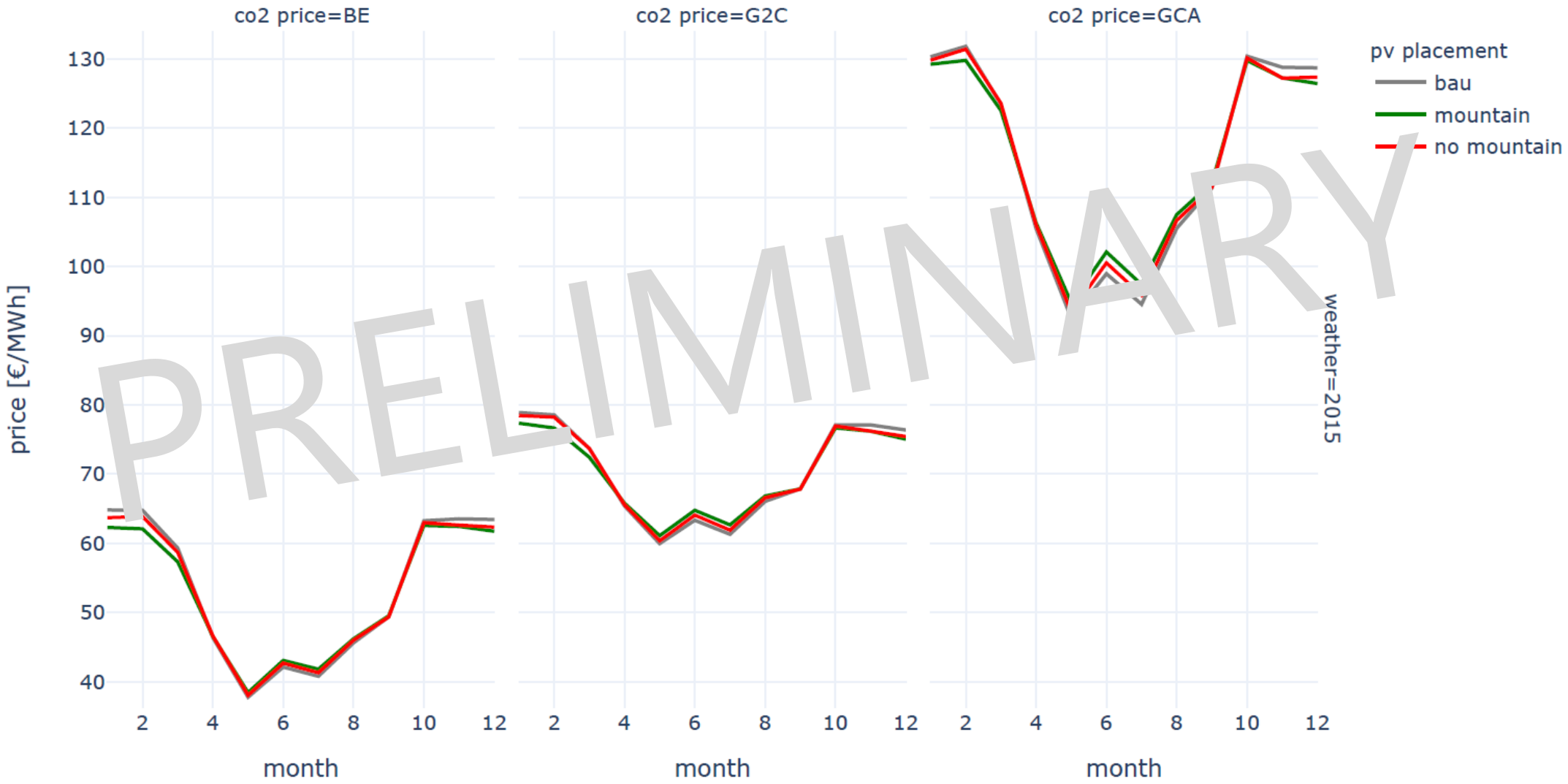
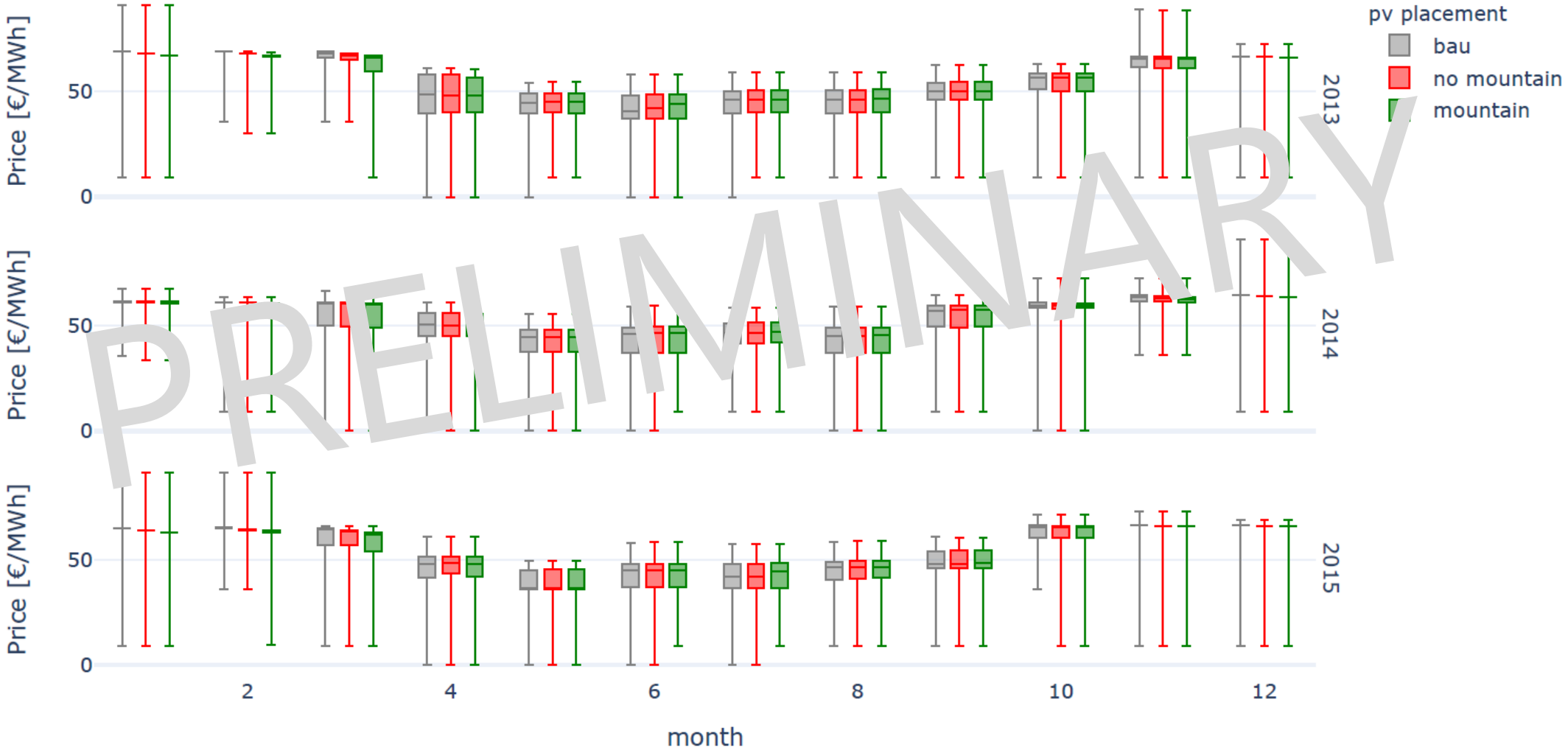
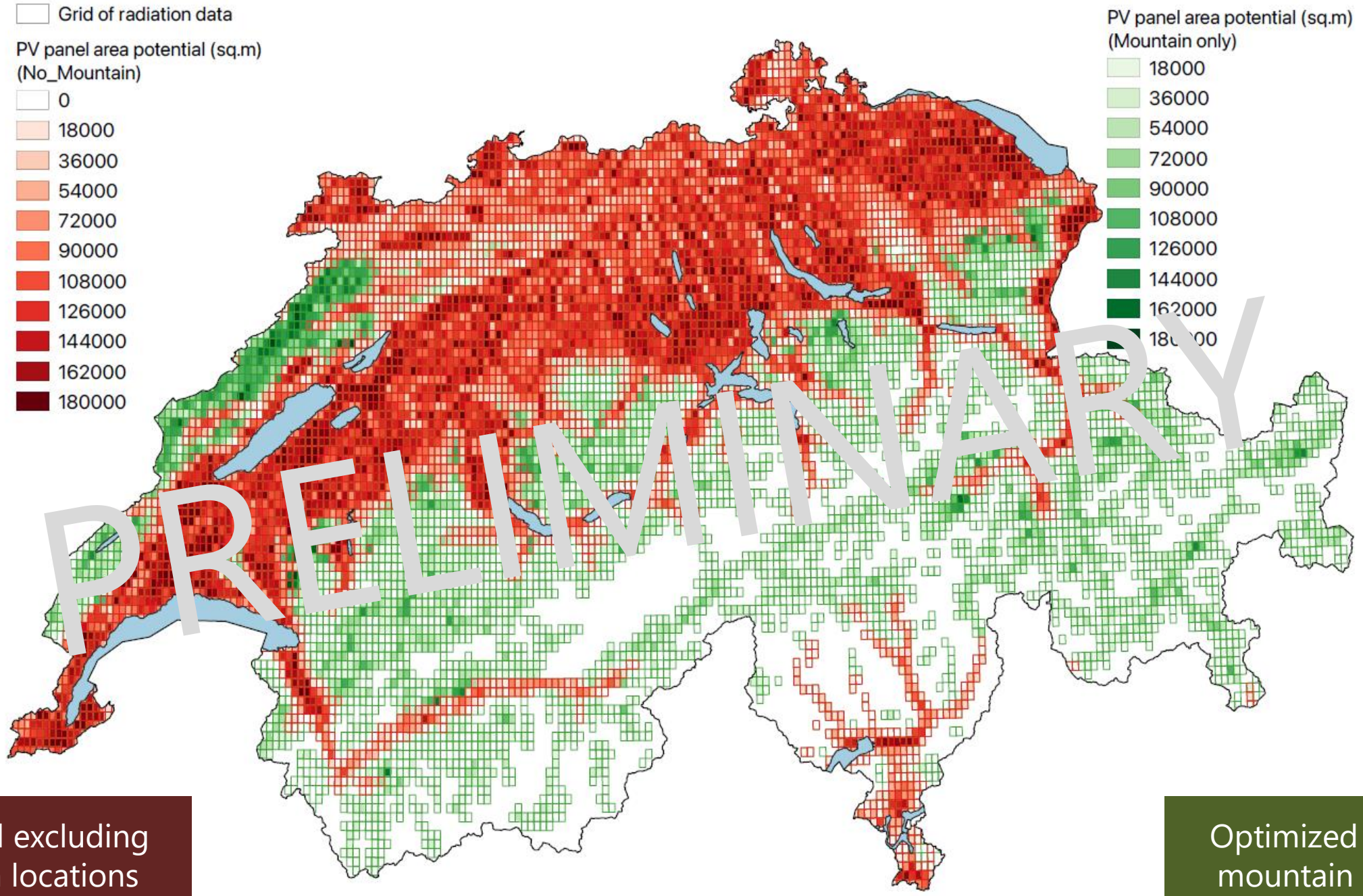

winter, alpine area
winter, non-alpine area
summer, alpine area
summer, non-alpine area
Average radiation (W/m²)
250
200
150
100
50
0
PRELIMINARY
alp
no-alp
jan-apr
may-oct
nov-dec
2013
2014
2015

Electricity prices decrease in winter and increase in summer



Electricity price variation increases in winter and decreases in summer





Optimized excluding mountain locations (No-Mountain)

Optimized including mountain locations (Mountain)

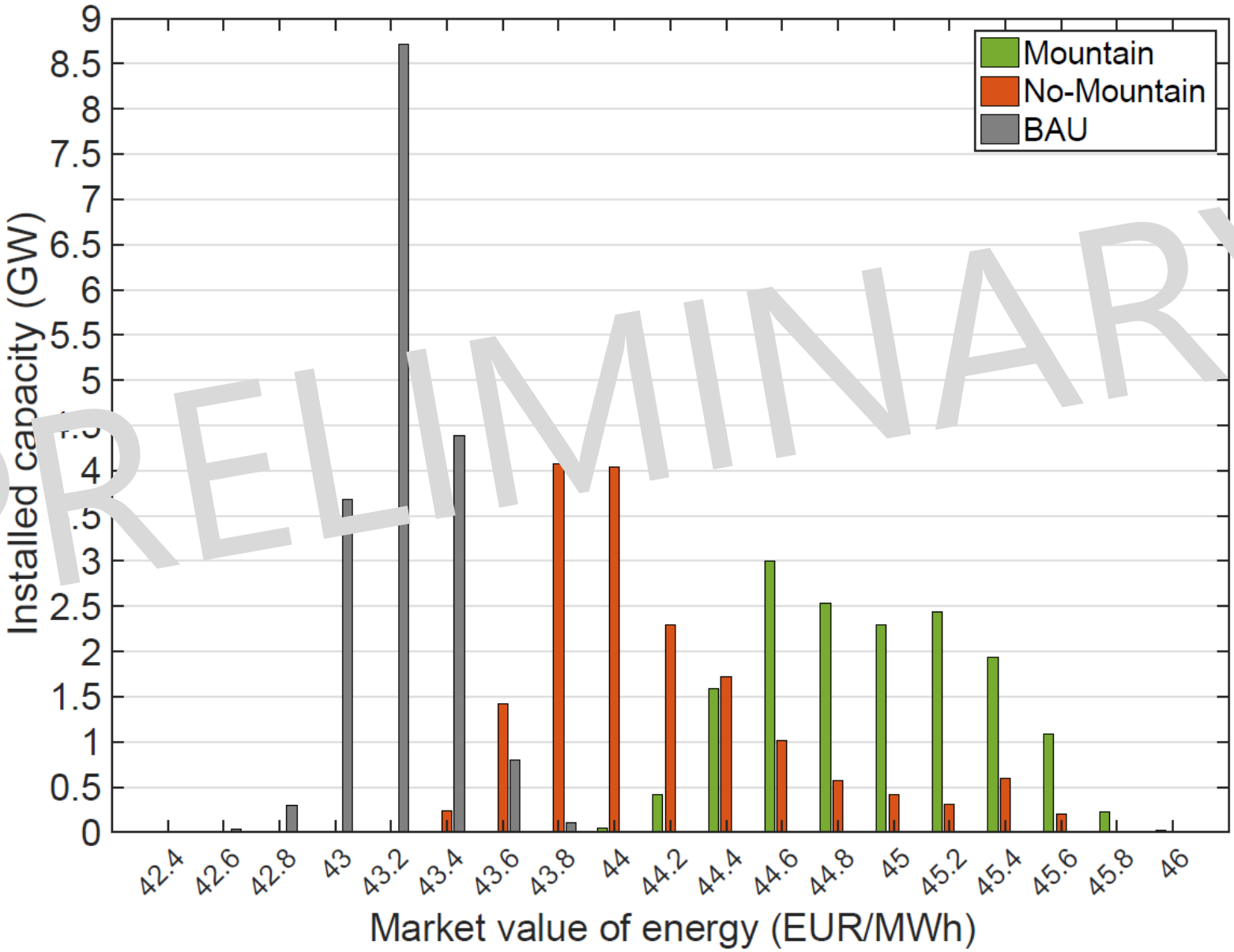
Mountain scenario increases market value

Energy system	CO2 price	PV placement	Value factor	Change in market value of energy	Change in market value of panel capacity
2025	BE	BAU	0.82	-	-
		No-Mountain	0.83	+ 1.42%	+ 8.17%
		Mountain	0.85	+ 3.2 %	19.28%
	G2C	BAU	.86	-	-
		No-M un a n	0 38	1.0%	+ 8.10%
		Moun in	0. 9	+ 3.07%	+ 19.34%
	C CA	AU	0.84	-	-
		No-Mountain	0.85	+ 1.75%	+ 8.49%
		Mountain	0.87	+ 4.17%	+ 20.35%
2040		BAU	0.66	-	-
		No-Mountain	0.68	+ 3.32%	+ 9.10%
		Mountain	0.71	+ 6.55%	+ 21.98%

Results hold across weather years

Weather	PV placement	Value factor	Change in market value of energy	Change in market value of panel capacity
2013	BAU	0.82	-	-
	No-Mountain	0.83	2.1[illegible]%	8.[illegible]2%
	Mountain	0.85	[illegible]04[illegible]%	24.5[illegible]%
2014	BAU	[illegible]86	-	-
	No-Mountain	0.[illegible]	0.35%	5.78%
	Mountain	0.89	2.12%	13.91%
2015	BAU	0.84	-	-
	No-Mountain	0.85	1.42%	8.17%
	Mountain	0.87	3.21%	19.28%

Distribution of market value is strongly shifted



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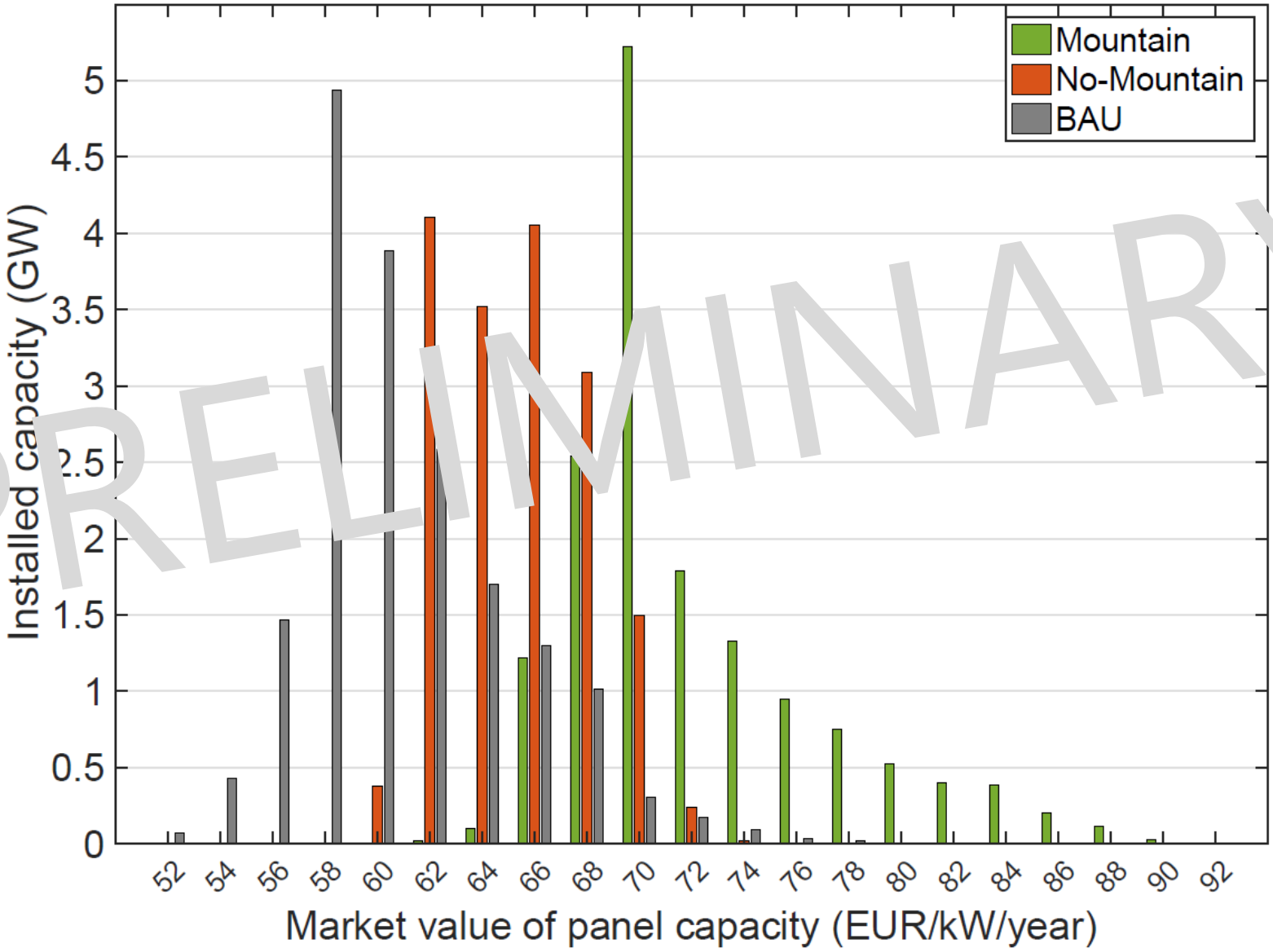
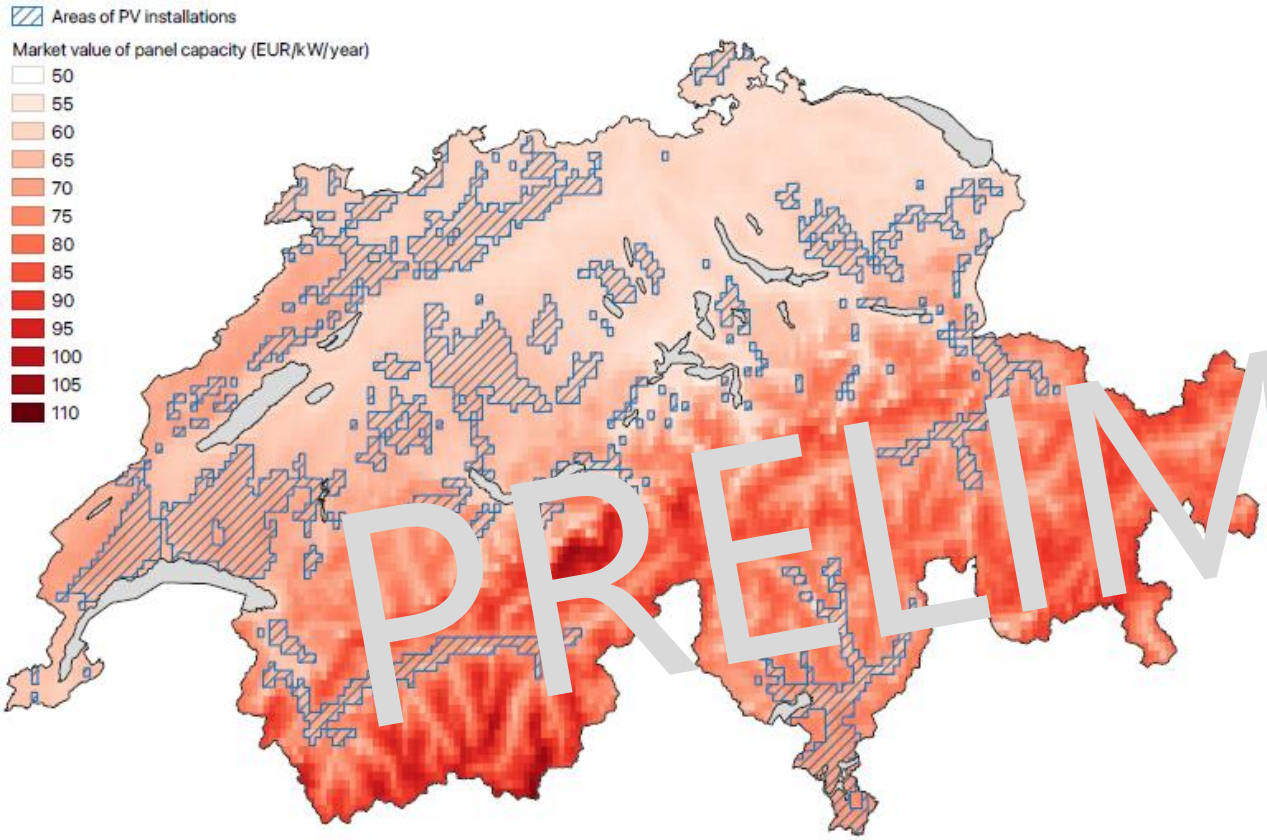
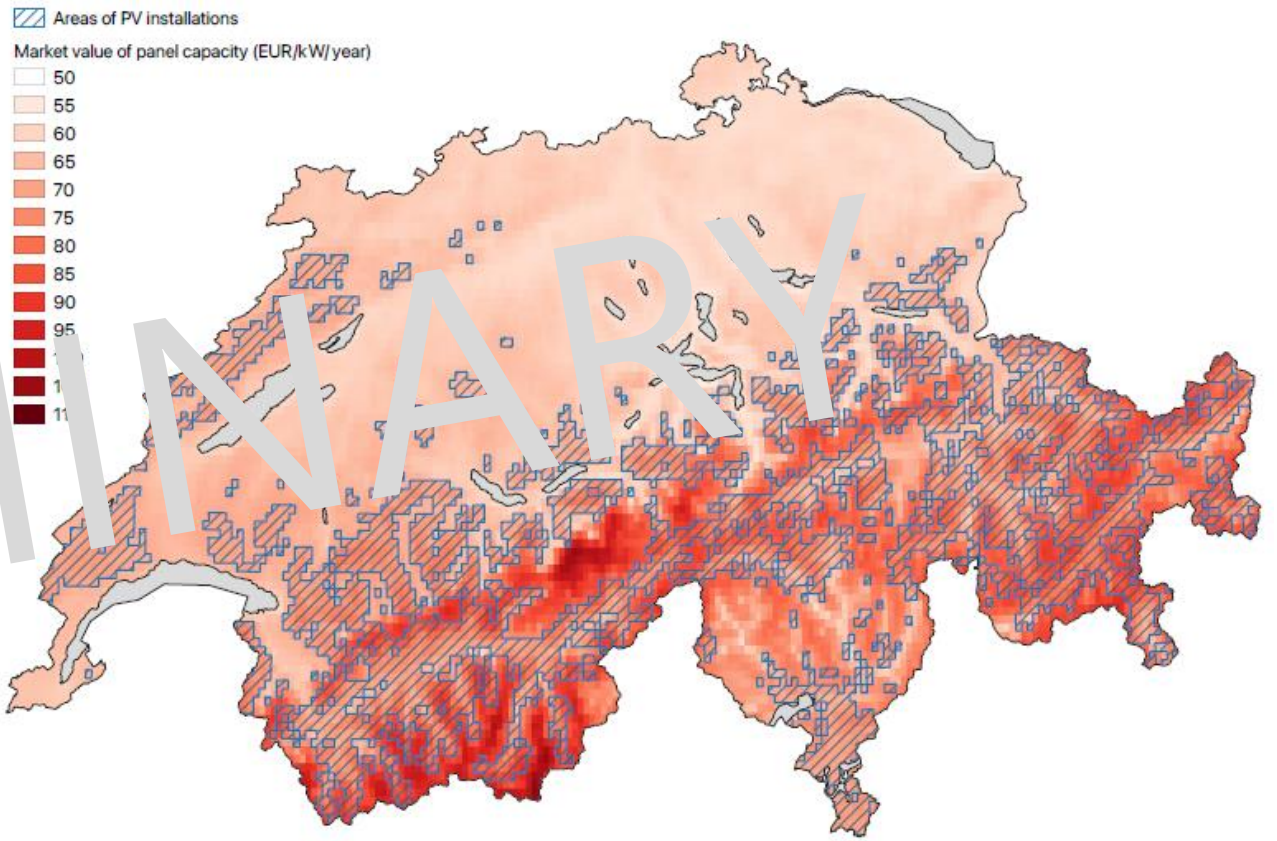




2015 No-Mountain



2015 Mountain

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