Comparing the system costs of baseload from CSP and nuclear power under high renewables scenarios in South Africa

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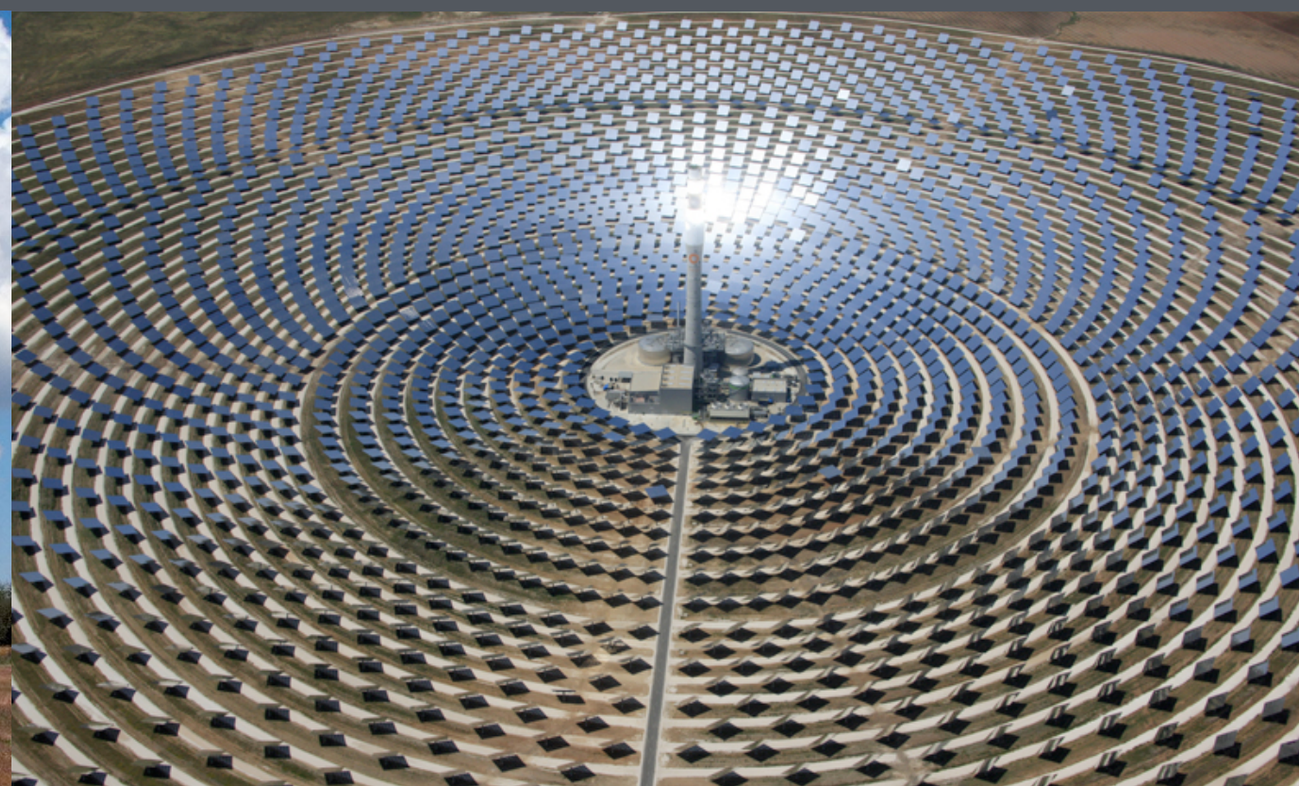
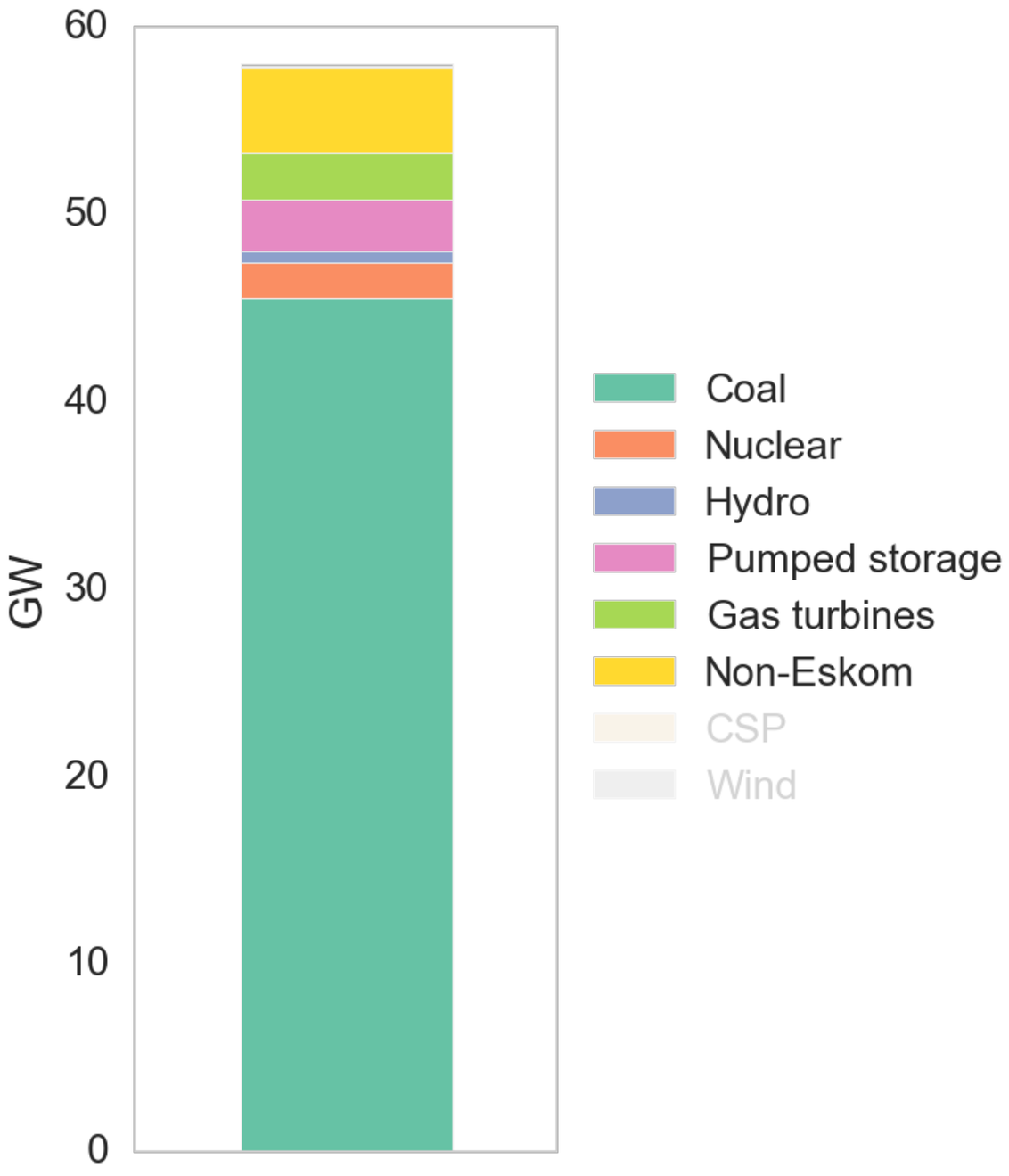
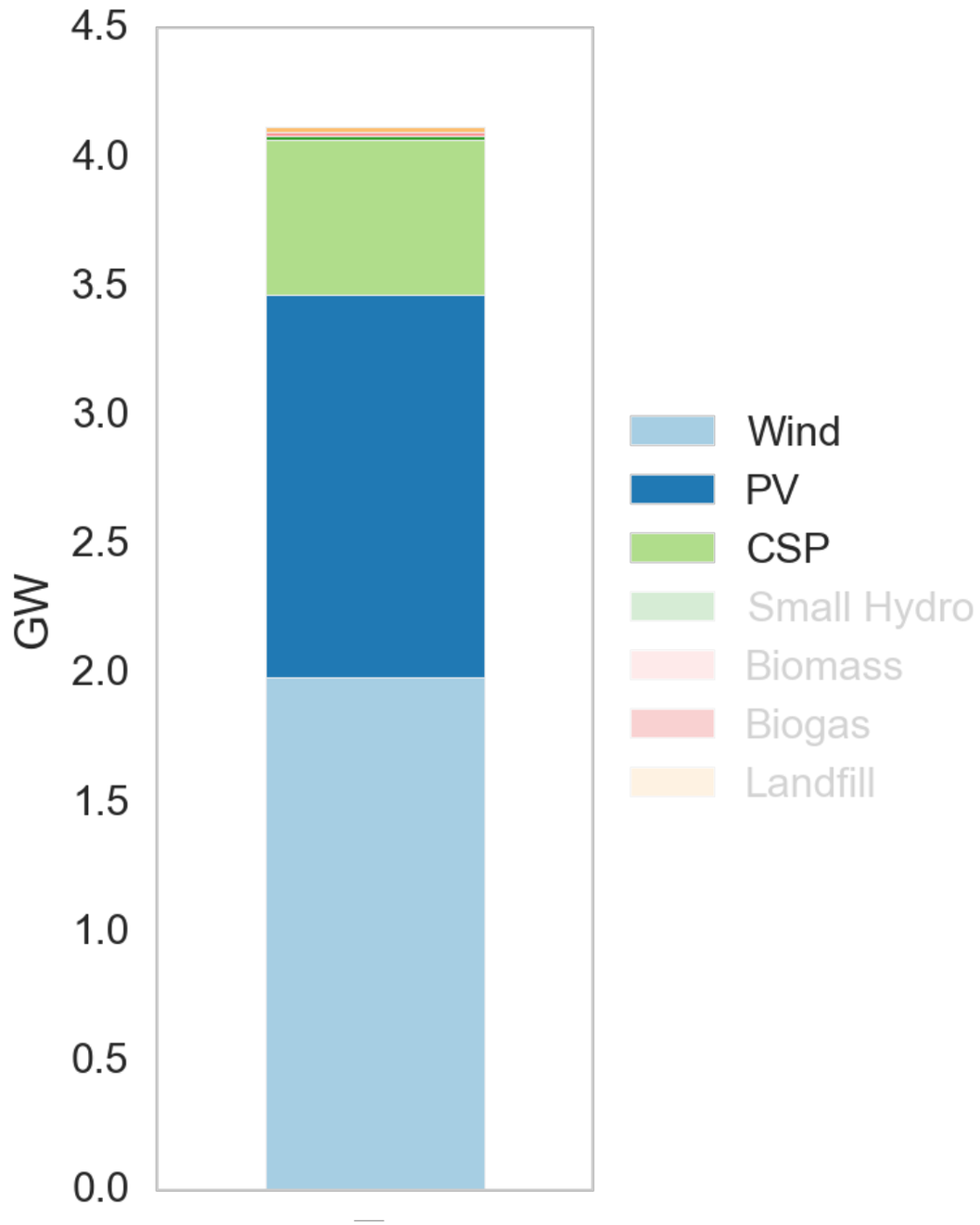
Image sources:
https://commons.wikimedia.org/wiki/File:Gemasolar.jpg
http://inweekly.net/wordpress/wp-content/uploads/2011/03/cooling-towers-of-a-nuclear-power-station.jpg



South Africa's power system



Current capacity



Renewable allocations to date

Baseload

Concentrating solar power (CSP)

Plants (NREL database):
54 operating

Investment:
8092 USD/kW

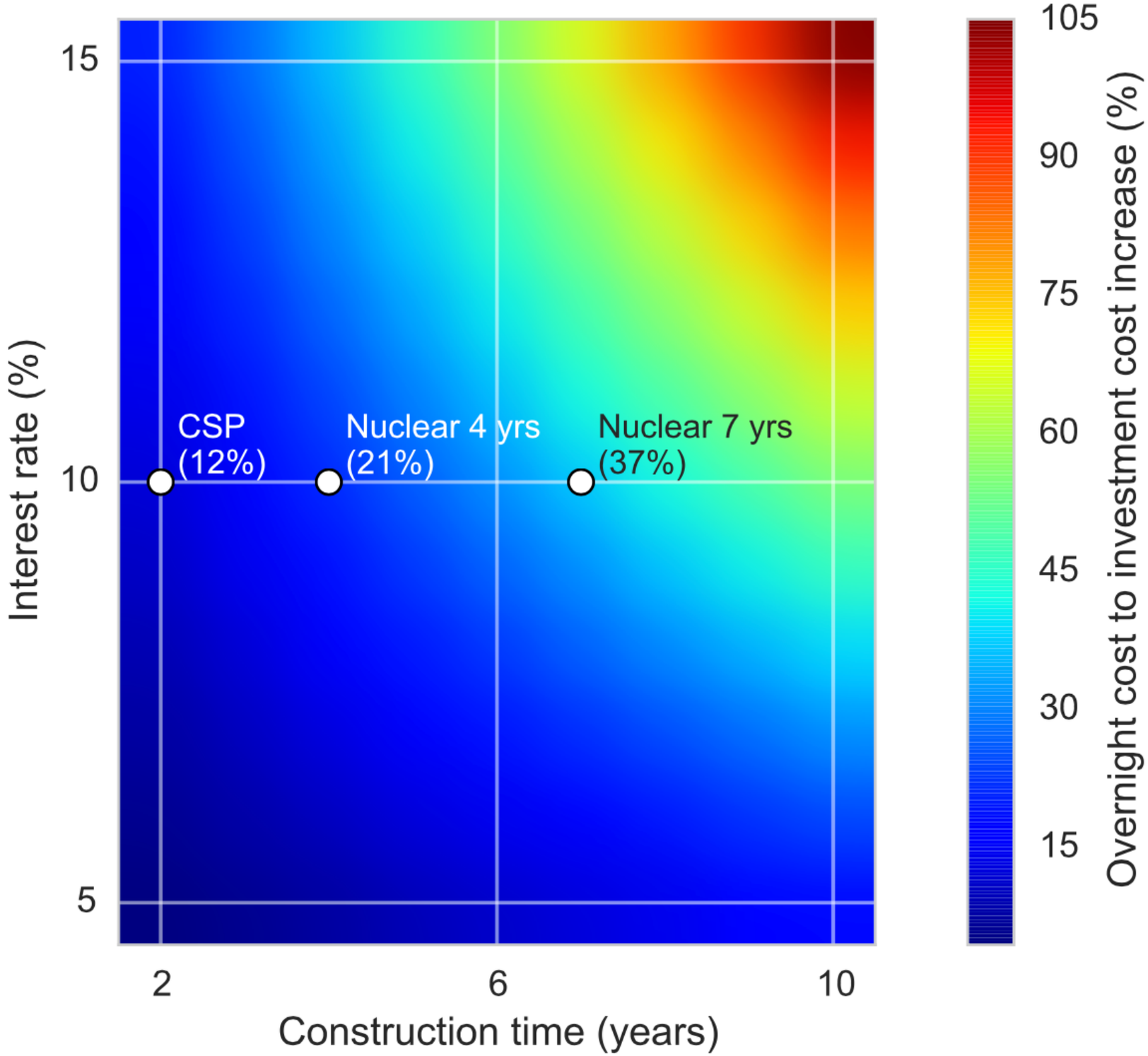
(2012 USD, based on current SA project cost with 2 hours of storage)

Nuclear

Investment/kW,
2012 USD,
incl. decommissioning:

Olkiluoto-3	7430
Flamanville-3	7180
Hinkley Point C	8567
Taishan 1&2	**2837**
IEA Africa	**5910**
IEA China	**3170**
IEA Europe	9472
EIA	8006
IRP 2013 Upd.	**8376**

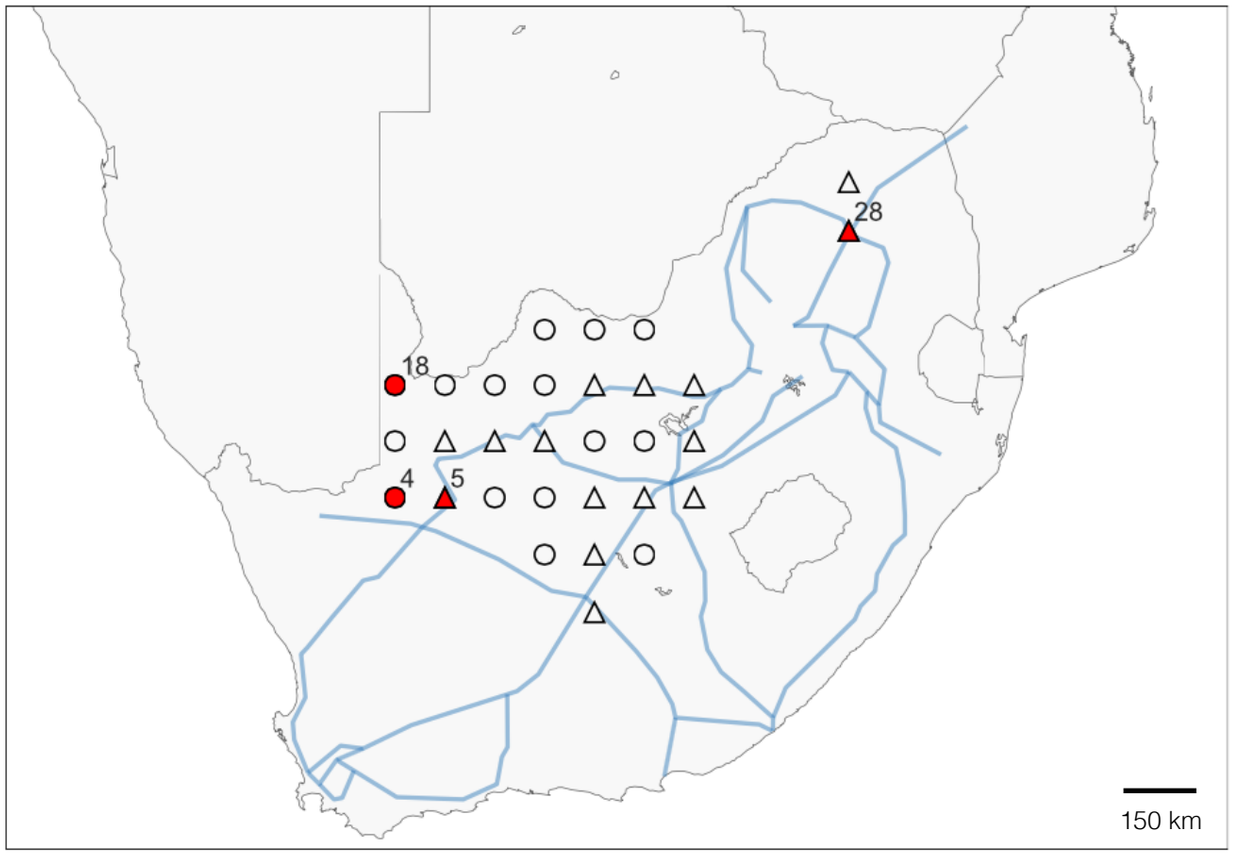
Construction time and interest rates



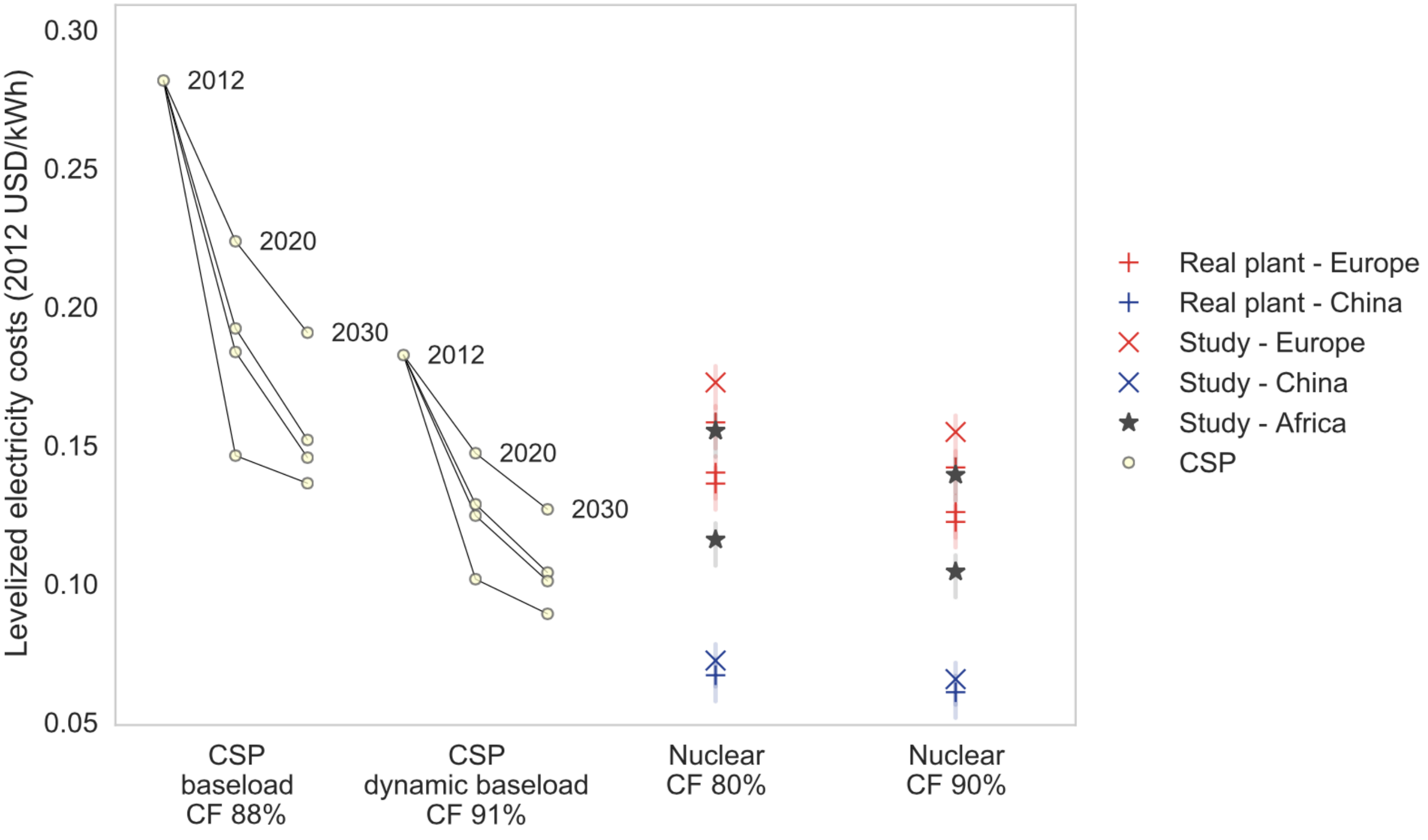
Model approach

Linear optimization of site selection, plant dimensioning and plant operation

Calliope modeling framework (www.callio.pe)



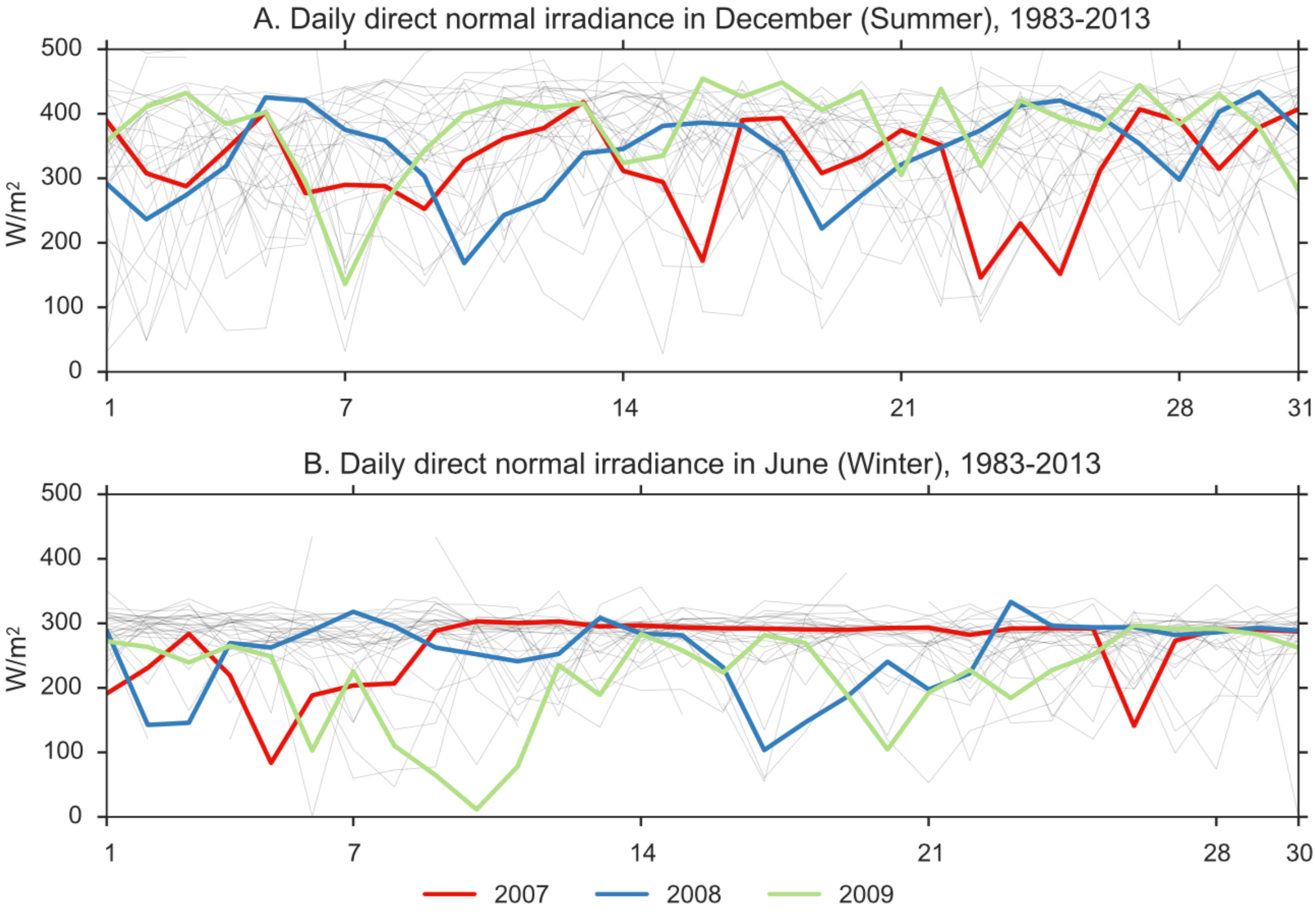
Levelized cost



Non-cost factors

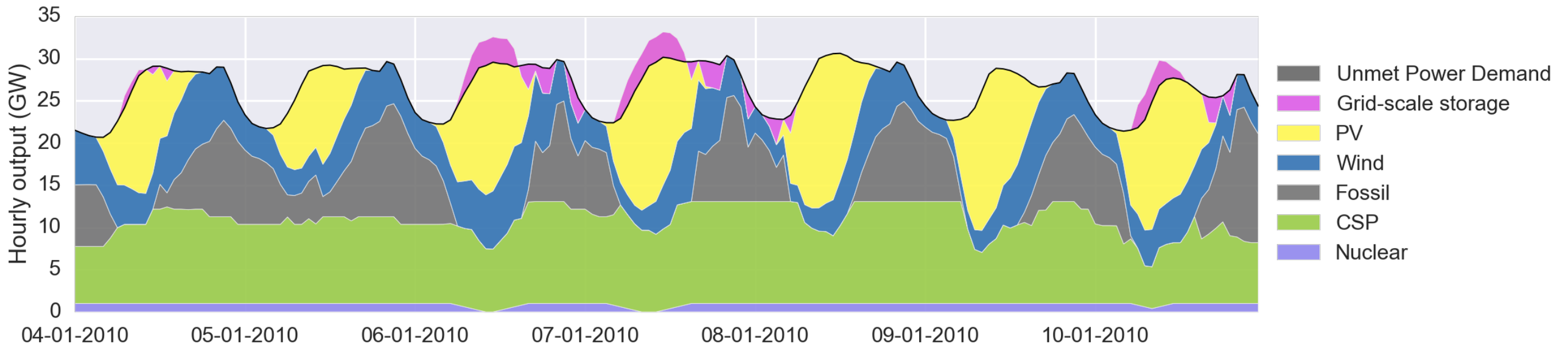
	Nuclear	CSP
Proven technology	✓	✓
Flexibility	?	✓
Environment	?	✓
Ease of deployment	?	✓
Vulnerability	?	?

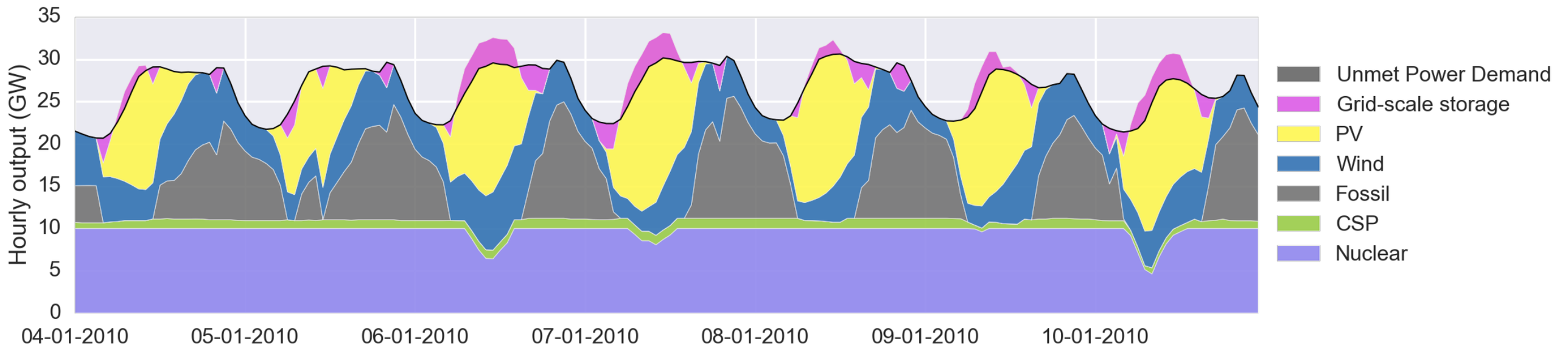
Non-cost factors: long-term climate



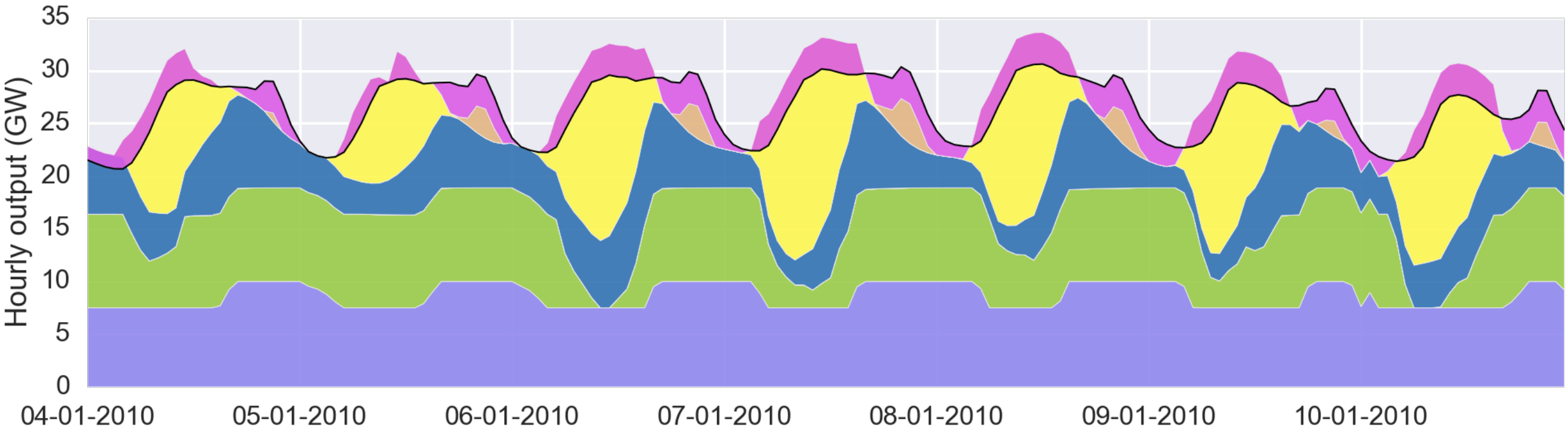
System Integration

System integration: operation





System integration: planning



Total generation LCOE (2012 USD):

0.08 USD/kWh

Conclusion

Summary

- Will baseload still be necessary?
- Perhaps. And if so, CSP could be cost-competitive with nuclear by 2030, or earlier.
- Flexible CSP could help balance a system with both variable renewables and nuclear power.
- CSP and nuclear may both have a role, in different parts of the world.

Contact

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More detail in paper, in press:

S. Pfenninger and J. Keirstead (2015). Comparing concentrating solar and nuclear power as baseload providers using the example of South Africa. *Energy* (in press). doi: 10.1016/j.energy.2015.04.077

Open-source modeling framework used:

www.callio.pe

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