Economic Value of CSP with Thermal Storage

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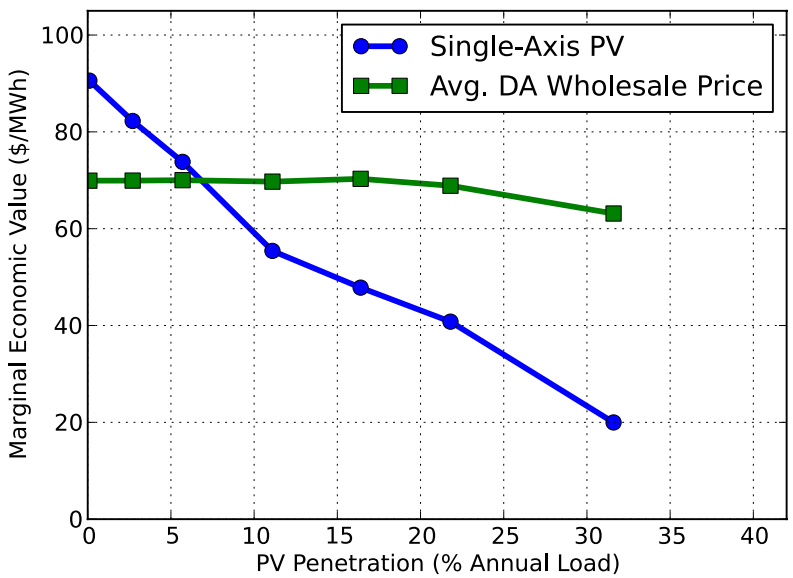
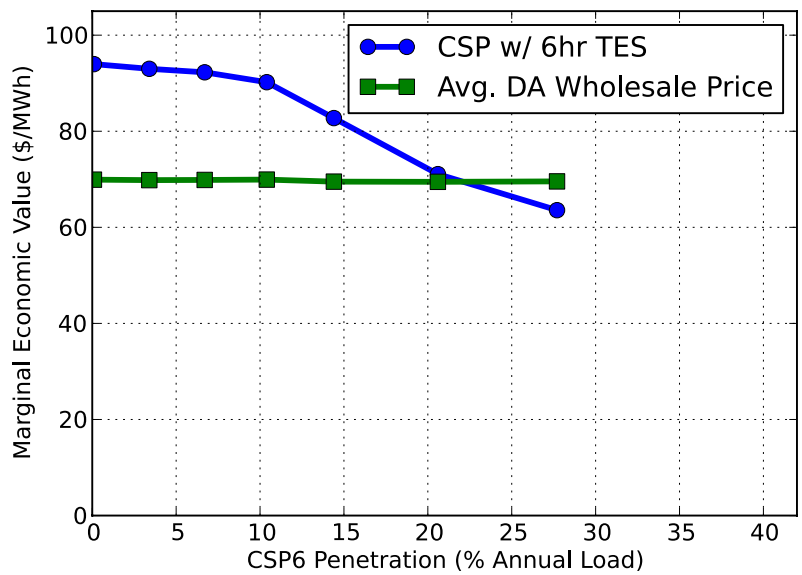
Marginal value of PV vs. CSP with thermal storage with increasing penetration





The benefits of thermal energy storage (TES) for CSP are increasing apparent relative to PV or CSP without TES at higher penetration levels.

The difference is primarily driven by the role of TES in maintaining the high capacity value and energy value of CSP with TES.

Marginal value of PV is high at low penetration due to high capacity value

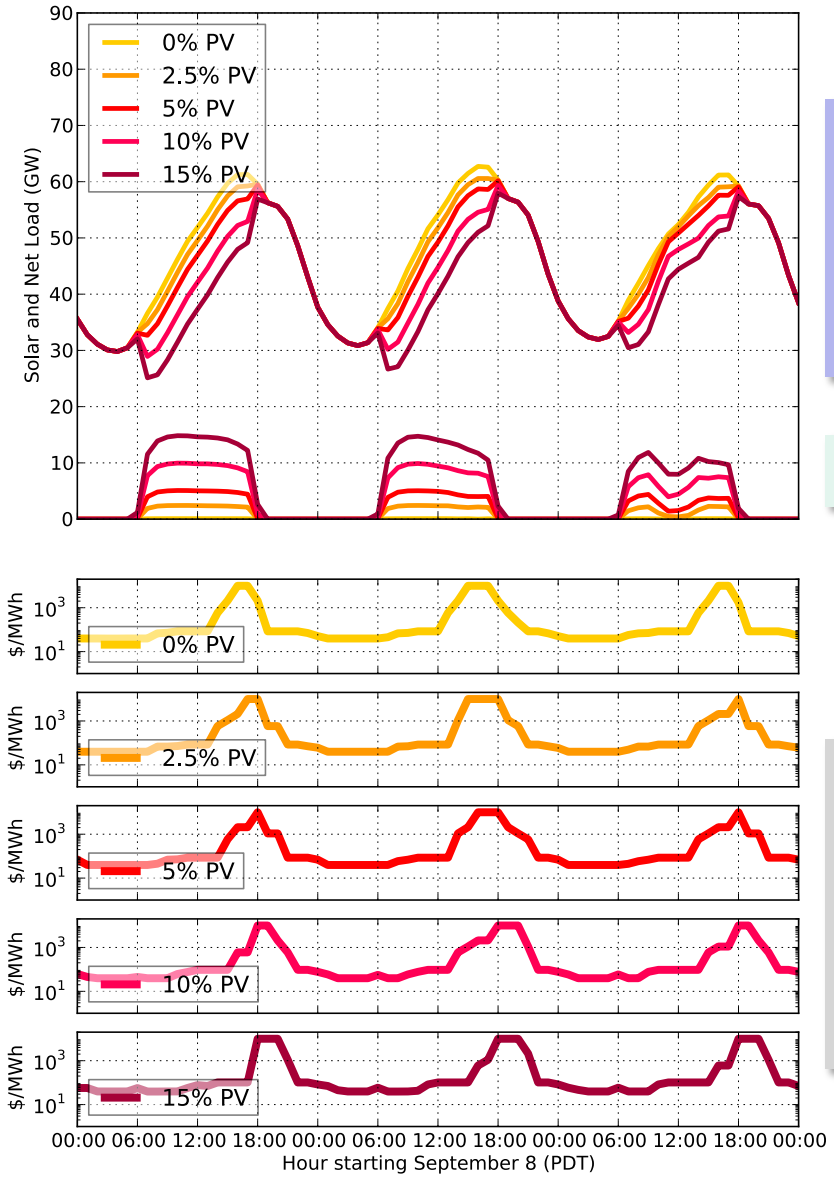
Component ($/MWh)	0% PV	2.5% PV	5% PV	10% PV	15% PV	20% PV	30% PV
+ Capacity Value (Capacity Value in $/kW-yr)	+37 (120)	+34 (110)	+27 (82)	+13 (39)	+8 (24)	+4 (11)	+1 (4)
+ Energy Value	+54	+53	+52	+49	+45	+41	+27
+ DA Forecast Error	-0.4	-5	-4	-6	-5	-4	-3
+ Ancillary Services	-0.9	-0.8	-0.7	-0.4	-0.2	-0.1	-0.0
= Marginal Economic Value	90	81	73	55	47	41	25

Single-axis PV and CSP without TES have similar relative magnitude of different components and similar changes in value of components with increasing penetration.

Marginal value of CSP with TES retains high level with higher penetration

Component ($/MWh)	0% CSP_6	2.5% CSP_6	5% CSP_6	10% CSP_6	15% CSP_6	20% CSP_6	30% CSP_6
+ Capacity Value (Capacity Value in $/kW-yr)	+37 (150)	+37 (160)	+37 (150)	+35 (150)	+24 (100)	+20 (85)	+15 (61)
+ Energy Value	+55	+55	+55	+55	+58	+53	+52
+ DA Forecast Error	-0.1	-1	-1	-1	-1	-2	-3
+ Ancillary Services	+1.4	+1.4	+1.3	+1.2	+1.0	+0.7	+0.1
= Marginal Economic Value	94	93	92	90	83	71	64

Times with high net load and high prices shift to early evening with increasing PV



Highest load hours are occur in late afternoon.

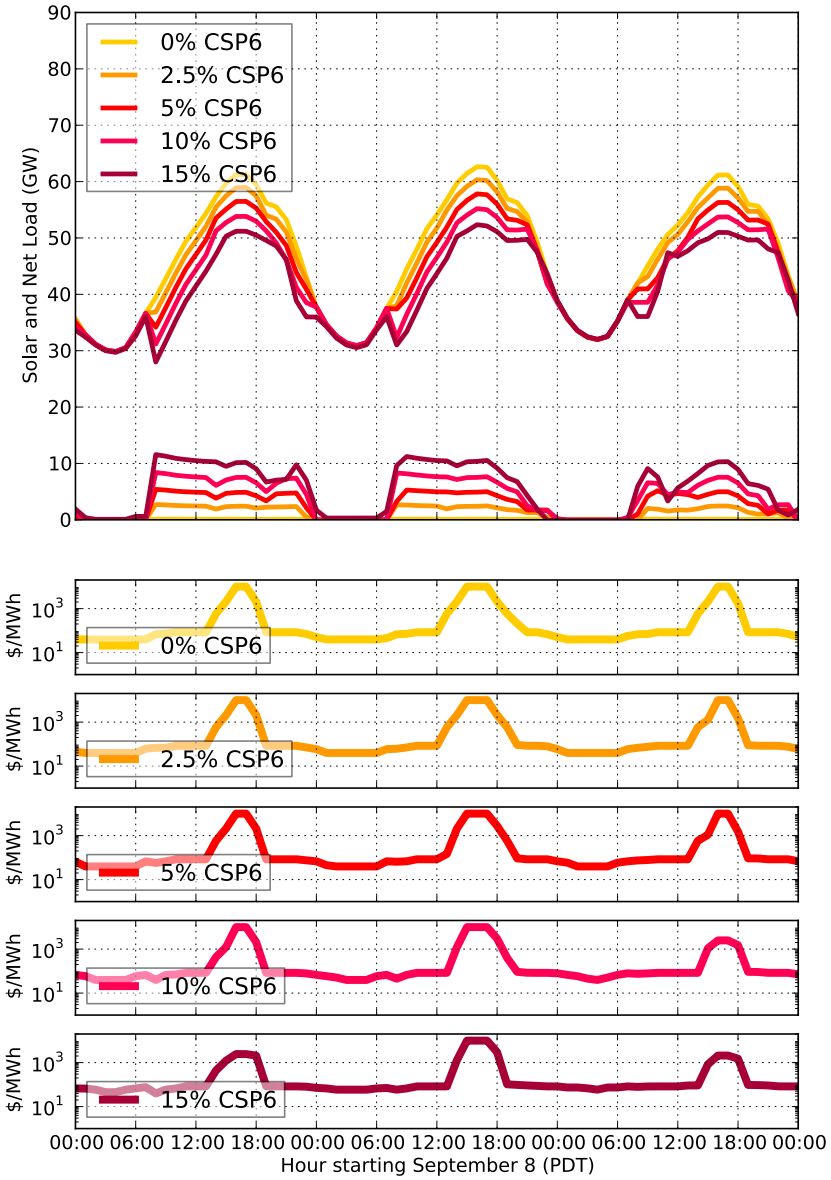
With high PV penetration, highest net-load hours occur in the early evening.

PV does not generate in early evening hours

High price periods shift from times with **high load** to times with **high net-load**

Contribution of high price hours to marginal economic value of PV declines with high PV penetration

Times with high net load remain similar with modest penetration of CSP_6



Highest load hours are occur in late afternoon.

With CSP_6, highest net-load hours remain in the late afternoon.

CSP_6 extracts energy from thermal storage starting in the early evening.

High price periods remain in the late afternoon even with increasing CSP_6 penetration

Contribution of high price hours to marginal economic value of CSP_6 remains relatively high even at 15% penetration

For More Information

Download the full report:

http://eetd.lbl.gov/ea/emp/reports/lbnl-5445e.pdf

Listen to a webinar presentation:

http://westgov.adobeconnect.com/p2bc7cavm3e/

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