Environmental *Change* Institute

Storage
What could possibly go wrong?

Phil Grunewald



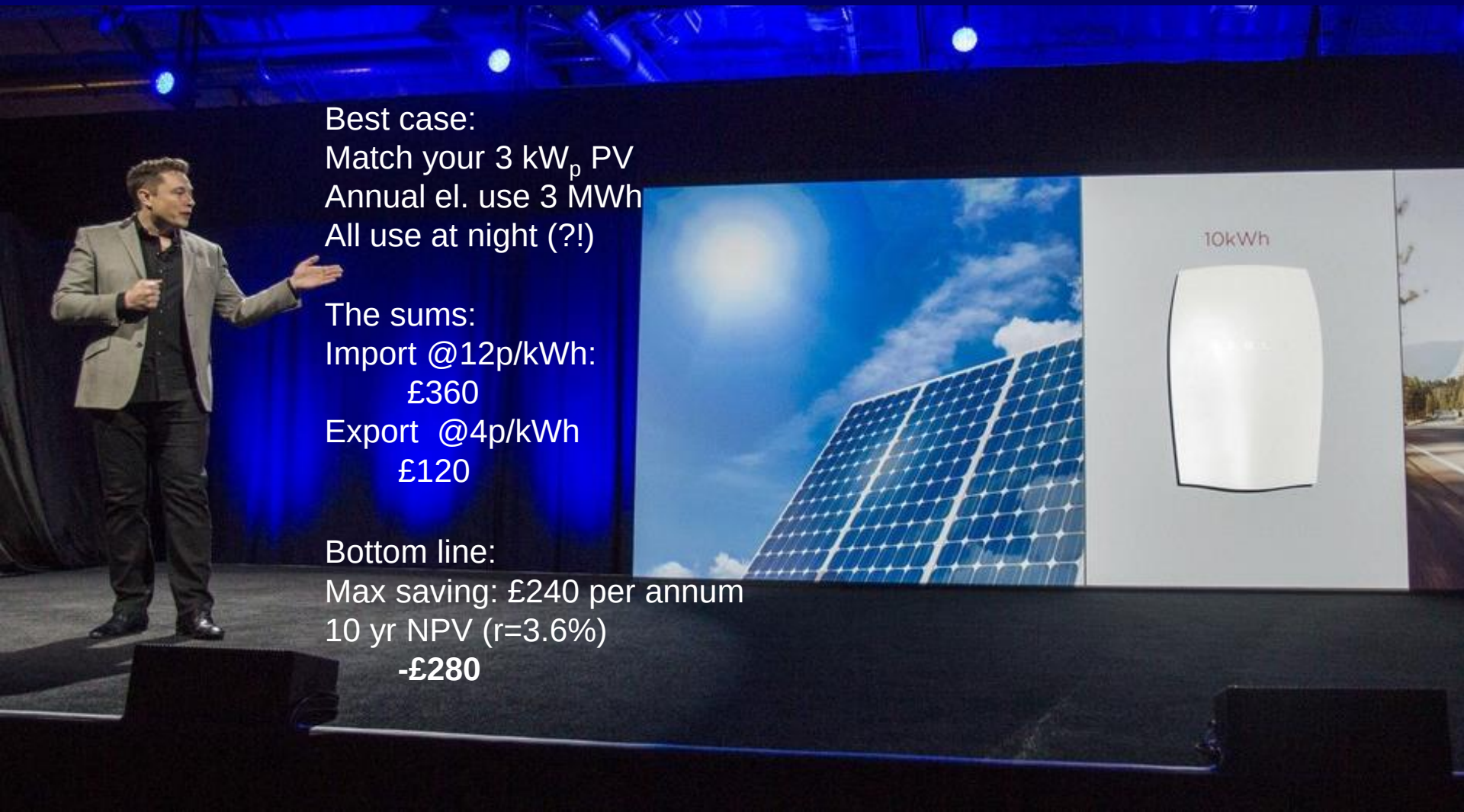


BIEE conference 21-22 Sep 2016

System value ≠ Market value

Best ≠ Best

Should I buy a Powerwall?



Best case:
Match your 3 kW_p PV
Annual el. use 3 MWh
All use at night (?!)

The sums:
Import @12p/kWh:
£360
Export @4p/kWh
£120

Bottom line:
Max saving: £240 per annum
10 yr NPV (r=3.6%)
-£280


TESLA
0800 856 2200

Operator	Strategy	Condition		Conflict
		Charge	Discharge	
End user (autonomy)	Minimise import Avoid export	High RES, low demand at home	Low RES, high demand at home	No alignment with system needs, poor grid use, higher grid cost for other users

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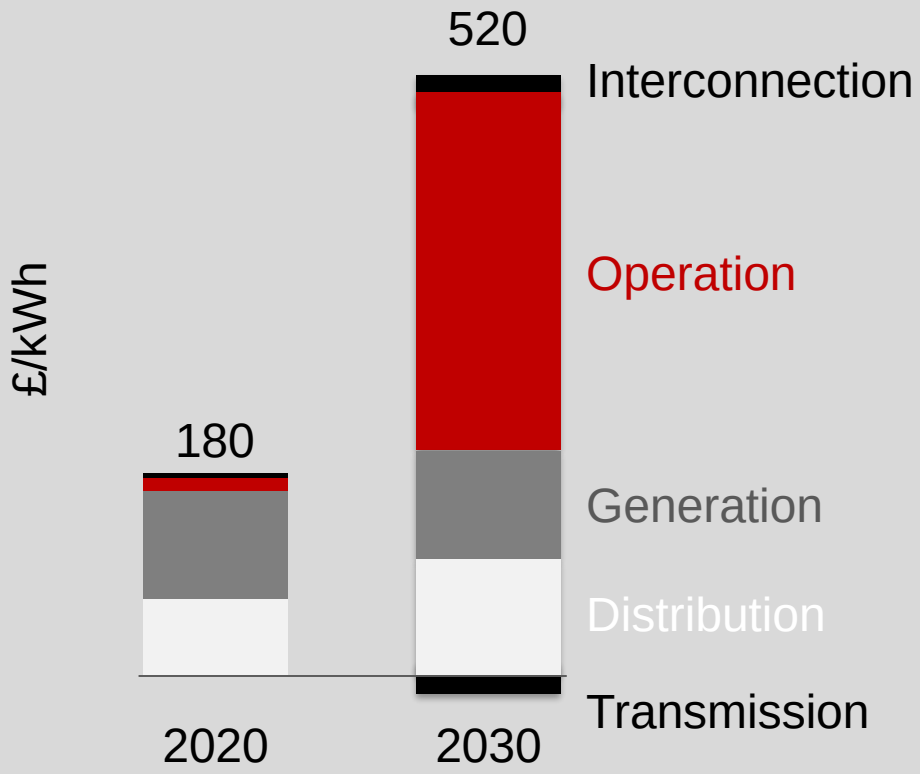
DNO (local)	Constrain demand to feeder capacity	Always, esp. briefly at voltage rise	When feeder constraint is reached	Low risk demands high charge level (strategic reserve)
TNO	Better utilisation of asset Avoid constraints	High RES, low demand in region A with storage	Low RES in A, high demand in region B without storage	Higher use of existing transmission capacity, less able to serve remote peaks
Utility (Generator)	Improve load factor of existing plant	When SO calls for plant turn down	Low RES, high national demand	Can create artificial peak by scheduling maintenance
System operator	Reduce cost of flexibility Displace part loaded plant	Fall in demand, rise in RES	Rise in demand, fall in RES	Operation based on rate (not quantity)
Independent commercial operator	Trade on market volatility and distortions	Low market price	High market price	If price ≠ value storage operation can reduce common value

SPLIT VALUE



System values: Strbac et al., Strategic Assessment of the Role and Value of Energy Storage Systems in the UK Low Carbon Energy Future, The Carbon Trust

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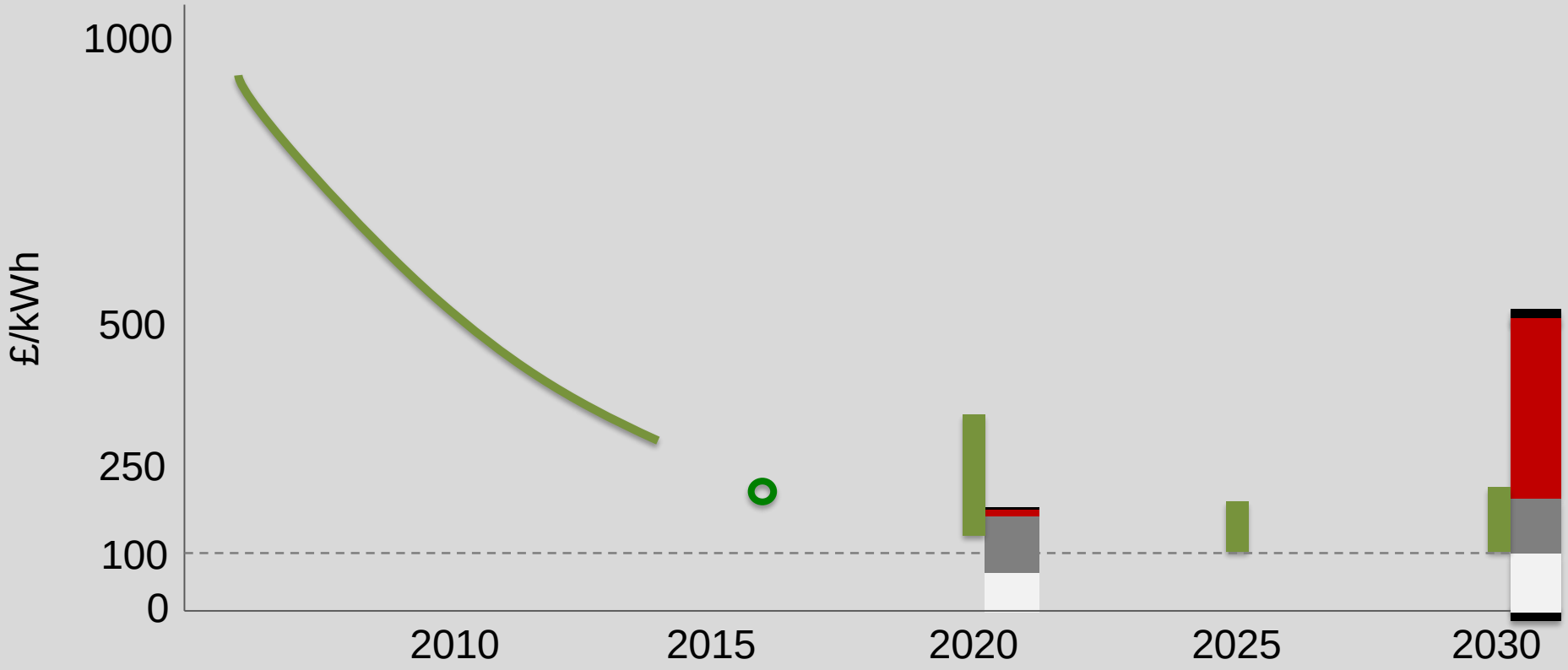
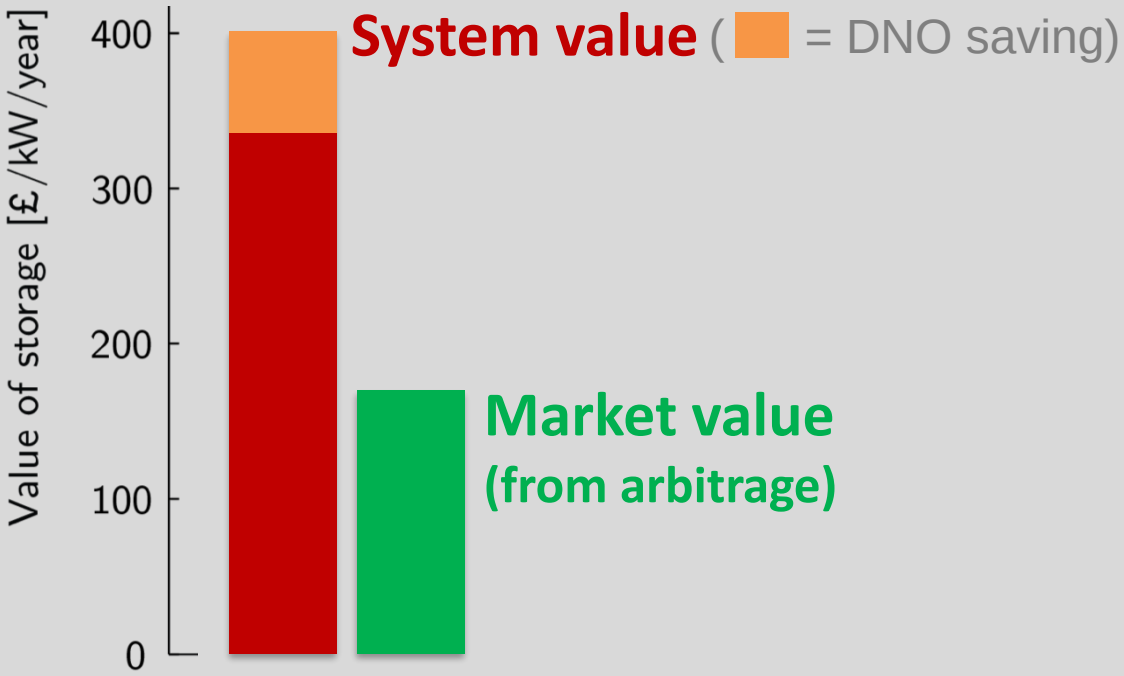
Battery costs are falling



Based on: B. Nykvist & M Nilsson, Nature Climate Change, 2015, and Malcolm McCulloch

System and Market Value



2030
High wind scenario
5 GW storage

System value: Strbac et al., 2012, Market value: Grunewald, 2013

Importance
Low Medium High

Cost	Lifetime	Energy	Power	Size	Weight	Efficiency
 Lack of alternatives	High device turnover	Daily charging accepted	Steady load modest peaks	Miniaturisa-tion	Handheld devices	Avoid overheating
 Early adopter willing to pay	High device turnover	Range anxiety	Fast charging Accelerate	Space is precious	Moving mass	Economics and range
 Competitors: gas, diesel…	Reliability required	Hours, days (and longer?)	Relative to energy	Esp. if on remote sites	Not an issue	Less important with high RES

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Li-Ion	500 (150)	3-10	2	0.001-10	1 – 1000	0.03 300	>90

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Flow battery	500	10	5+	0.1 – 100	10 – 10k	20 – 20k	80
Pumped hydro	150	60	4-30	200 – 2000	10m	10m+	73
Compressed air	80 – 250	40	2-26	100 – 300	100k – 500k	?	45 – 70
Thermal	5 – 300	10 – 30	10	0.001 – 100	0.1 – 10k	0.1 – 10k	40 – 80
Power to gas	4 – 50	10 +	10 ++	0.01 – 100	100 – 500k	?	35

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