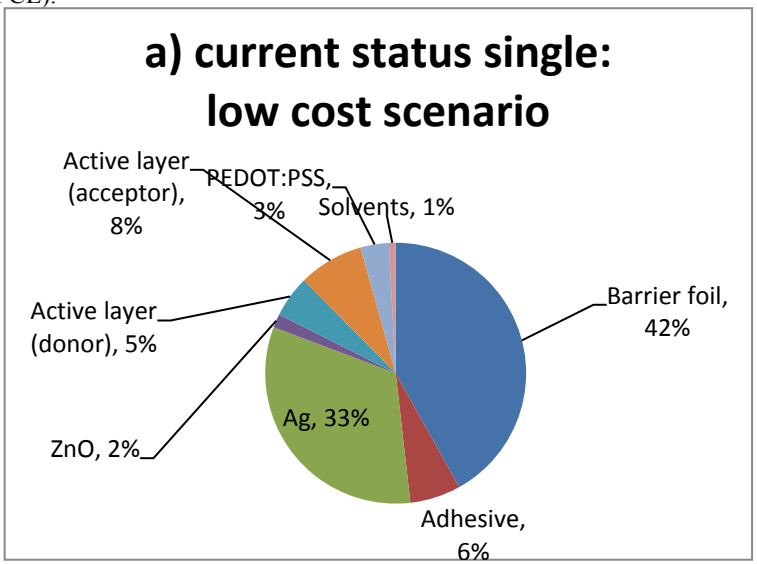
Electronic Supplementary Material (ESI) for Energy & Environmental Science.

Supplementary information:

Cost analysis of roll-to-roll fabricated ITO free single and tandem organic solar modules based on data from manufacture

Florian Machui,[a,*] Markus Hösel,[b] Ning Li,[a] George D. Spyropoulos,[a] Tayebeh Ameri,[a] Roar R. Søndergaard,[b] Mikkel Jørgensen,[b] Arnulf Scheel,[c] Detlef Gaiser,[c] Kilian Kreul,[d] Daniel Lenssen,[d] Mathilde Legros,[e] Noëlla Lemaitre,[e] Marja Vilkman,[f] Marja Välimäki,[f] Sirpa Nordman,[f] Christoph J. Brabec[a] and Frederik C. Krebs[b]

Fig. S1: Share of overall costs: current status – active layer scenarios for single devices. a) P3HT:PCBM (1:1 ratio) (low cost and PCE), MH301:PCBM (1:2 ratio) (high cost and PCE).



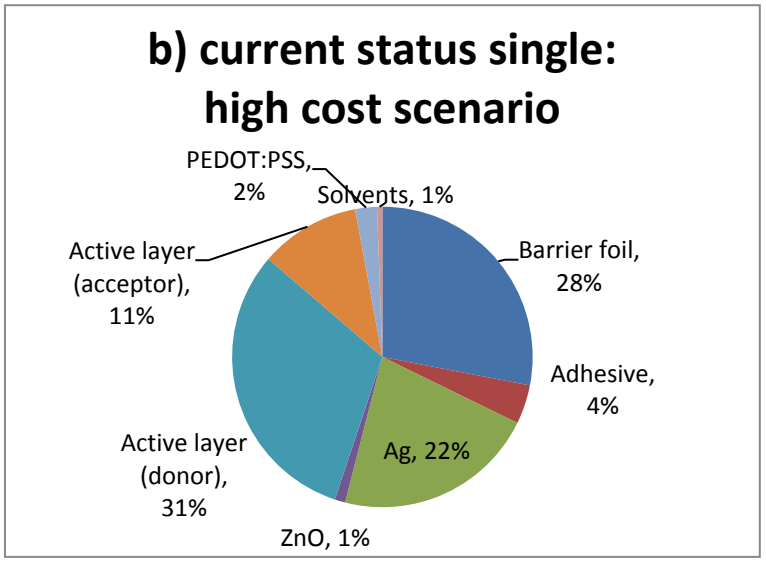
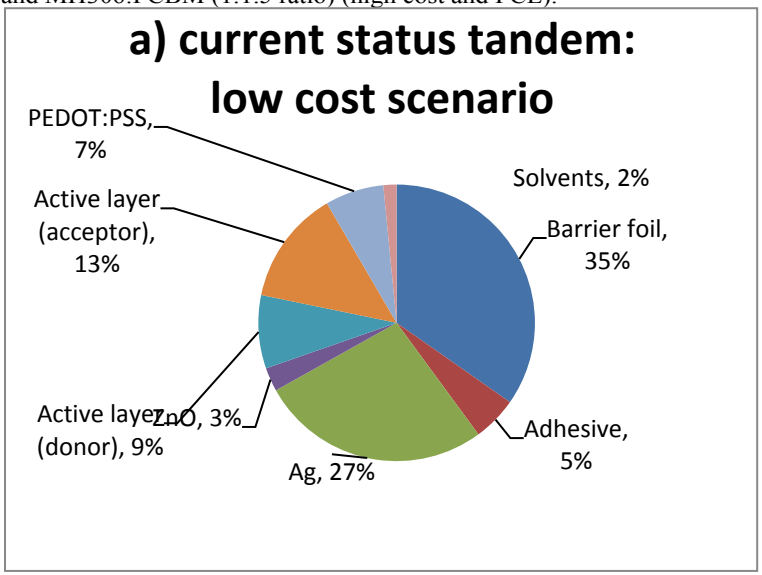


Fig. S2: Share of overall costs: current status –active layer scenarios for tandem devices. a) P3HT:PCBM (1:1 ratio) in both sub-cells (low cost and PCE), MH301:PCBM (1:2 ratio) and MH306:PCBM (1:1.5 ratio) (high cost and PCE).



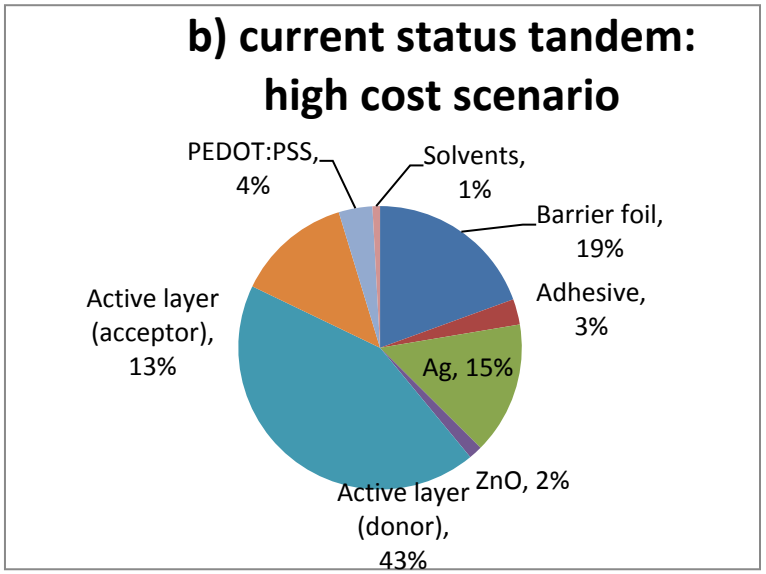
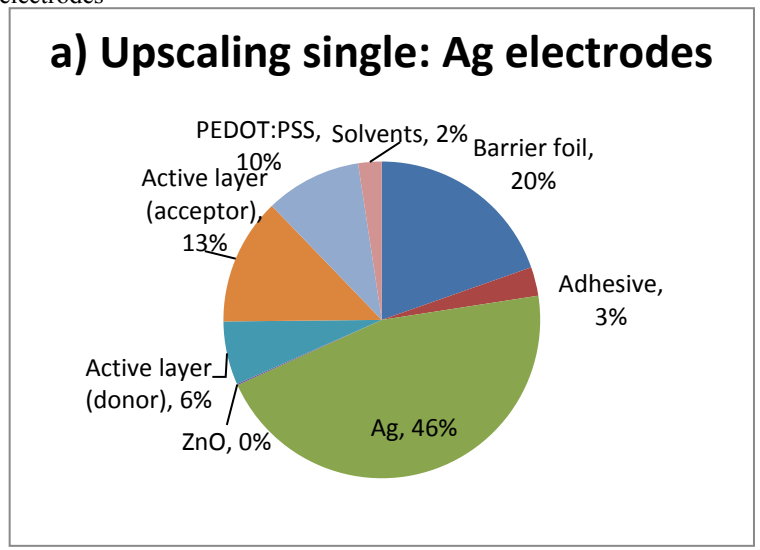
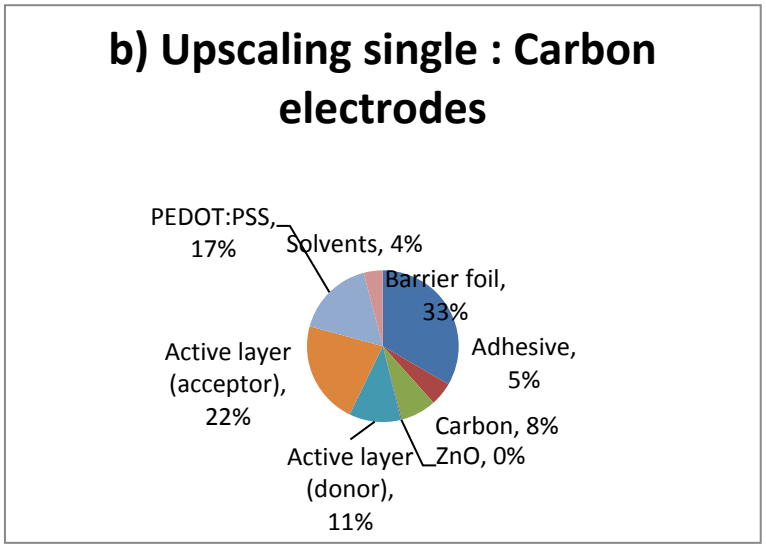


Fig. S3 Share of overall costs upscaling scenario of single devices: different electrode models. a) Ag electrodes, b) Ag front electrode, Aluminium back electrode, c) Carbon electrodes





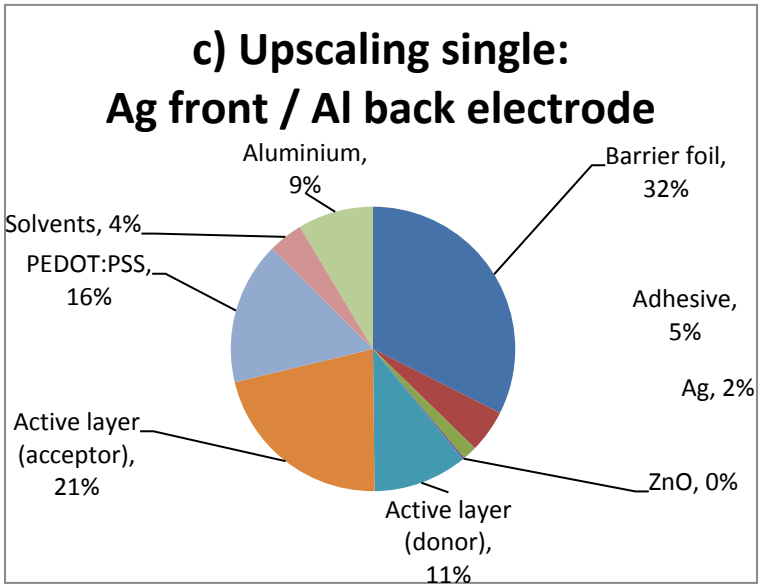
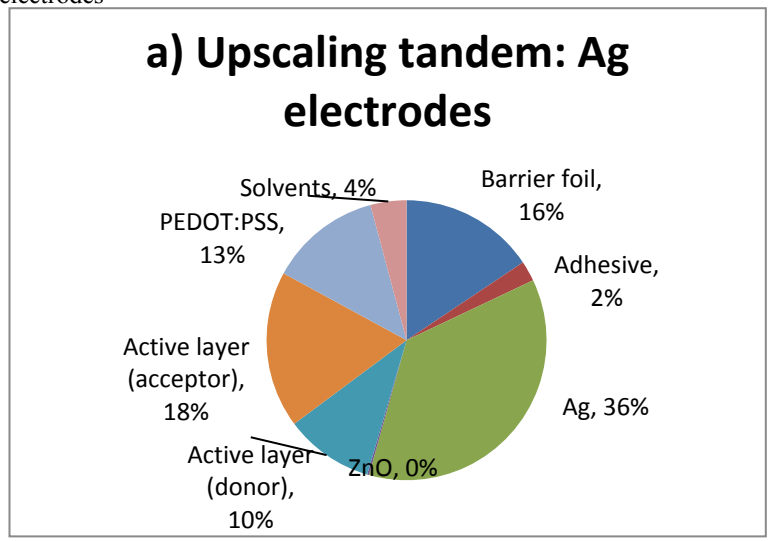
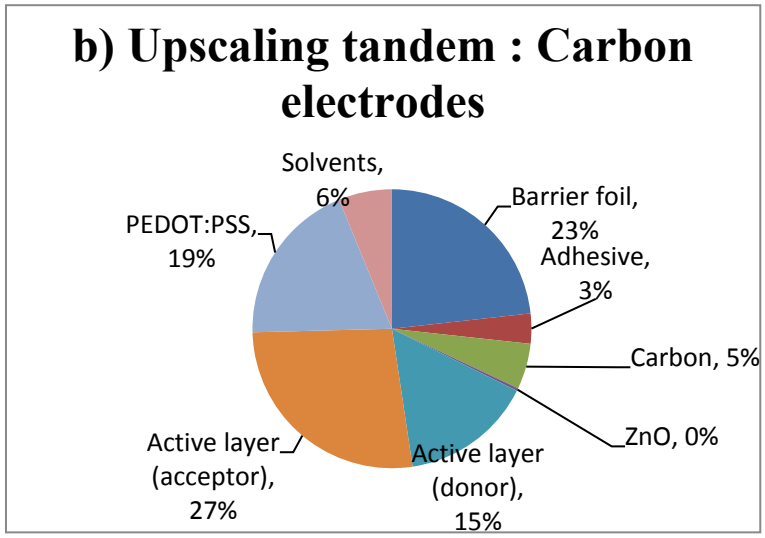


Fig. S4 Share of overall costs upscaling scenario of tandem devices: different electrode models. a) Ag electrodes, b) Ag front electrode, Aluminium back electrode, c) Carbon electrodes





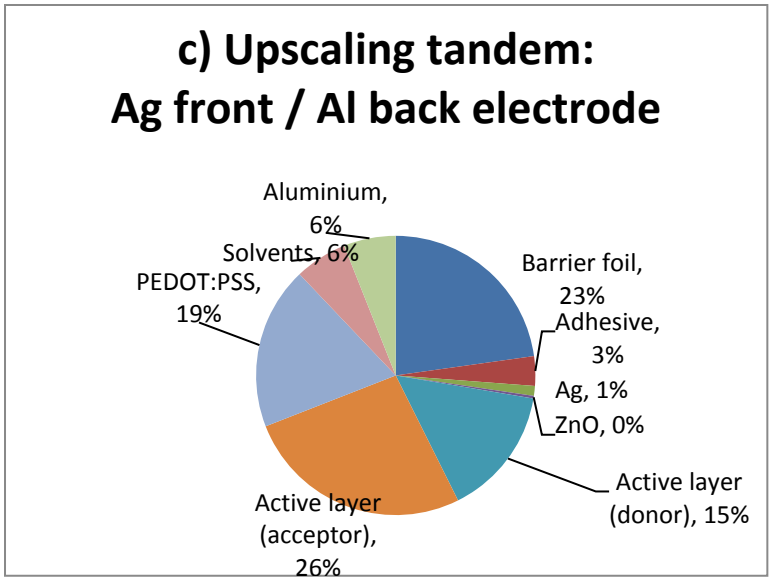
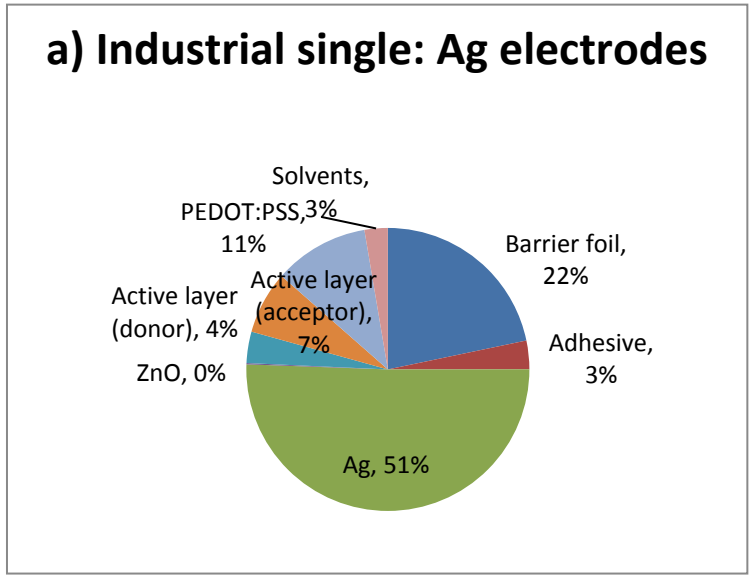
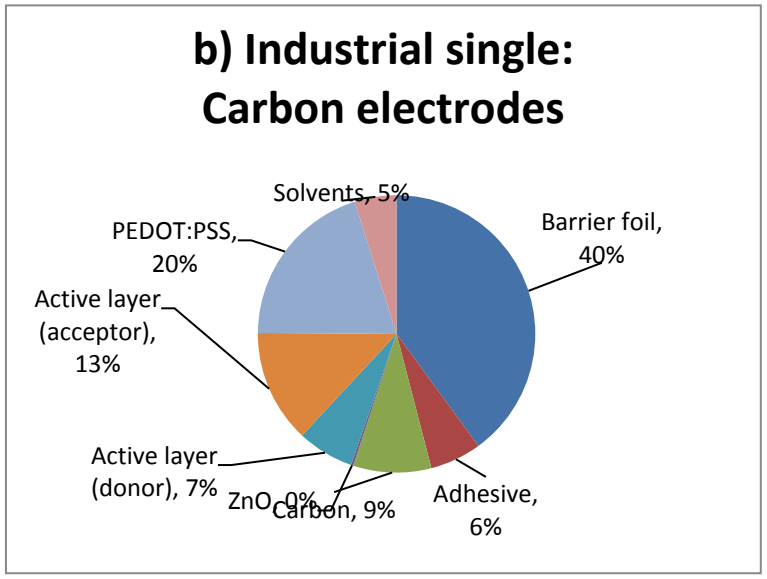


Fig. S5 Share of overall costs industrial scenario of single devices: different electrode models. a) Ag electrodes, b) Ag front electrode, Aluminium back electrode, c) Carbon electrodes





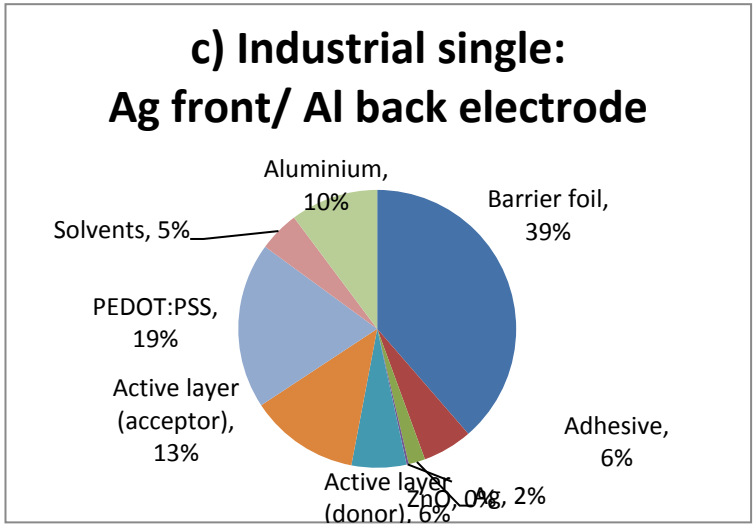
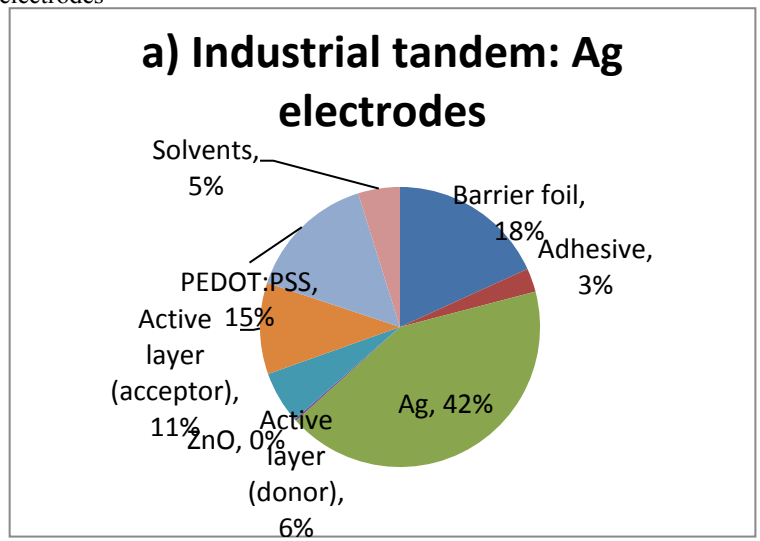
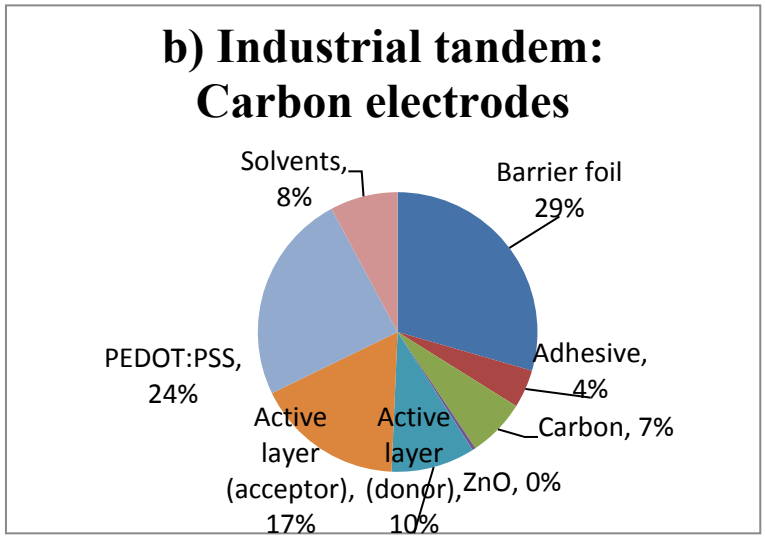


Fig. S6 Share of overall costs industrial scenario of tandem devices: different electrode models. a) Ag electrodes, b) Ag front electrode, Aluminium back electrode, c) Carbon electrodes





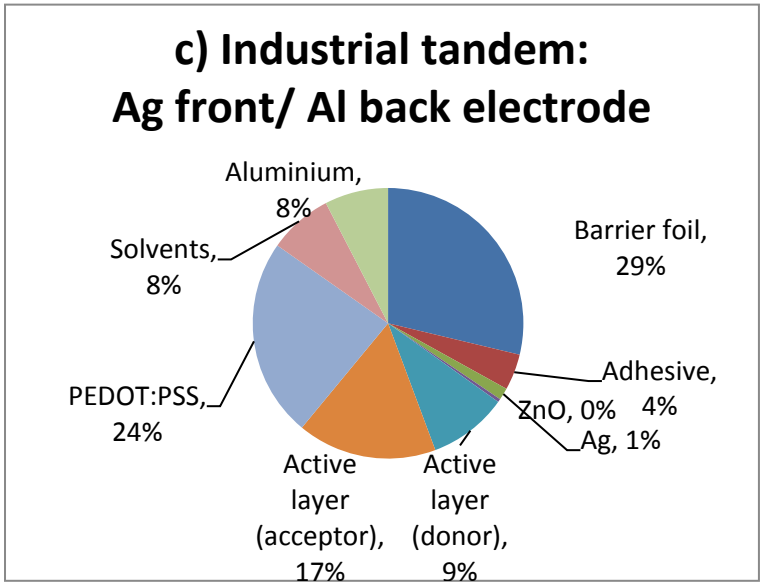


Fig. S7: Cost model for a comparison of single and tandem devices with an expected PCE increase of 40 % for tandem devices in comparison to the single devices (€/m² - €/Wp). Industrial scenario, Carbon electrode model.

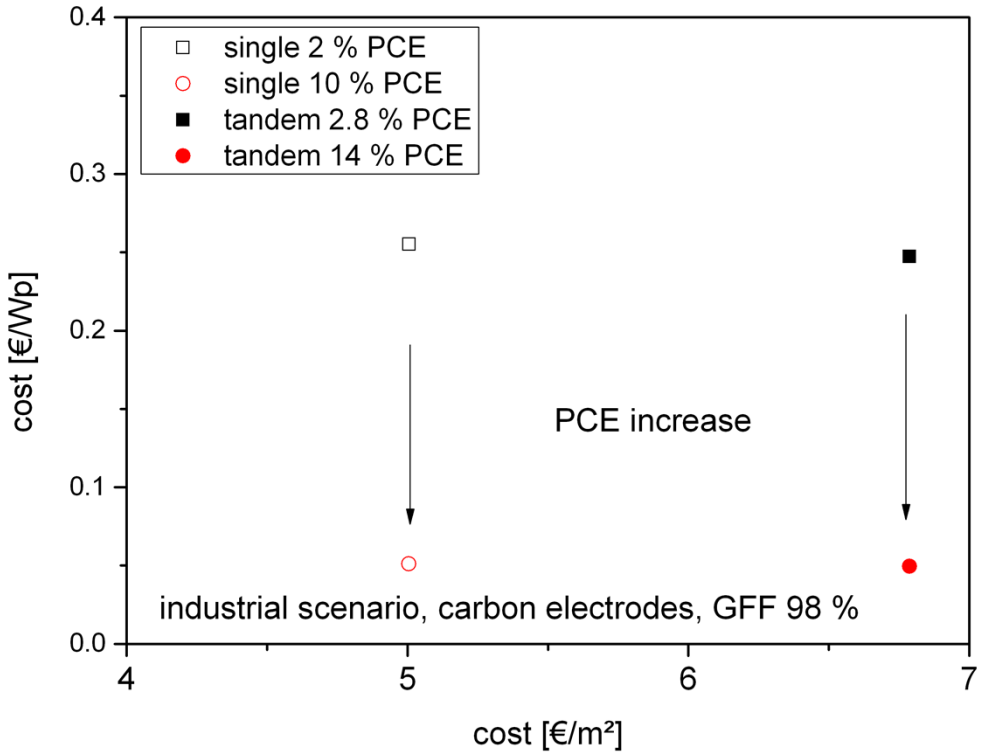


Table S1 Cost structure current status free OPV modules (P3HT:PCBM, single cell modules)

Material	Supplier	Type	Used amount	Unit	Cost	Unit	Cost [€/m²]
Barrier foil	Amcor		1.000	m²	6.000	m²	6.000
Ag	Pchem	PFI-722	0.525	g/m²	2.000	€/g	1.050
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.480	€/mL	0.480
Active layer (donor)	Merck	P3HT	0.033	g/m²	45.000	€/g	1.485
Active layer (acceptor)	Merck	PCBM	0.033	g/m²	70.000	€/g	2.310
Active layer solvent	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.024	€/mL	0.110
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Ag	Dupont	5025	6.230	g/m²	1.327	€/g	8.267
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.600	€/g	1.800
Barrier foil	Amcor		1.000	m²	6.000	m²	6.000
							28.633

Table S2 Cost structure current status high cost model (MH301:PCBM, single cell modules)

Material	Supplier	Type	Used amount	Unit	Cost	Unit	Cost [€/m²]
Barrier foil	Amcor		1.000	m²	6.000	m²	6.000
Ag	Pchem	PFI-722	0.525	g/m²	2.000	€/g	1.050
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.480	€/mL	0.480
Active layer (donor)	MH301	MH301	0.033	g/m²	404.412	€/g	13.346
Active layer (acceptor)	Merck	PCBM	0.066	g/m²	70.000	€/g	4.620
Active layer solvent	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Ag	Dupont	5025	6.230	g/m²	1.327	€/g	8.267
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.600	€/g	1.800
Barrier foil	Amcor		1.000	m²	6.000	m²	6.000
							42.808

Table S3 Cost structure current status high cost model (MH301:PCBM/MH306:PCBM, tandem cell modules)

Material	Supplier	Type	Used amount	Unit	Cost	Unit	Cost [€/m²]
Barrier foil	Amcor		1.000	m²	6.000	m²	6.000
Ag	Pchem	PFI-722	0.525	g/m²	2.000	€/g	1.050
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.480	€/mL	0.480
Active layer 1 donor	DTU	MH301	0.033	g/m²	404.412	€/g	13.346
Active layer 1 acceptor	Merck	PCBM	0.066	g/m²	70.000	€/g	4.620
Active layer 1 solvent	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios AI 4083	1.600	mL/m²	0.420	€/mL	0.672
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.480	€/mL	0.480
Active layer 2 donor	DTU	MH306	0.033	g/m²	404.412	€/g	13.259
Active layer 2 acceptor	Merck	PCBM	0.050	g/m²	70.000	€/g	3.500
Active layer 2 solvent	Sigma-Aldrich	Chloroform	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios AI 4083	1.666	mL/m²	0.420	€/mL	0.700
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Ag	Dupont	5025	6.230	g/m²	1.327	€/g	8.267
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.600	€/g	1.800
Barrier foil	Amcor		1.000	m²	6.000	m²	6.000
							61.706

Table S4 Cost structure upscaling scenario (Ag electrodes single cell modules)

Material	Supplier	Type	Used amount	Unit	Cost	Unit	Cost [€/m²]
Barrier foil			1.000	m²	1.000	m²	1.000
Ag	Pchem	PFI-722	0.263	g/m²	2.000	€/g	0.525
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
active layer 1		MH301 based calculation	0.033	g/m²	20.00	€/g	0.660
active layer 1		PCBM based calculation	0.066	g/m²	20.00	€/g	1.32
active layer 1	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Ag	Dupont	5025	3.115	g/m²	1.327	€/g	4.133
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.100	€/g	0.300
Barrier foil			1.000	m²	1.000	m²	1.000
							10.197

Table S5 Cost structure upscaling scenario (Carbon electrodes single cell modules)

Material	Supplier	Type	Used amount	Unit	Cost	Unit	Cost [€/m²]
Barrier foil			1.000	m²	1.000	m²	1.000
Carbon			0.263	g/m²	0.135	€/g	0.035
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
active layer 1		MH301 based calculation	0.033	g/m²	20.00	€/g	0.660
active layer 1		PCBM based calculation	0.066	g/m²	20.00	€/g	1.32
active layer 1	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Carbon			3.115	g/m²	0.135	€/g	0.420
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.100	€/g	0.300
Barrier foil			1.000	m²	1.000	m²	1.000
							5.995

Table S6 Cost structure upscaling scenario (Carbon electrodes tandem cell modules)

Material	Supplier	Type	Used amount	Unit	Cost	Unit	Cost [€/m²]
Barrier foil			1.000	m²	1.000	m²	1.000
Carbon			0.263	g/m²	0.135	€/g	0.035
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
Active layer 1 donor		MH301 based calculation	0.033	g/m²	20.00	€/g	0.660
Active layer 1 acceptor		PCBM based calculation	0.066	g/m²	20.00	€/g	1.32
Active layer 1 solvent	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT	Heraeus	PEDOT AI 4083	1.600	mL/m²	0.200	€/mL	0.320
	Sigma-Aldrich	Sigma-Aldrich	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
Active layer 2 donor		MH306 based calculation	0.033	g/m²	20.00	€/g	0.656
Active layer 2 acceptor		PCBM based calculation	0.050	g/m²	20.00	€/g	1.000
Active layer 2 solvent	Sigma-Aldrich	Chloroform	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios AI 4083	1.666	mL/m²	0.200	€/mL	0.333
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Carbon			3.115	g/m²	0.135	€/g	0.420
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.100	€/g	0.300
Barrier foil			1.000	m²	1.000	m²	1.000
							8.605

Table S7 Cost structure upscaling scenario (Al back electrode single cell modules)

Material	Supplier	Type	Used amount	Unit	Cost	Unit	Cost [€/m²]
Barrier foil			1.000	m²	1.000	m²	1.000
Ag	Pchem	PFI-722	0.263	g/m²	2.000	€/g	0.100
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
active layer 1		MH301 based calculation	0.033	g/m²	20.00	€/g	0.660
active layer 1		PCBM based calculation	0.066	g/m²	20.00	€/g	1.32
active layer 1	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Aluminium	VTT		7.780	g/m²	0.068	€/g	0.529
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.100	€/g	0.300
Barrier foil			1.000	m²	1.000	m²	1.000
							6.168

Table S8 Cost structure upscaling scenario (Al back electrode tandem cell modules)

Material	Supplier	Type	Used amount	Unit	Cost	Unit	Cost [€/m²]
Barrier foil			1.000	m²	1.000	m²	1.000
Ag	Pchem	PFI-722	0.263	g/m²	2.000	€/g	0.100
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	SIsopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
Active layer 1 donor		MH301 based calculation	0.033	g/m²	20.00	€/g	0.660
Active layer 1 acceptor		PCBM based calculation	0.066	g/m²	20.00	€/g	1.320
Active layer 1 Solvent	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT	Heraeus	PEDOT AI 4083	1.600	mL/m²	0.200	€/mL	0.320
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
Active layer 2 donor		MH306 based calculation	0.033	g/m²	20.00	€/g	0.656
Active layer 2 acceptor		PCBM based calculation	0.050	g/m²	20.00	€/g	1.000
Active layer 2 Solvent	Sigma-Aldrich	Chloroform	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios AI 4083	1.666	mL/m²	0.200	€/mL	0.333
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Aluminium	VTT		7.780	g/m²	0.068	€/g	0.529
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.100	€/g	0.300
Barrier foil			1.000	m²	1.000	m²	1.000
							8.778

Table S9 Cost structure industrial scenario (Ag electrodes single cell modules)

Material	Supplier	Type	Used amount	unit	Cost	Unit	Cost [€/m²]
Barrier foil			1.000	m²	1.000	m²	1.000
Ag	Pchem	PFI-722	0.263	g/m²	2.000	€/g	0.525
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
active layer 1		MH301 based calculation	0.033	g/m²	10.00	€/g	0.330
active layer 1		PCBM based calculation	0.066	g/m²	10.00	€/g	0.660
active layer 1	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Ag	Dupont	5025	3.115	g/m²	1.327	€/g	4.133
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.100	€/g	0.300
Barrier foil			1.000	m²	1.000	m²	1.000
							9.207

Table S10 Cost structure industrial scenario (Ag electrodes, tandem cell modules)

Material	Supplier	Type	Used amount	unit	Cost	Unit	Cost [€/m²]
Barrier foil			1.000	m²	1.000	m²	1.000
Ag	Pchem	PFI-722	0.263	g/m²	2.000	€/g	0.525
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
Active layer 1 donor		MH301 based calculation	0.033	g/m²	10.00	€/g	0.330
Active layer 1 acceptor		PCBM based calculation	0.066	g/m²	10.00	€/g	0.660
Active layer 1 Solvent	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT	Heraeus	PEDOT AI 4083	1.600	mL/m²	0.200	€/mL	0.320
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
Active layer 2 donor		MH306 based calculation	0.033	g/m²	10.00	€/g	0.328
Active layer 2 acceptor		PCBM based calculation	0.050	g/m²	10.00	€/g	0.500
Active layer 2 Solvent	Sigma-Aldrich	Chloroform	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios AI 4083	1.666	mL/m²	0.200	€/mL	0.333
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Ag	Dupont	5025	3.115	g/m²	1.327	€/g	4.133
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.100	€/g	0.300
Barrier foil			1.000	m²	1.000	m²	1.000
							10.989

Table S11 Cost structure industrial scenario (Carbon electrodes single cell modules)

Material	Supplier	Type	Used amount	unit	Cost	Unit	Cost [€/m²]
Barrier foil			1.000	m²	1.000	m²	1.000
Carbon			0.263	g/m²	0.135	€/g	0.035
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
active layer 1		MH301 based calculation	0.033	g/m²	10.00	€/g	0.330
active layer 1		PCBM based calculation	0.066	g/m²	10.00	€/g	0.660
active layer 1	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Carbon			3.115	g/m²	0.135	€/g	0.420
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.100	€/g	0.300
Barrier foil			1.000	m²	1.000	m²	1.000
							5.005

Table S12 Cost structure industrial scenario (Al back electrode, single cell modules)

Material	Supplier	Type	Used amount	unit	Cost	Unit	Cost [€/m²]
Barrier foil			1.000	m²	1.000	m²	1.000
Ag	Pchem	PFI-722	0.263	g/m²	2.000	€/g	0.100
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
active layer 1		MH301 based calculation	0.033	g/m²	10.00	€/g	0.330
active layer 1		PCBM based calculation	0.066	g/m²	10.00	€/g	0.660
active layer 1	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Aluminium	VTT		7.780	g/m²	0.068	€/g	0.529
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.100	€/g	0.300
Barrier foil			1.000	m²	1.000	m²	1.000
							5.178

Table S13 Cost structure industrial scenario (Al back electrode, tandem cell modules)

Material	Supplier	Type	Used amount	unit	Cost	Unit	Cost [€/m²]
Barrier foil			1.000	m²	1.000	m²	1.000
Ag	Pchem	PFI-722	0.263	g/m²	2.000	€/g	0.100
PEDOT:PSS	Heraeus	Clevios FET DK	1.666	mL/m²	0.325	€/mL	0.541
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
Active layer 1 donor		MH301 based calculation	0.033	g/m²	10.00	€/g	0.330
Active layer 1 acceptor		PCBM based calculation	0.066	g/m²	10.00	€/g	0.660
Active layer 1 Solvent	Sigma-Aldrich	Chlorobenzene	4.590	mL/m²	0.025	€/mL	0.115
PEDOT	Heraeus	PEDOT AI 4083	1.600	mL/m²	0.200	€/mL	0.320
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
ZnO	DTU	ZnO	1.000	mL/m²	0.013	€/mL	0.013
Active layer 2 donor		MH306 based calculation	0.033	g/m²	10.00	€/g	0.328
Active layer 2 acceptor		PCBM based calculation	0.050	g/m²	10.00	€/g	0.500
Active layer 2 Solvent	Sigma-Aldrich	Chloroform	4.590	mL/m²	0.025	€/mL	0.115
PEDOT:PSS	Heraeus	Clevios AI 4083	1.666	mL/m²	0.200	€/mL	0.333
	Sigma-Aldrich	Isopropanol	3.331	mL/m²	0.026	€/mL	0.087
PEDOT:PSS	Heraeus	Clevios F010	3.331	mL/m²	0.138	€/mL	0.460
	Sigma-Aldrich	Isopropanol	1.666	mL/m²	0.026	€/mL	0.043
Aluminium	VTT		7.780	g/m²	0.068	€/g	0.529
Adhesive	DELO	DELO-KATIOBOND LP655	3.000	g/m²	0.100	€/g	0.300
Barrier foil			1.000	m²	1.000	m²	1.000
							6.960

Table S14 Processing cost assumption freeOPV

	freeOPV	
	web speed	processing costs/ layer
	m/min	€/m²
Ag	20	0.22
PEDOT:PSS	inline	inline
ZnO	10	0.44
Active layer (donor)	inline	inline
PEDOT:PSS	8	0.56
Ag	8	0.56
Adhesive	2	2.22
Cutting	4	1.11
Sum		5.11

Table S15 Processing cost assumption current status: tandem device high cost model

current status high cost model	web speed m/min	processing costs/ layer €/m²
Ag	20	0.22
PEDOT:PSS	20	0.22
ZnO	10	0.44
Active layer 1 donor	1.5	2.96
PEDOT:PSS	1	4.44
ZnO	inline	inline
Active layer 2 donor	1.2	3.70
PEDOT:PSS	1	4.44
PEDOT:PSS	inline	inline
Ag	2	2.22
Adhesive	1.5	2.96
Cutting	4	1.11
Sum		22.74

Table S16 Processing cost assumption 100 MW production regime: tandem devices (Ag electrodes)

100 MW production regime: tandem devices (Ag electrodes)		
	web speed	processing costs/ layer
	m/min	€/m²
Ag	60	0.07
PEDOT:PSS	inline	inline
ZnO	60	0.07
Active layer 1 donor	inline	inline
PEDOT:PSS	60	0.07
ZnO	inline	inline
Active layer 2 donor	60	0.07
PEDOT:PSS	60	0.07
PEDOT:PSS	inline	inline
Ag	inline	inline
Adhesive	60	0.07
Cutting	60	0.07
Sum		0.52

Table S17 Processing cost assumption 100 GW production regime: tandem devices (Carbon electrodes)

100 GW production regime: tandem devices (Carbon electrodes)		
	web speed	processing costs/ layer
	m/min	€/m²
Carbon	300	0.01
PEDOT:PSS	inline	inline
ZnO	inline	inline
Active layer 1 donor	inline	inline
PEDOT:PSS	300	0.01
ZnO	inline	inline
Active layer 2 donor	300	0.01
PEDOT:PSS	300	0.01
PEDOT:PSS	inline	inline
Carbon	inline	inline
Adhesive	300	0.01
Cutting	60	0.07
Sum		0.15

Fig. S8: Ratio material and processing costs for different scenarios