Supporting Information

Sustainable and Biobased Self-blown Polycarbonate Foams: From Synthesis to Application

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Table S1. Four different polyols that vary in hydroxyl value (I_{OH}), functionality, and viscosity, and their molar equivalents and corresponding weight percentages used in foam formulations.

Entry	Polyol	I_{OH} [mg KOH g^{-1}]	Functionality	Viscosity @25 °C [mPa s]	Polyol (eq *vs* BC_6)	Polyol [wt%][e]
F_1	Sovermol 750	315	3	1100	0.167	14
F_2	Cardolite NX-9004[a]	185	4.1	5250	0.122	21
F_3	Priplast 3162	110	2	[d]	0.25	31
F_4	Lignin25%-PEG_{300}[a, b]	405	NA[c]	9580	0.5	11

[a]DBU (3.125 mol% vs cyclic carbonates). [b]Aromatic polyol used in F_4 was synthesized with a lignin content of 25 wt% and polyethylene glycol (PEG, M_n = 300 g mol^{-1}). [c]This information is not available. [d]1080 mPa s at 80 °C. [e][(weight of polyol/weight of total formulation) x 100%]

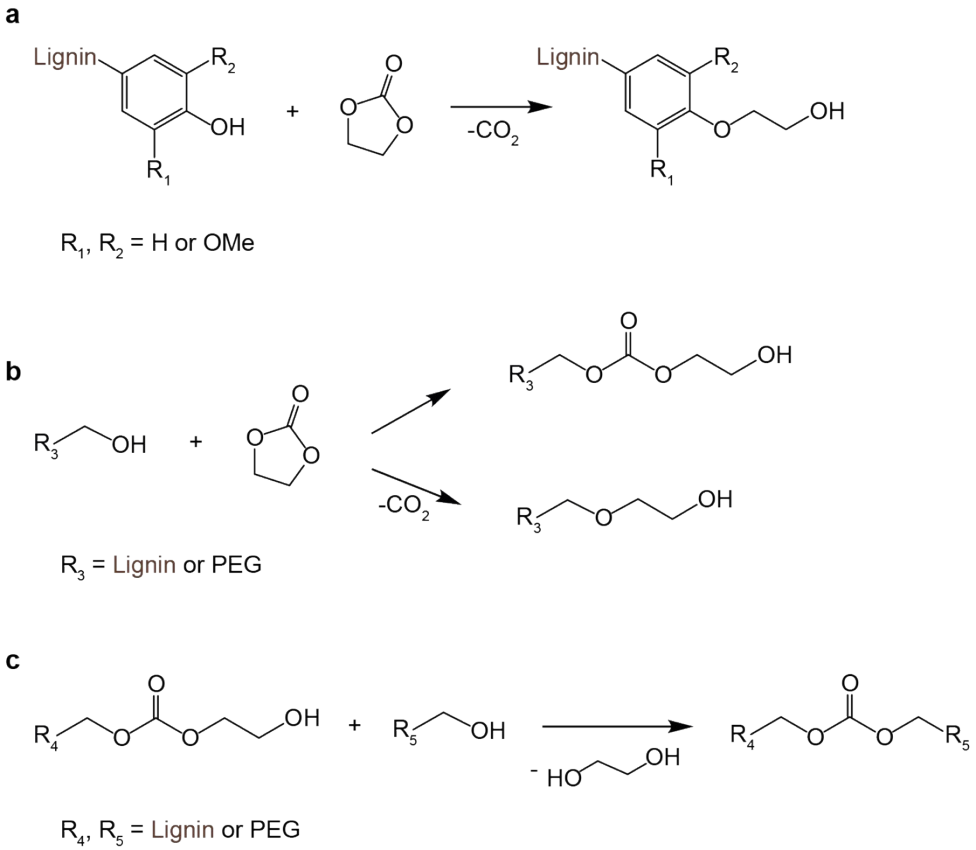

Figure S1. Reactions of ethylene carbonate with lignin and polyethylene glycol (PEG): (a) reaction with lignin's phenolic hydroxyl groups, (b) reaction with the aliphatic hydroxyl groups of lignin or PEG, (c) chain coupling via transcarbonation.

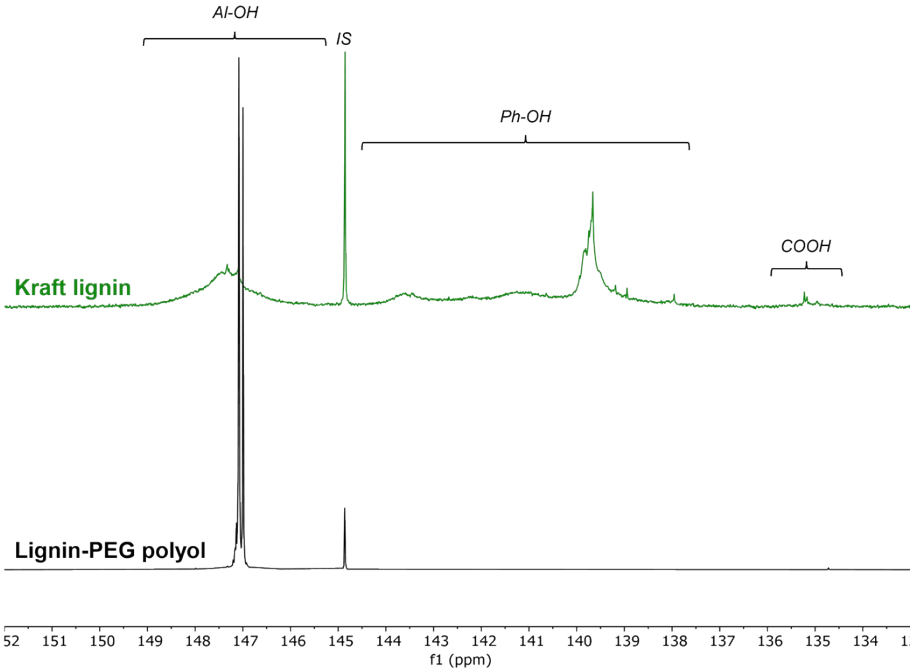

Figure S2. ^{31}P NMR spectra of Kraft lignin and Lignin-PEG polyol. Lignin contains aliphatic OH (Al-OH), phenolic OH (Ph-OH) and COOH groups. After reaction with ethylene carbonate (see Figure S1), the polyol only contains aliphatic OH groups. IS = internal standard (cholesterol).

Further comments: Hydroxyl values were calculated based on the integration values of the ^{31}P NMR. The ^{31}P NMR spectra showed the complete disappearance of lignin phenolic OH groups and the formation of new aliphatic OH groups, confirming the successful modification of lignin by ethylene carbonate.

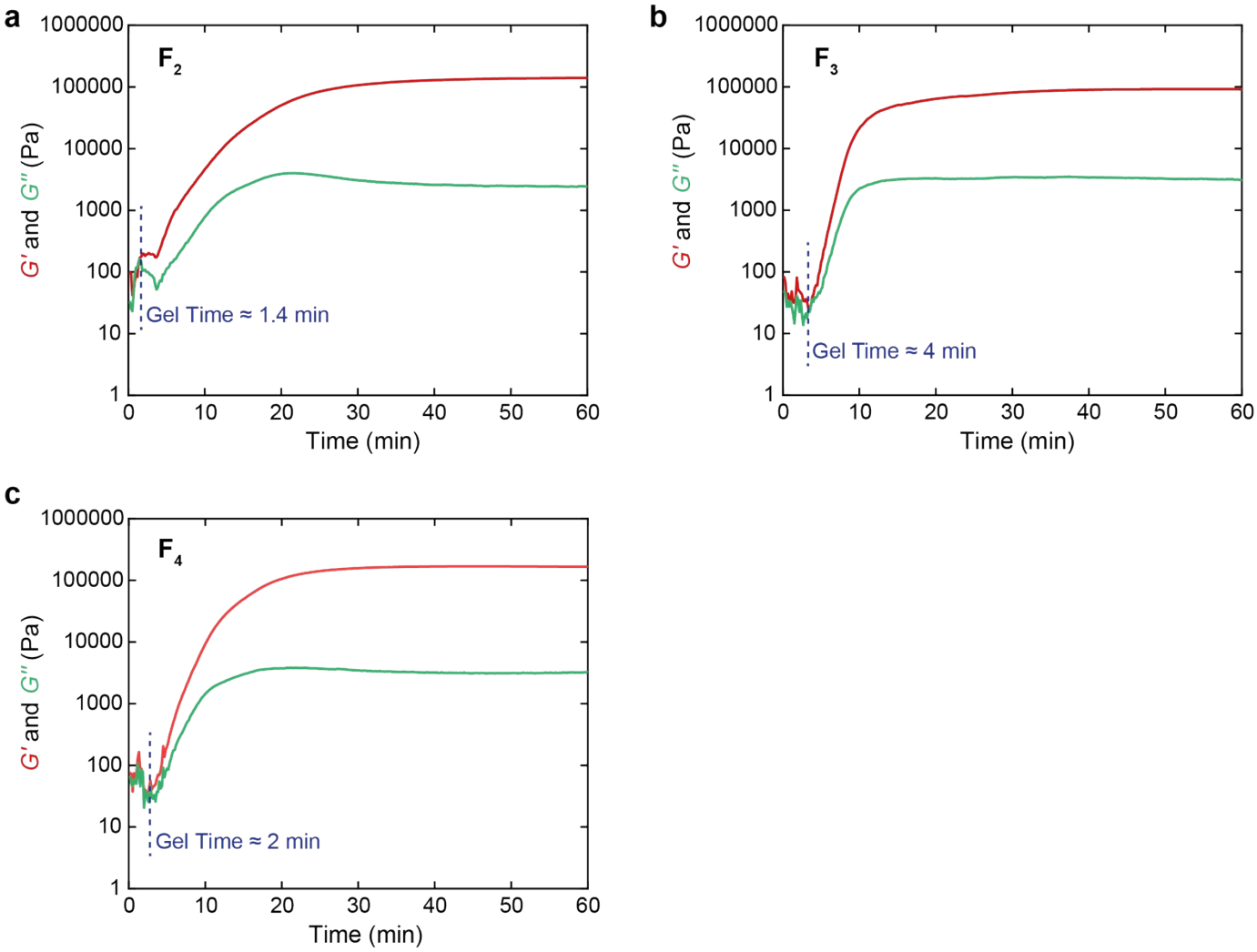

Figure S3. Rheology experiments were carried out on three foam formulations: (a) CNSL-based formulation (F_2), (b) Priplast-based formulation (F_3), and (c) Lignin-PEG-based formulation (F_4). Gel times were approximated at G'/G'' = 1.

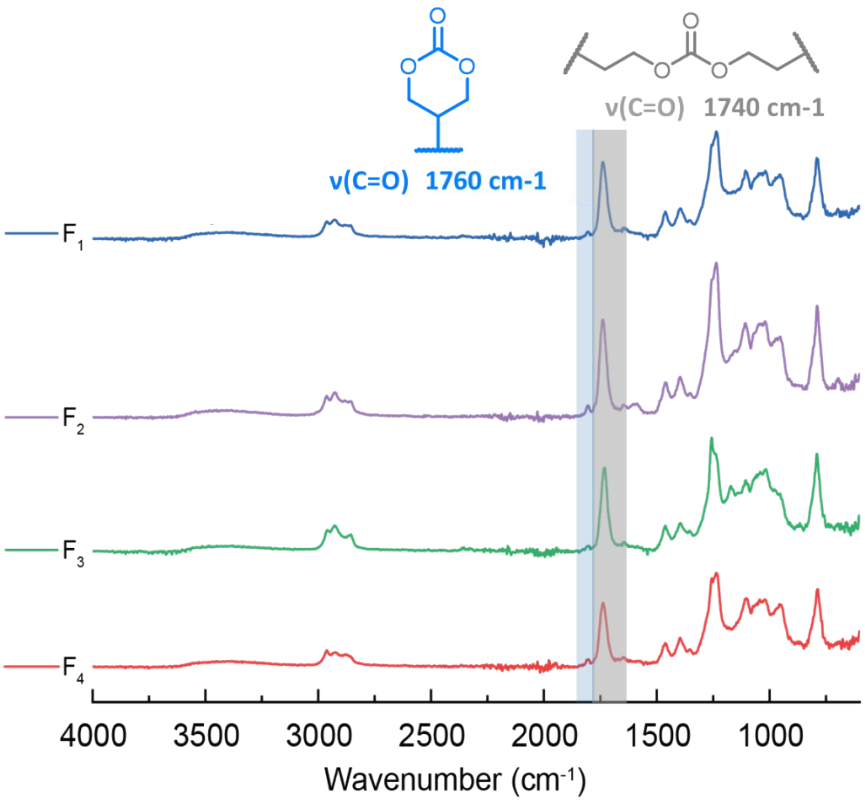

Figure S4. ATR-FTIR spectra of the bio-based self-blown PC foams for F_1, F_2, F_3, and F_4.

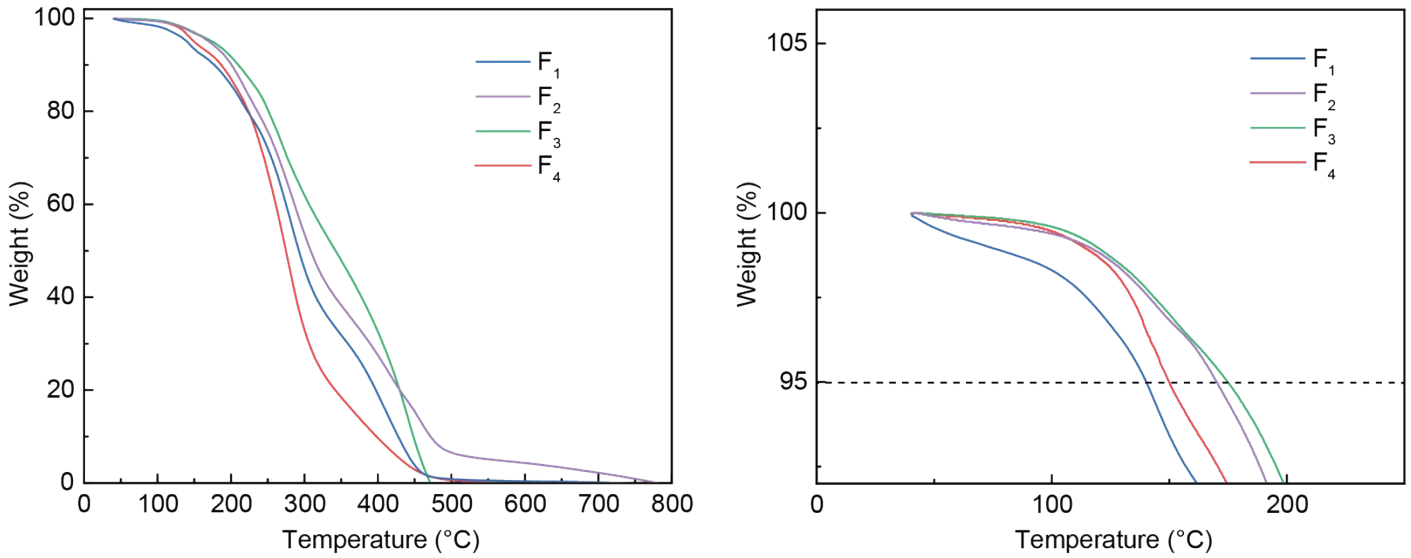

Figure S5. TGA thermograms of the four PC formulations (left) with a zoom on the 5% loss mass region (right).

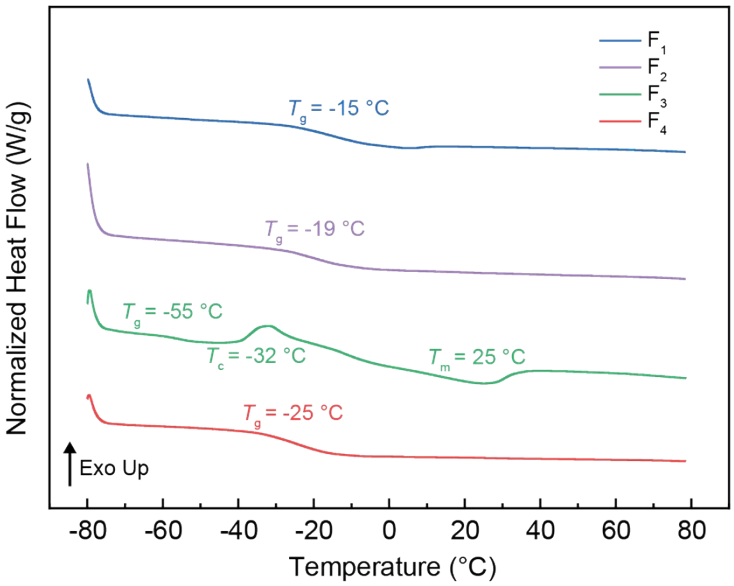

Figure S6. DSC thermograms of all four PC formulations (second heating step).

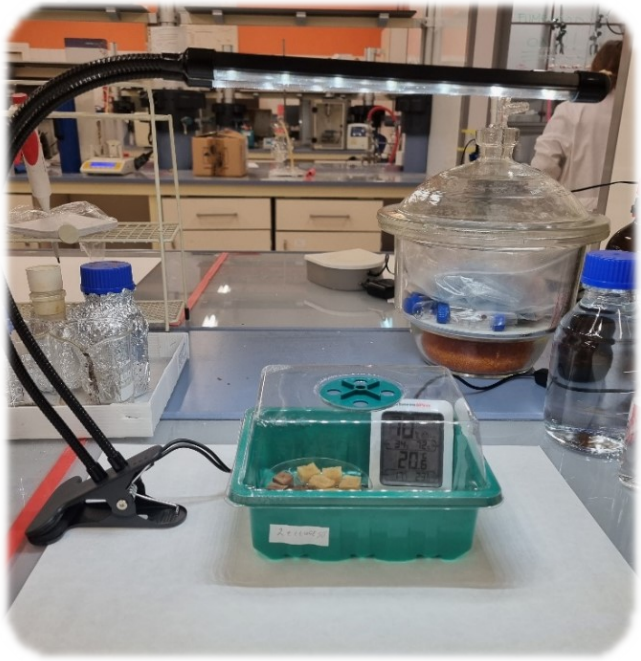

Figure S7. Photograph of the germination set up, including LED lights and temperature and humidity control.

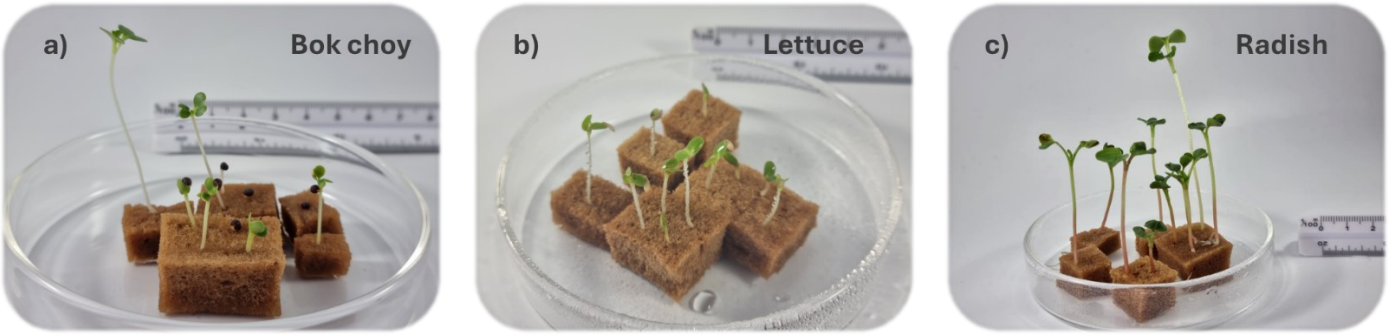

Figure S8. Photographs of the germinated seeds after 12 days for bok choy (a), and 10 days for lettuce (b) and radish (c).

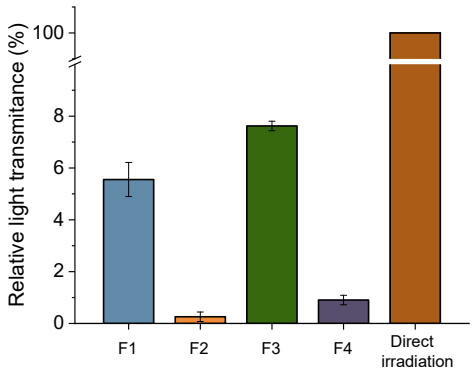

Figure S9. Relative light transmittance (%) of different foam materials as well as soil and direct LED-light irradiation, average sample thickness 7.5 mm.

Figure S10. Root penetration into the cashew nutshell-based foam substrate. Roots of (a) radish and (b) lettuce seedlings grown beyond the substrate.

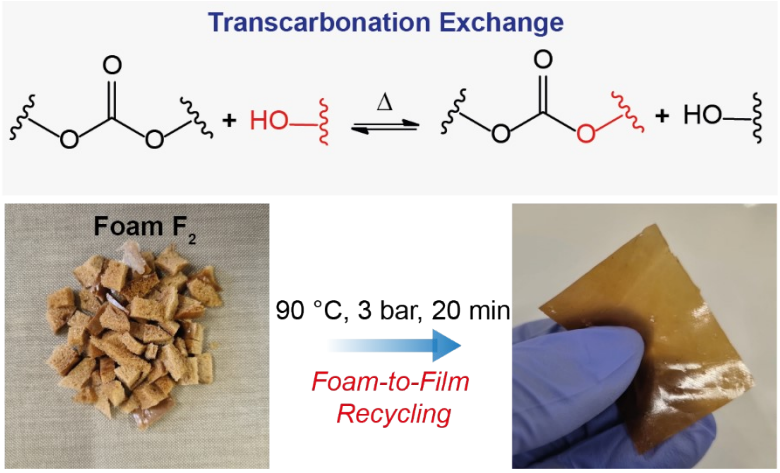

Figure S11. Transcarbonation bond exchanges allow cross-linked foam F_2 to be reprocessed into a film via hot pressing for 20 min at 90 °C under a pressure of 3 bar.