Environmental impact and embodied energy: Case study – Noorland footbridge, the Netherlands

There are few life cycle impact assessments publicly available, but there appears to be a consensus that considering only carbon impacts is acceptable, since other impacts are relatively small. The Noordland footbridge case study paper does include water and air pollution, and demonstrates that the impact from the FRP bridge is the lowest. So it may be concluded that considering only carbon impacts will tend to be conservative from the perspective of demonstrating the environmental benefits of FRP bridges, though fuller studies would clarify this.

Noordland footbridge, the Netherlands[i]
Replacement of a corroded steel footbridge, consisting of two 13.5m spans, was required in Noordland inner harbour in the Netherlands. The location experiences severe weather conditions and high chloride levels. The client demanded a bridge solution that offered the most ecological benefits. Five material options were considered:

Material	Mass (t)	Material energy consumption (MJ/kg) & recycled content (%) assumed	Energy consumption on delivery (GJ)	Energy consumption during use (GJ)	Total Energy consumption (GJ)
Structural steel	6.0	Primary 80% 46-7=39 Secondary 20% 36-7=29	222	72	294
Stainless steel	5.6	Primary 70% 69-11=58 Secondary 30% 54-11=43	300	30	330
Composite (GRP pultruded sections)	4.0	33-9=24	96	24	120
Aluminum	3.2	Primary 60% 137-33=104 Secondary 40% 45-33=12	215	54	269
Concrete	28.0	11-2=9	252	25	277

The author notes that the recycling figures assumed for aluminium may be optimistic, and that the analysis is sensitive to this. He also notes the lack of consistent environmental material data available. However, he concludes that despite some disputable assumptions, the composite bridge is a clear winner.

[i] R.A. Daniel: Environmental considerations to structural material selection for a bridge. European Bridge Engineering Conference, Lightweight Bridge Decks, Rotterdam, March 2003