

Question:

When considering a choice for a greener solvent for a reaction, water is certainly a possibility. Which of the following factors is considered a drawback when evaluating the greenness of water compared to many other solvents?

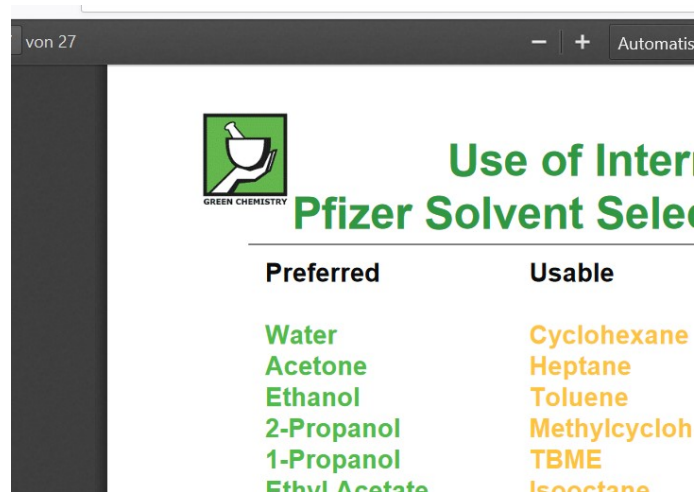
- a) Availability
- b) Boiling point**
- c) Cost
- d) Toxicity

Answer: b) Boiling point

A very good **overview** over green solvents and how they have been assessed, gives the article "Searching for green solvents" by P. Jessop.¹ The solvent of choice for green chemistry is water, which is a non-toxic liquid. The only property, that makes water less attractive as a green solvent, is its high boiling point compared to other solvents, which makes it difficult to distil it off after the reaction.²

Additional information:

Pfizer is providing a **solvent selection guide** for solvents, in which the solvents are categorized based on their greenness:



Preferred	Usable
Water	Cyclohexane
Acetone	Heptane
Ethanol	Toluene
2-Propanol	Methylcyclohexane
1-Propanol	TBME
Ethyl Acetate	Isooctane

Figure 1: Solvents listed in Pfizer's solvent selection guide.

When evaluating the greenness of a solvent many different factors can be taken into account. A type 1 greenness assessment takes the manufacturing process into account, which includes (see Fig. 2):¹

- (A) energy to manufacture
- (B) cumulative energy demand
- (C) impact on health and the environment

In a type 2 assessment, the solvents are compared regarding a specific application. For more information see P. Jessop "Searching for green solvents".¹

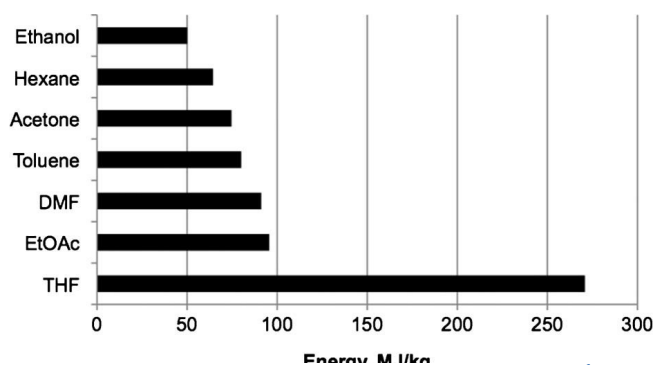


Figure 2: Energy needed to produce 1kg of solvent.¹

References:

1. Jessop, Philip G. "Searching for green solvents." *Green Chemistry* 13.6 (2011): 1391-1398.
2. <http://www.organic-chemistry.org/topics/green-chemistry.shtm>
3. https://www.acs.org/content/dam/acsorg/greenchemistry/education/summerschool/Tamer%20Andrea_Greener%20Solvents.pdf
4. <https://www.dbu.de/media/130508051211a525.pdf>