Desalination of seawater by direct sunlight

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- Greenhouse gases: CO_2@400 [ppm] tips the balance

CO_2 levels since 1950 (60 vs. 5 years)

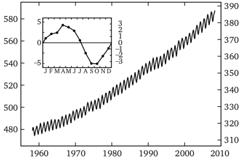
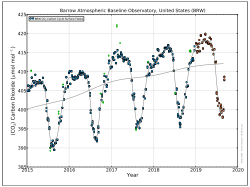


FIGURE 1.6 Mass fraction (left axis, in parts per million) and molar mixing ratio (righ axis, in parts per million) of CO_2 as measured at Mauna Loa Observatory, Hawaii. In



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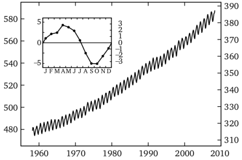

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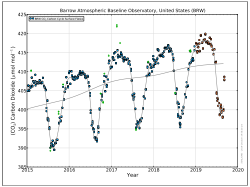

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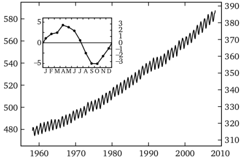

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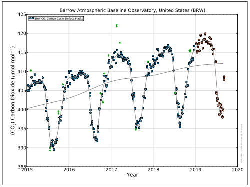

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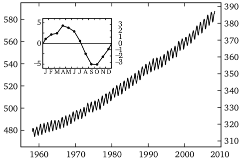

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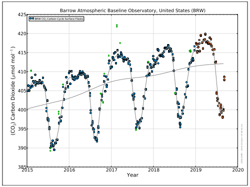

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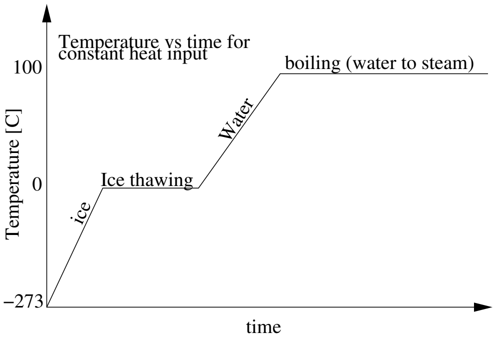

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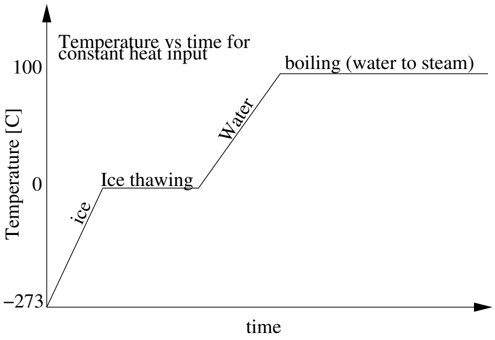

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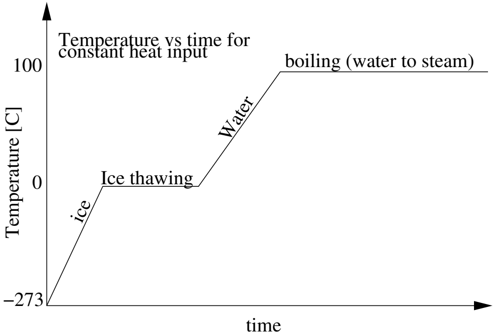

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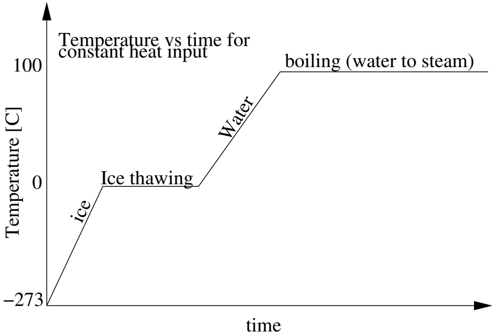

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- At $T = 100°$C temperature remains constant.

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  1. Use solar warming to evaporate water ($T\uparrow$) and seawater's cold to condense the vapor ($T\downarrow$)
  2. This $\uparrow\downarrow$ cycle can produce huge amounts of water at low cost
  3. Goal: Sun as the energy source $\Rightarrow$ seawater $\rightarrow$ pure water

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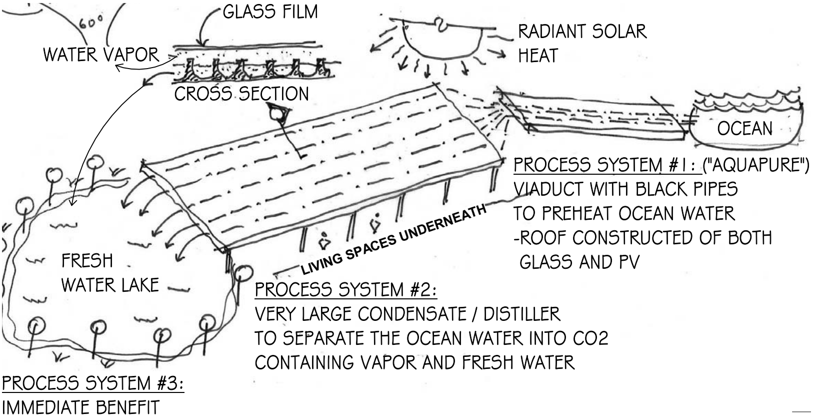

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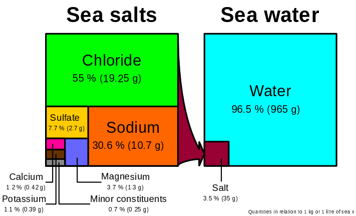

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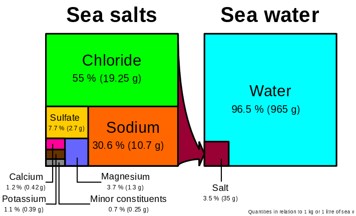

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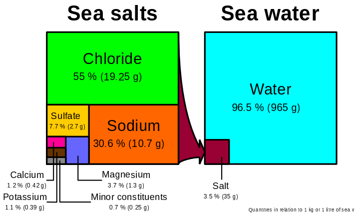

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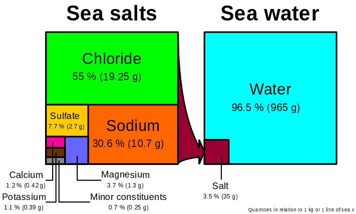

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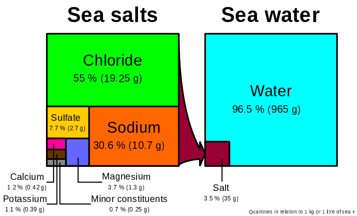

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- Evaporation gives pure water, leaving the salt behind
- The water can be used to grow plants in the desert, which consumes the CO_2.

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Recovery of latent heat: This is the key question

- The main question is: *How much of the heat of the vapor and its resulting condensed liquid, may be recovered?*
- First the sun heats the water to the due point, giving 5% vapor
- Then the vapor is cooled releasing the latent heat into the cold water
- Thus less sunlight is needed to get to 40°(T_{max})
- Given a proper heat exchange design, and assuming cold (e.g. 15°C) inlet seawater, the $T \uparrow\downarrow$ efficiency can be high

The design should pass the vapor under the inlet seawater to expose it to the inlet seawater, cooling the vapor and heating the inlet water.

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- A business model is need to proceed.

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WangEtAl.19