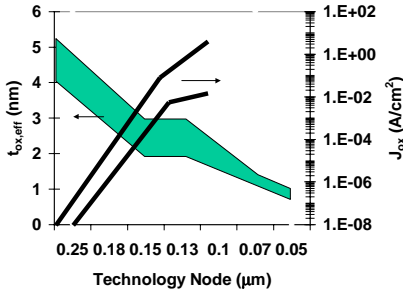


# Oxide Roadmap (SIA)

- General belief that SiO<sub>2</sub> limit ~2nm due to leakage



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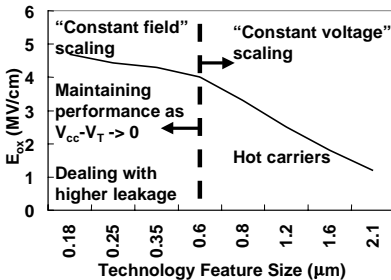


# Technology Scaling Limits

- Various possible constraints
  - Reliability  $\propto \exp(-\gamma V/t_{ox}) * \exp(-E_g/k_B T)$
  - Power  $\propto fCV^2 + I_{sb}(V,T) + I_G(t_{ox})$
  - Performance -  $I_{on}/I_{off}$ ,  $(V_{cc} - V_T)$ ,  $R_{ext}$
  - Manufacturability
- With excessive Ig, one can work to
  - find/design circuits to withstand the leakage
  - find ways to test/burn-in parts
  - find ways to supply power/remove heat
- OR
  - find the next manufacturable gate dielectric

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# Is Technology Scaling Limited by Oxide Reliability?



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# Reliability Limits

- Why does reliability impose limits?
  - Leakage current increases
  - Circuits fail (functionality or speed loss)
- How sensitive are various circuit types to soft and hard oxide breakdown?
  - “Analog” vs. “digital” circuits
  - Static vs. dynamic nodes
- How does Temperature influence performance and reliability? Is heat the real limit?

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