ACHIEVING 300 BUSHEL-PER-ACRE CORN SUSTAINABLY

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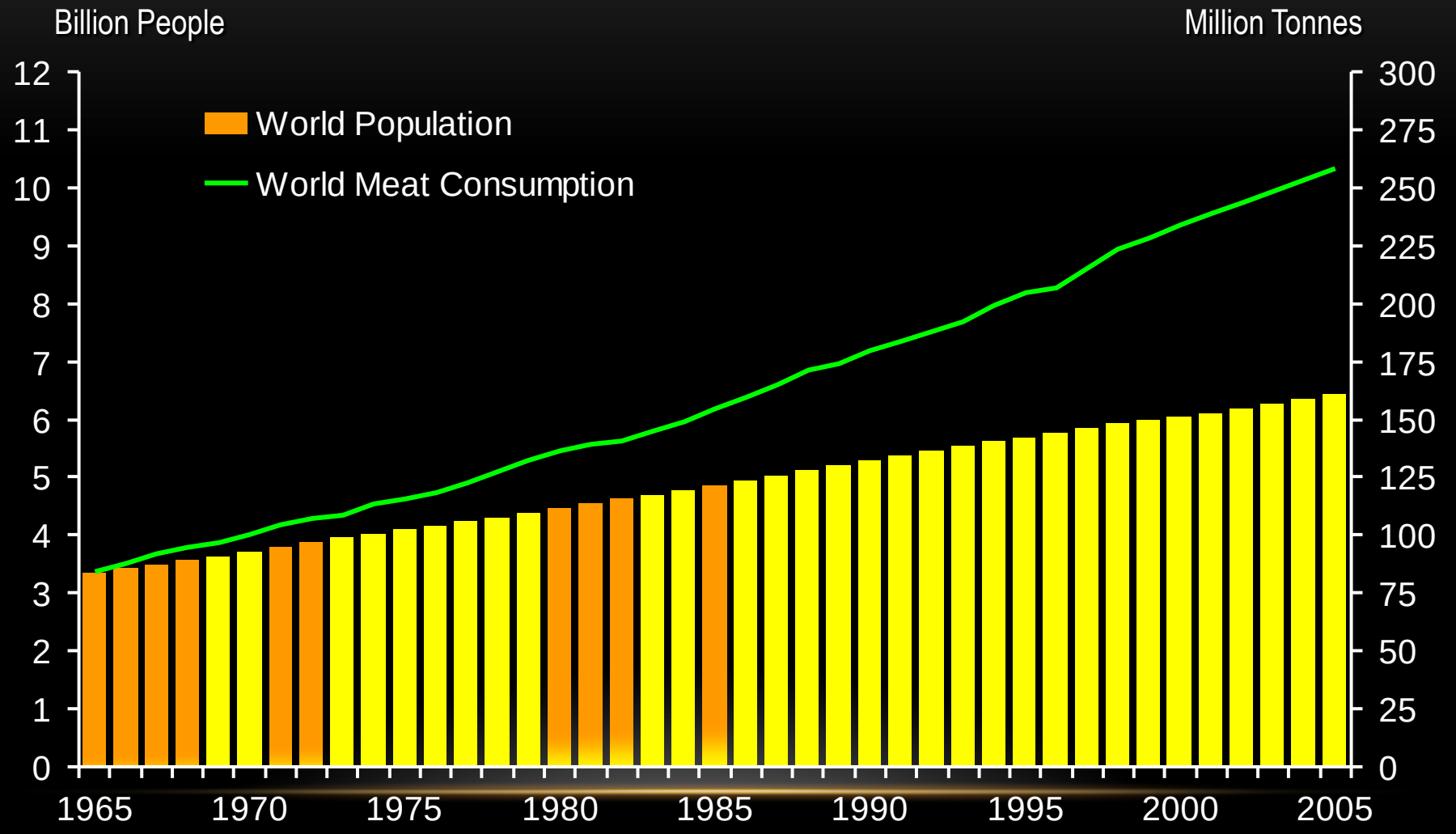
Image: Nuulaa.visualsociety.com

THE FIRST QUESTIONS TO PONDER:

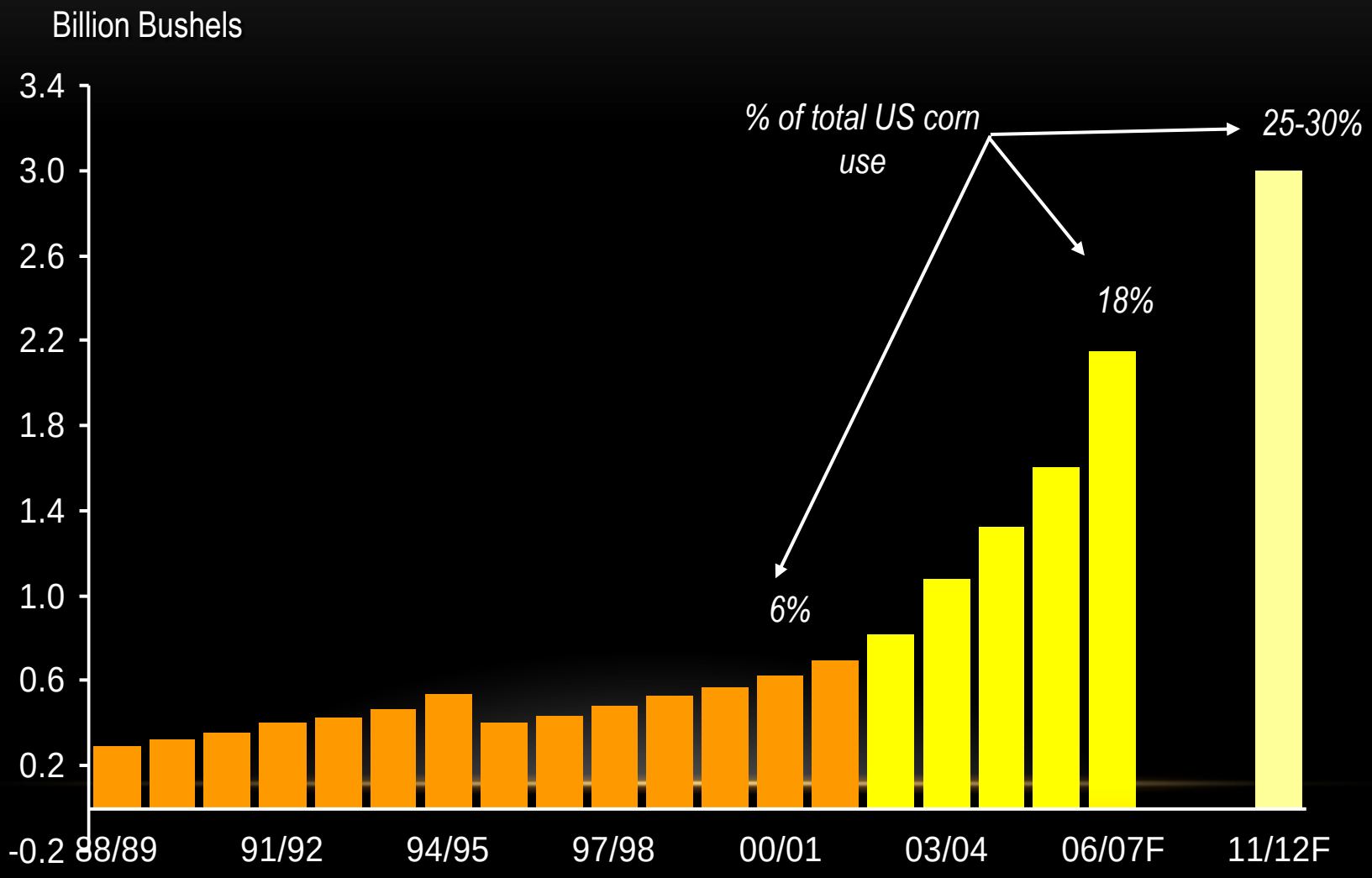
- Do we really need to grow more corn?
- Must high-yielding production systems necessarily be less sustainable than conventional?
- How far can we *sustainably* push corn yields?

WORLD POPULATION GROWTH AND MEAT CONSUMPTION



Source: United Nations, FAO

US CORN GRAIN USED FOR ETHANOL



Source: USDA, PotashCorp

DO WE REALLY NEED TO GROW MORE CORN?

- Yes, IF…
- IF populations projections are correct and
- IF per capita grain consumption is maintained or increases
- And if so…we must grown corn more intensively than our conventional systems

AGRICULTURAL SUSTAINABILITY:

A system of crop and animal production that, over the long term,

- Satisfies human food, fiber, forage, and fuel needs,
- Sustains the economic vitality of farm operations,
- And maintains or improves
  - Soil organic matter
  - Soil structure
  - Water quality

Modified from the 1990 Farm Bill

3 FACTORS OF SUSTAINABILITY

- Maintains or improves
  - Soil Organic Matter (increase soil C sequestration/reduce GHG emissions)
    - Why? Improves soil physical, chemical, and biological properties
    - How to achieve? 1 : Increase plant population & yield & reduce tillage; 2 : reduce number of passes across fields, increase organic inputs

Image: Polish Institute for Permaculture

"The wealth of Illinois is in her soil and her strength lies in its intelligent development" –Draper
-Davenport Hall (Old Agriculture Building), UIUC

MAINTAINS OR IMPROVES

- Soil Structure
  - Why?
    - Reduces soil erosion; reduces soil compaction; improves drainage; provides plant-available water; supports a diverse microbial and invertebrate community
  - How to achieve? Reduced tillage systems , controlled traffic patterns, & increasing SOM

3 FACTORS OF SUSTAINABILITY

- Maintains or improves
  - Water quality
    - Why? Agriculture identified as largest non-point source of nutrient pollution to surface & ground waters
    - How to achieve? Increase nutrient uptake efficiency & use by improving NUE, optimizing placement of inputs, & providing the best root environment

MUST INTENSIVE CORN PRODUCTION BE LESS SUSTAINABLE THAN CONVENTIONAL?

Image: Visitsaltlake.com

OBSERVATIONS: WHY IT MIGHT MAKE SENSE TO INTENSIFY CORN PROD'N

- Improved input uptake efficiency @ high plant pop'ns
- Increased plant pop'ns (yield) = greater C sequestration
- More stover to use for biofuel production while roots and exudates maintain/build SOM levels
- U.S. maize production has one of the highest N uptake efficiencies in large-scale cereal crop production
- In terms of grain yield per unit area, wheat and rice produce about 2/3 of corn yield

ASSESSING AGRICULTURAL SUSTAINABILITY

- We propose: Assessing agricultural sustainability in terms of the ENERGY RESOURCES we produce today and preserve for future generations
- Produce Energy
  - Food & Fuel for today's needs
- Preserve Energy and Resources
  - Fossil fuels
  - A highly productive soil resource
  - High-quality water

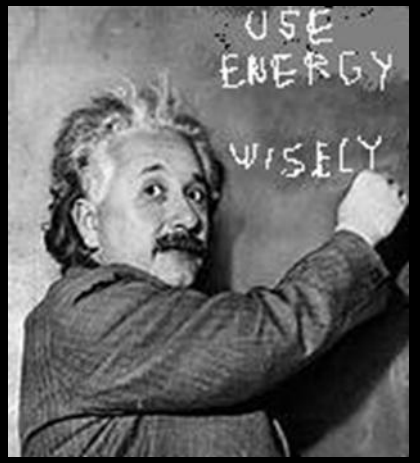


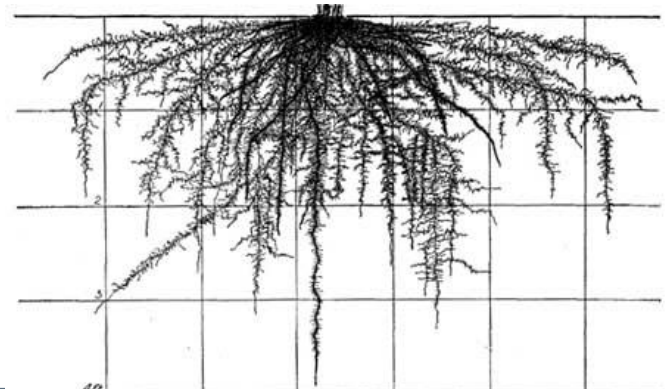
Image: energyeconomyonline.com

ALL CORN BIOMASS CONTAINS ENERGY

GRAIN
- 70% starch
- 8% protein
- 5% oil
- SHORT TERM E

STOVER
- Bioenergy
- Animal Feed
- SOM

SHORT & LONG TERM E



BELOW GROUND CARBON
- Roots & Exudates
- SOM
- Priming for nutrient cycling

LONG TERM (SUSTAINABLE) E

CARBON FRACTION ENERGY EFFICIENCY (CFEE)

CFEE – an accounting system for balancing today's agricultural production costs with tomorrow's production potential

- Net E required to capture carbon in the whole plant

and

- Partial energies associated with short-term and long-term (sustainable) plant fractions

IN CONCLUSION

- Intensive crop management has the potential to increase crop yields to 300+ bushel per acre
- Evaluate fundamental questions regarding sustainability potential of high-yielding corn systems
- Hypothesis: High-yield corn environments can be more environmentally sustainable than current production systems
- Results will allow comparison of high-yield and conventional systems for both yield potential & sustainable production

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