Addressing challenges at the water-energy-food nexus...

Chemical Engineering Matters

Dr. Desmond King
Past President

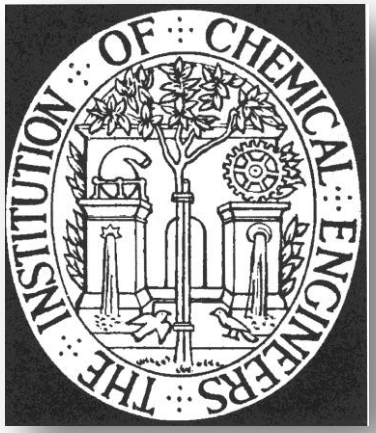
AIChE Fall Meeting, San Francisco
5 November 2013

IChemE ADVANCING CHEMICAL ENGINEERING WORLDWIDE

Then and now

Founded in Philadelphia in 1908

45,000 members from over 90 countries



Founded in London in 1922

38,000 members in 120 countries

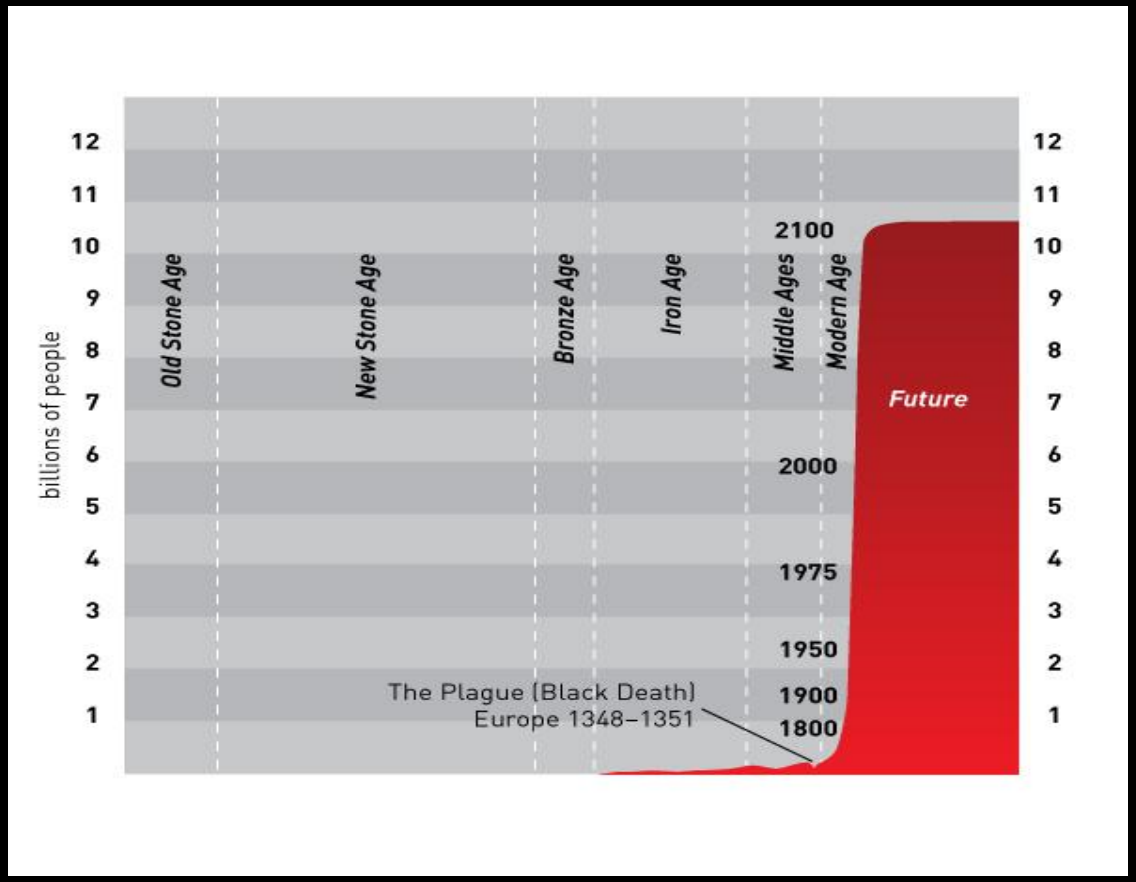
Chemical engineering changed the world

$N_2 + 3H_2 \rightleftharpoons 2\ NH_3$
$(\Delta H = -92.22\ kJ \cdot mol-1)$

Fritz Haber
1868-1934

Carl Bosch
1874-1940

One planet – 7 billion people (and rising)



Source: Royal Geographical Society

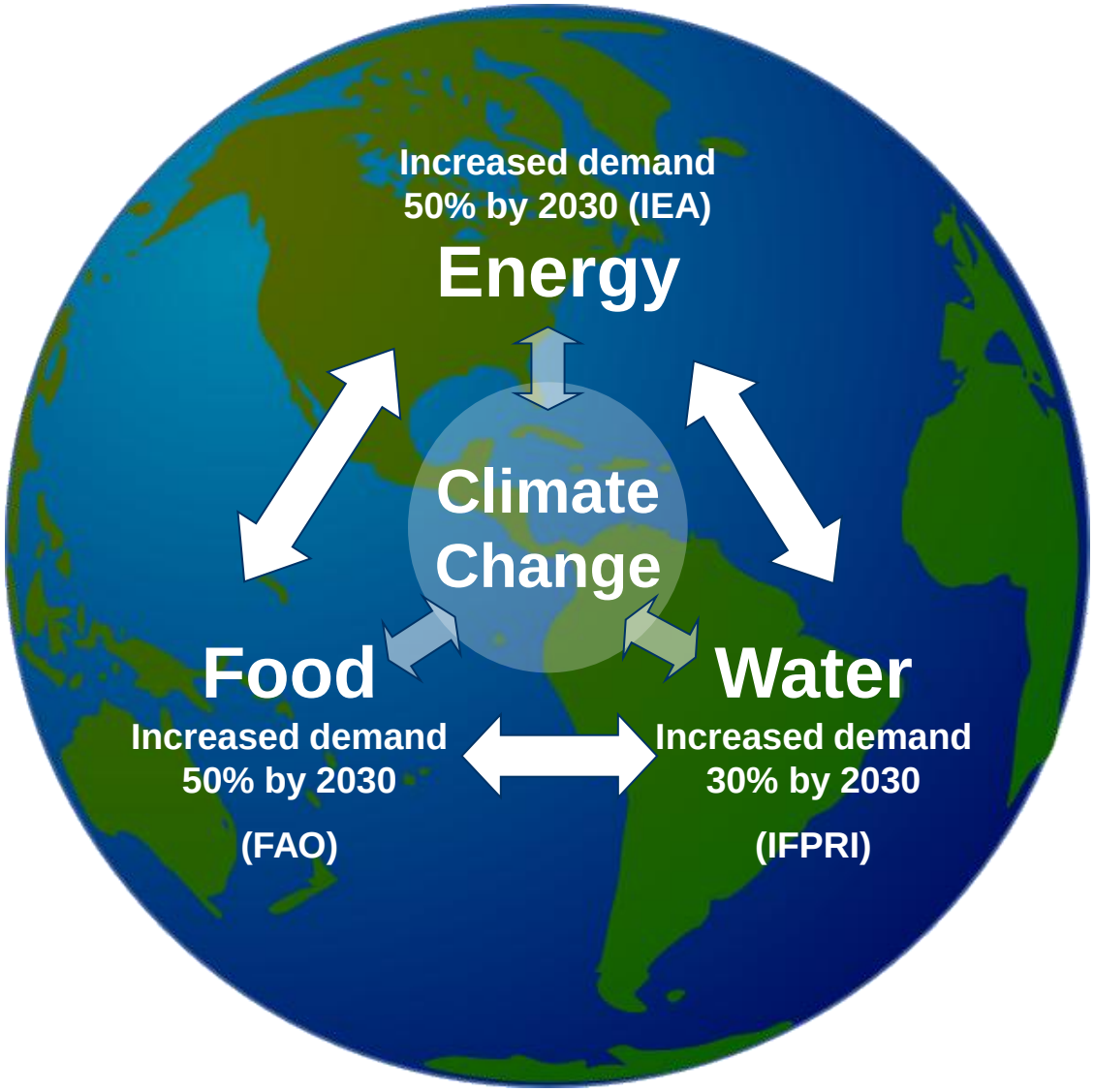
Everyone wants what we've got (and why shouldn't they)

Life for the ‘bottom billion’

Image courtesy of the World Resources Institute

The Perfect Storm?

1. Increasing population
2. Increasing levels of urbanisation
3. The rightful goal to alleviate poverty
4. Climate Change



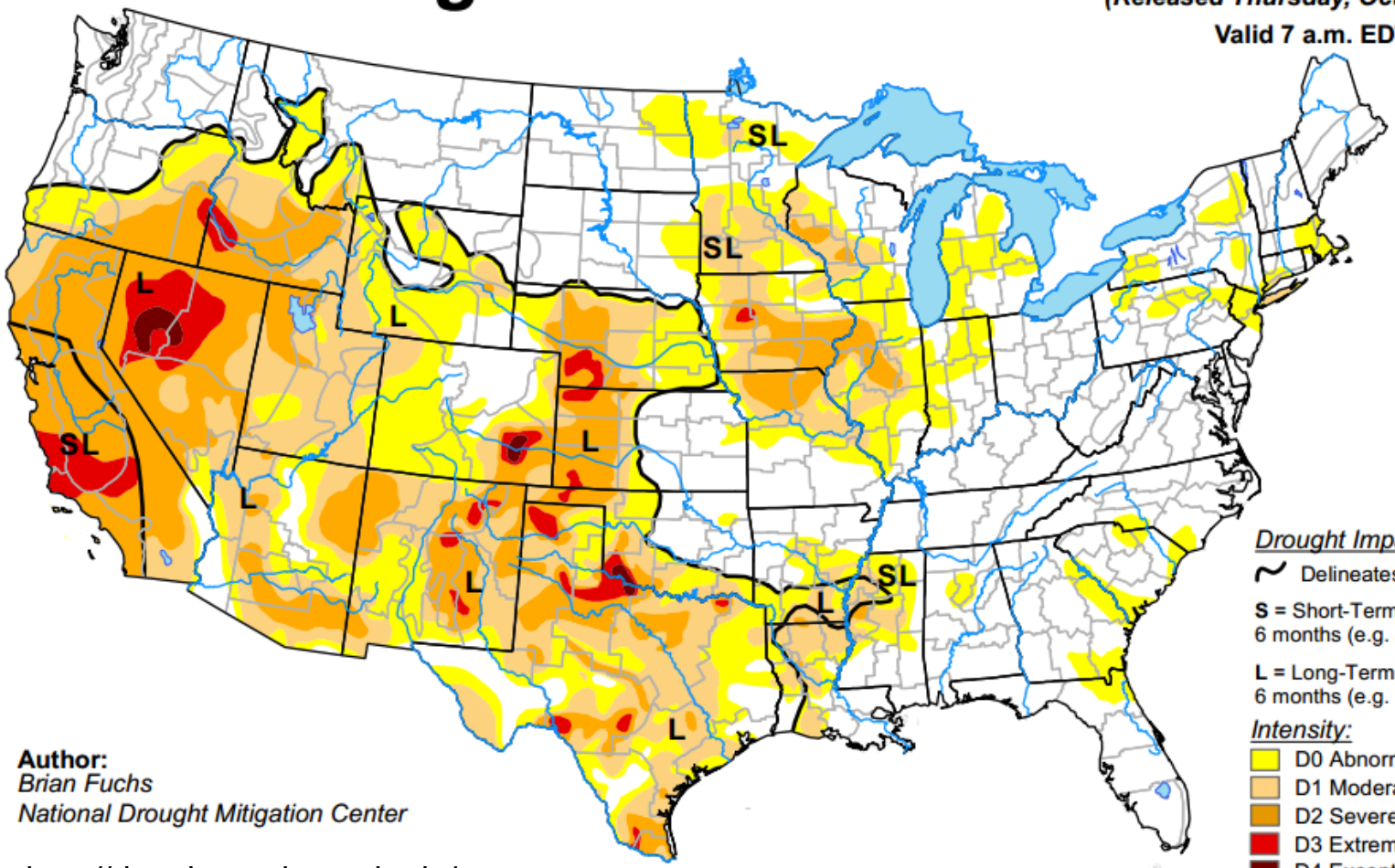
Government Office for Science

U.S. Drought Monitor

October 22, 2013

(Released Thursday, Oct. 24, 2013)

Valid 7 a.m. EDT



Author:
Brian Fuchs
National Drought Mitigation Center

http://doughtmonitor.unl.edu/

Drought Impact Types:

Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

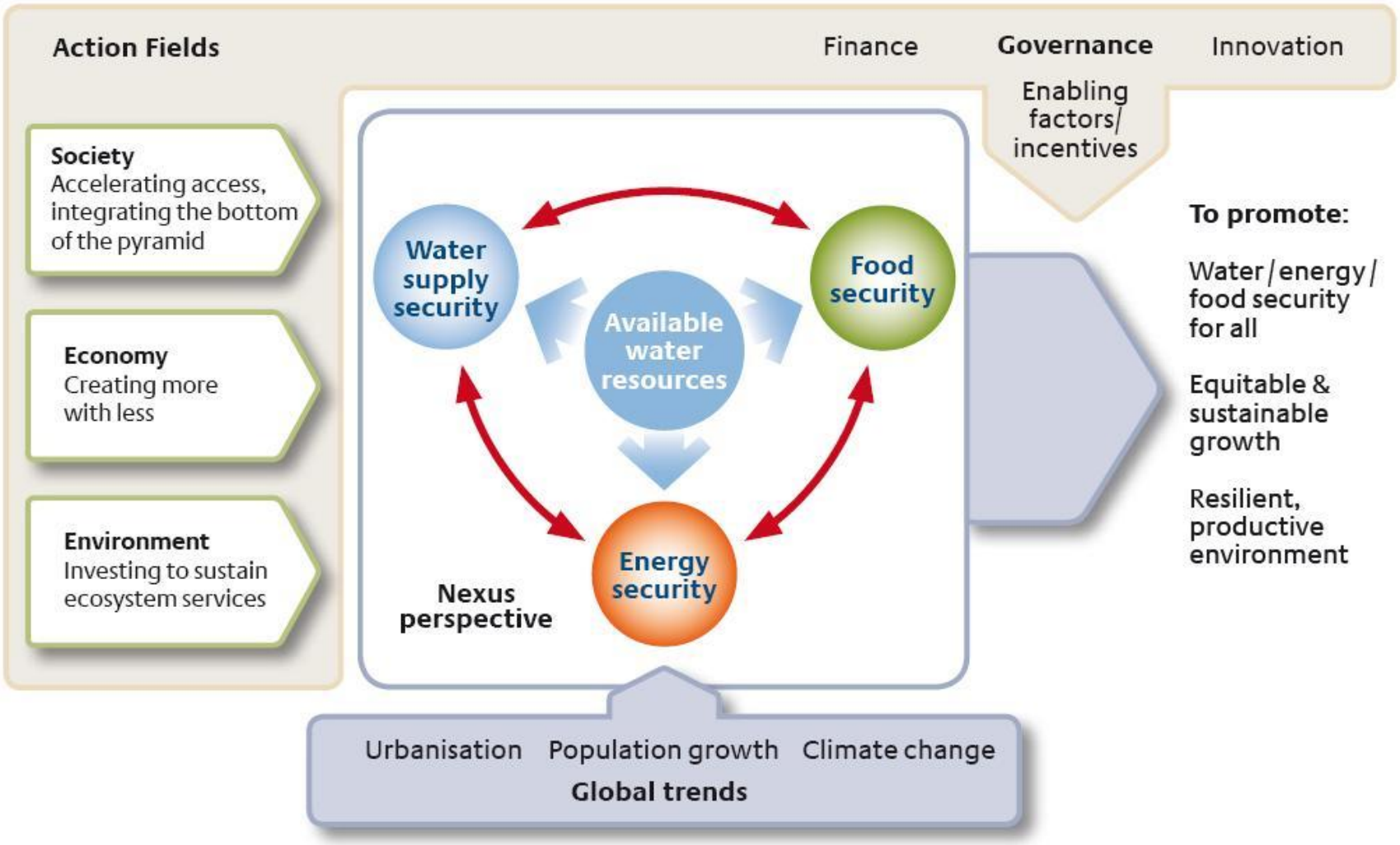
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

USDA National Drought Mitigation Center

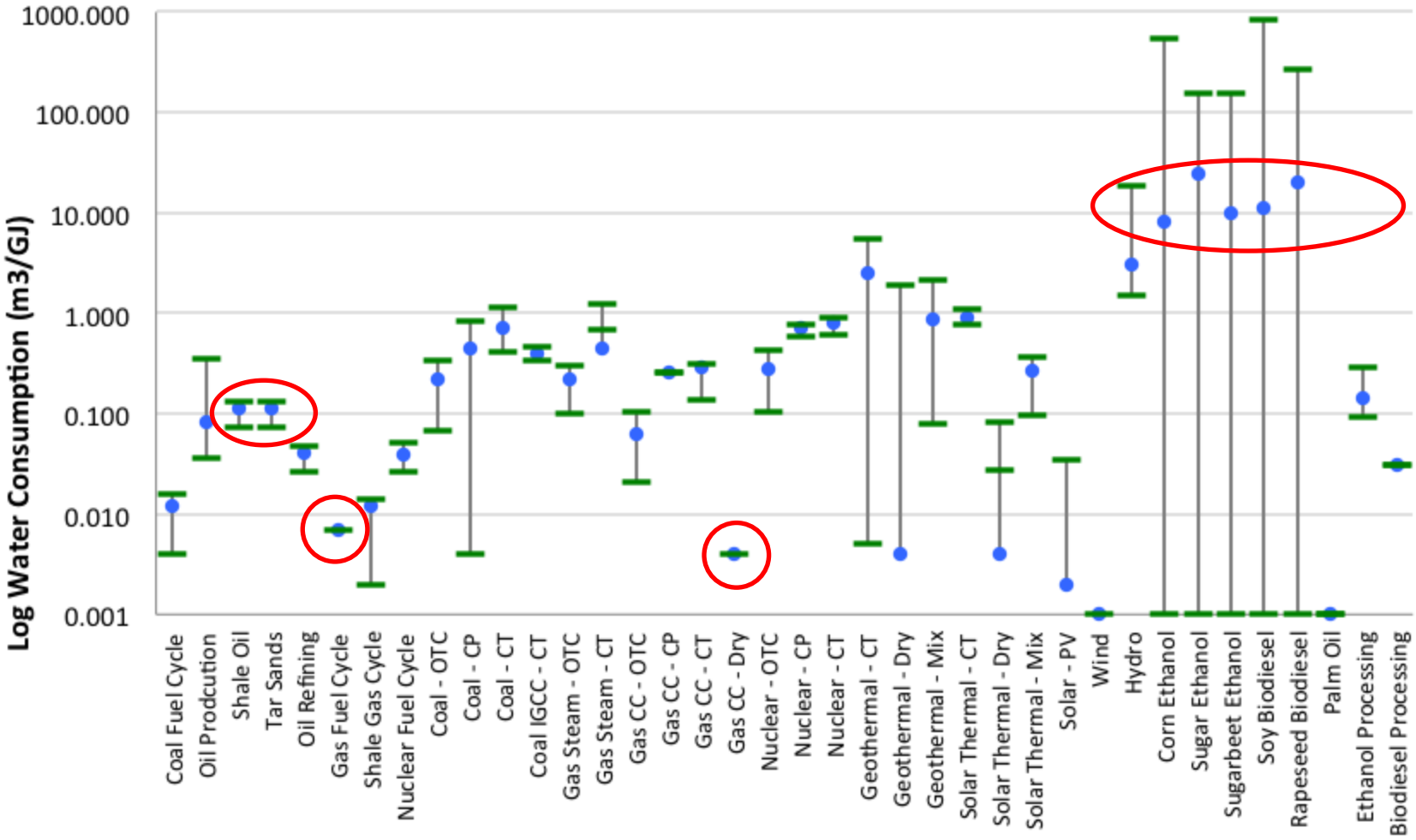
The water-energy- food ‘Nexus’



Source: Understanding the Nexus, Stockholm Environmental Institute, 2011

Water for energy production

Water consumption coefficients for energy technologies



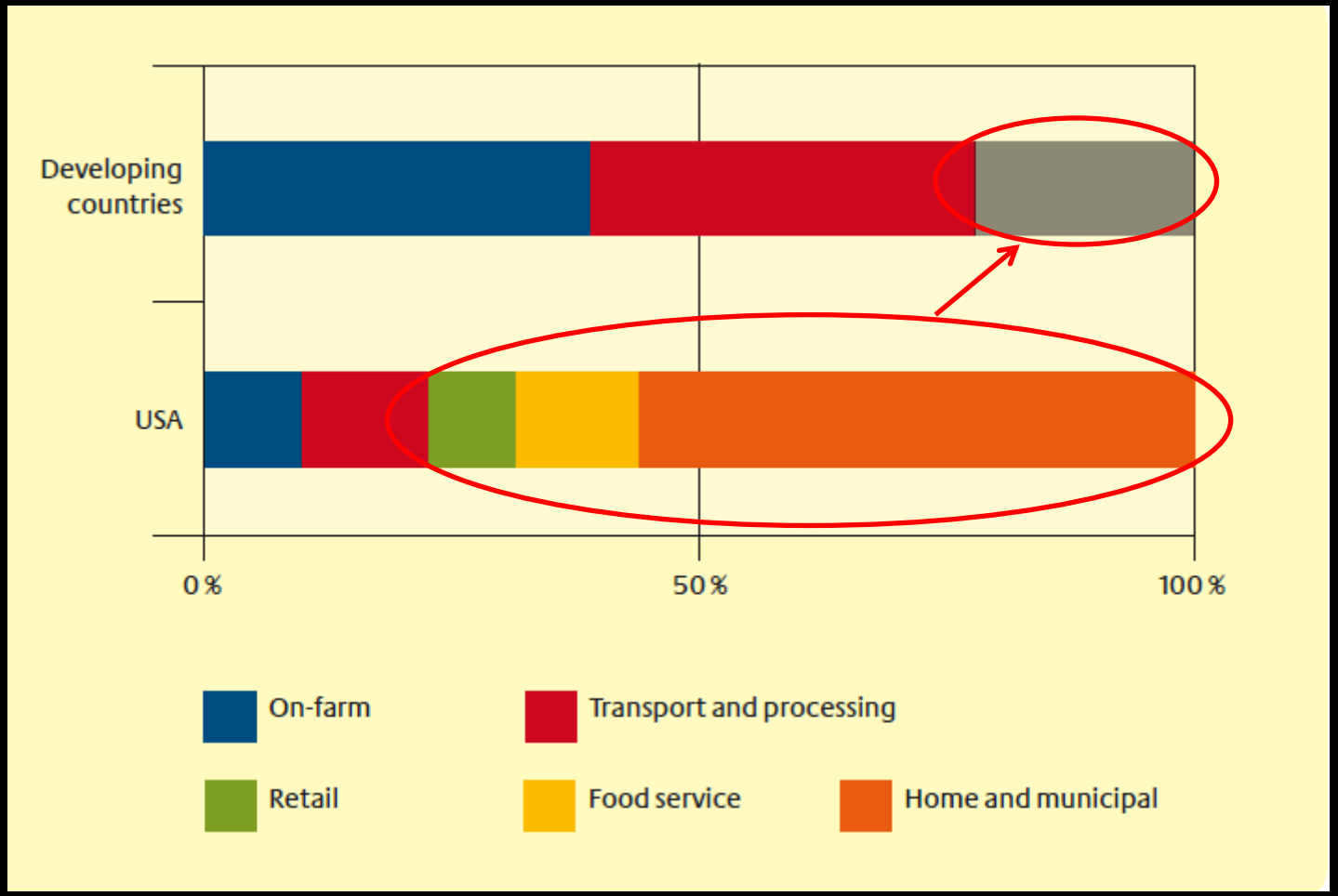
Dr. Edward Spang, CWEE, University of California, Davis
A thirst for power: A global analysis of water consumption for energy production, 2012

Energy for water production

Image: Nalette

Water for food production

Make up of total food waste in developed and developing countries



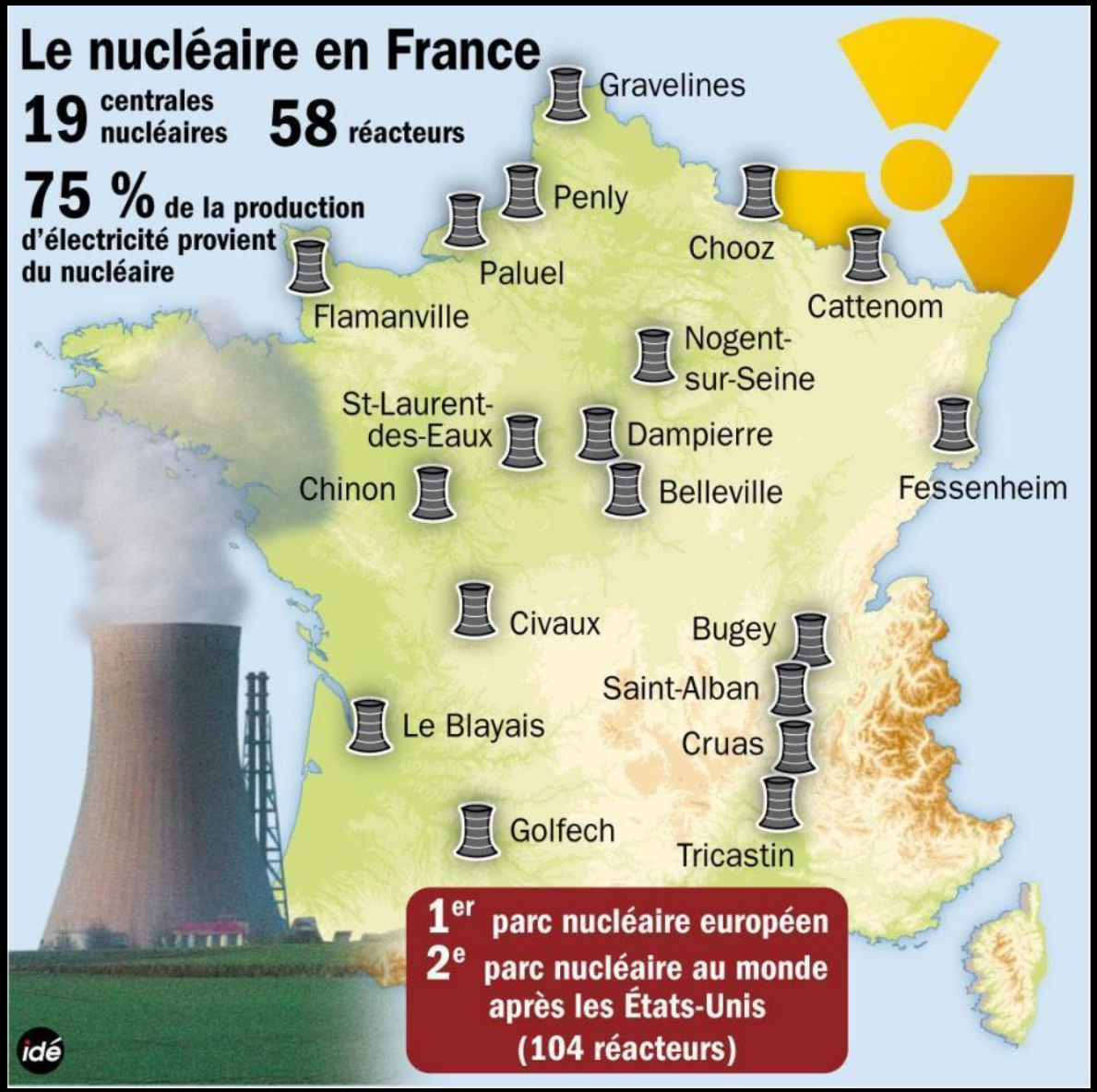
Godfray et al ,Food security: The challenge of feeding 9 billion people. Science 327, 812, DOI: 10.1126/science.1185383 2010

Energy for food production

Image courtesy of GEA Group

Climate change

Image courtesy of the World Resources Institute


Le nucléaire en France
19 centrales nucléaires
58 réacteurs
75 % de la production d'électricité provient du nucléaire
Gravelines
Penly
Paluel
Flamanville
Chooz
Cattenom
Nogent-sur-Seine
St-Laurent-des-Eaux
Dampierre
Chinon
Belleville
Fessenheim
Civaux
Bugey
Saint-Alban
Le Blayais
Cruas
Golfech
Tricastin
1er parc nucléaire européen
2e parc nucléaire au monde après les États-Unis (104 réacteurs)
idé

Leadership for chemical engineers

- An integrated systems approach.
- A stronger focus on process and product efficiency
- Better lifecycle assessments in terms of water and energy use

Chemical engineering matters…

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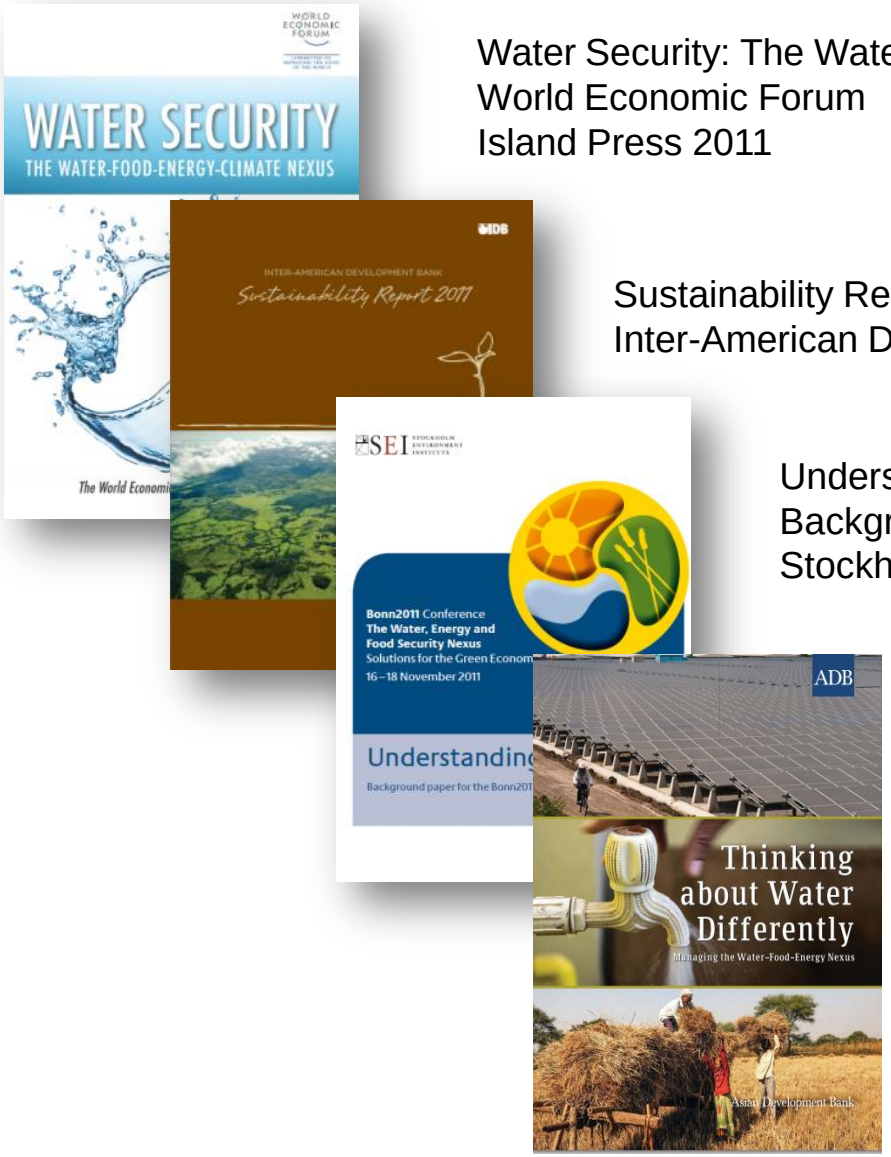
Reference sources



Water Security: The Water-Food-Energy- Climate Nexus
World Economic Forum
Island Press 2011

Sustainability Report 2011
Inter-American Development Bank

Understanding the Nexus
Background Paper for the Bonn 2011 Nexus Conference
Stockholm Environment Institute

Thinking About Water Differently
Managing the Water-Food-Energy Nexus
Asian Development Bank 2013