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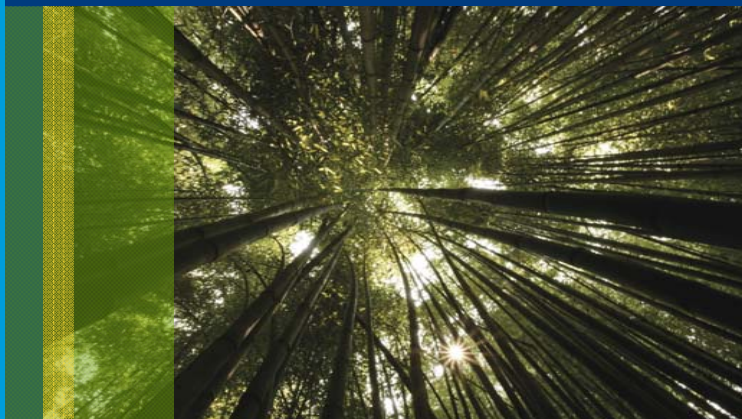
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New Sources for Biofuels: What Are They?



Rick Zalesky
Vice President
Chevron Technology Ventures

U.S. Department of Agriculture
2008 Outlook Forum
Arlington, Virginia – February 21, 2008



Framing the Future of Energy

- Significant growth is expected in global energy demand
- Adding and accelerating diversification is essential
- Scale matters and scaling up has effects
- Infrastructure development is often overlooked
- Renewable energy requires different business models
- Energy strategies and solutions require a holistic view, including addressing carbon constraints

For a comprehensive analysis of the future of energy to 2030, see the major new study at: www.npc.org



The Dimensions of Energy

Scale	Time	Capital
<p>Global fuel volume:</p> <p>Today:</p> <ul style="list-style-type: none">• One thousand barrels per second• > 1 trillion gal/yr• 0.5 gal for every human, every day <p>Tomorrow – 2030</p> <ul style="list-style-type: none">• Mid-range growth forecasts at + 50%• Low-range growth forecasts at +30%	<p>Manufacturing and infrastructure:</p> <ul style="list-style-type: none">• Takes decades to develop at scale; lasts generations• Large ethanol plant: 100 MM gal/yr• Large crude refinery: 3000 MM gal/yr <p>Technology:</p> <ul style="list-style-type: none">• Avg. >15 yrs from invention to large scale deployment	<p>Estimates of future investment call for \$20+ trillion over the next 30 years</p>

Chevron's View of the Next Generation of Global Energy



Conventional Fuels

Finding and Developing the Next Trillion Barrels



Alternative Fuels

Converting Unconventional Resources with Molecular Transformation



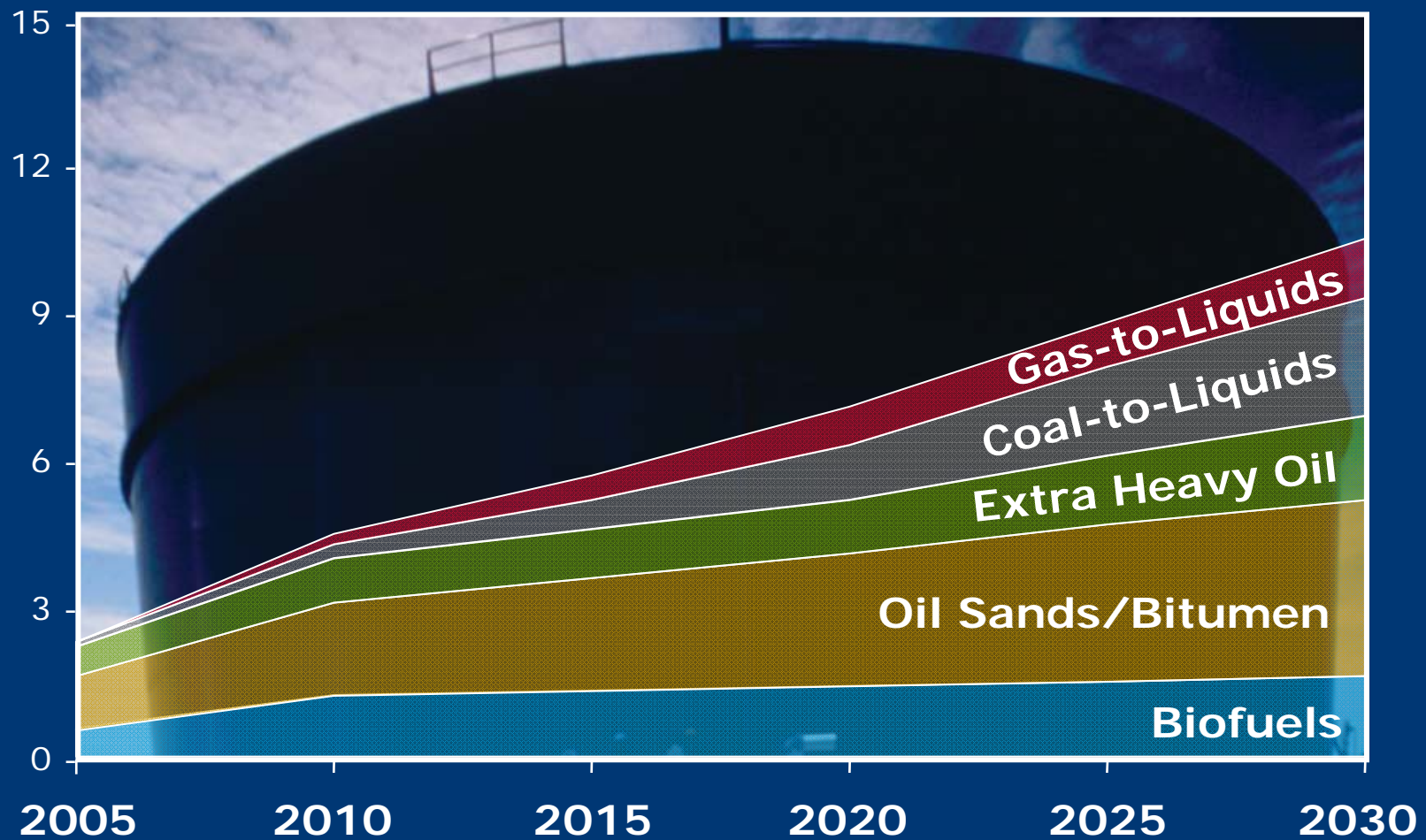
Renewable Fuels

Building Industrial-Scale, Sustainable Business Models

Fuels from Unconventional Resources



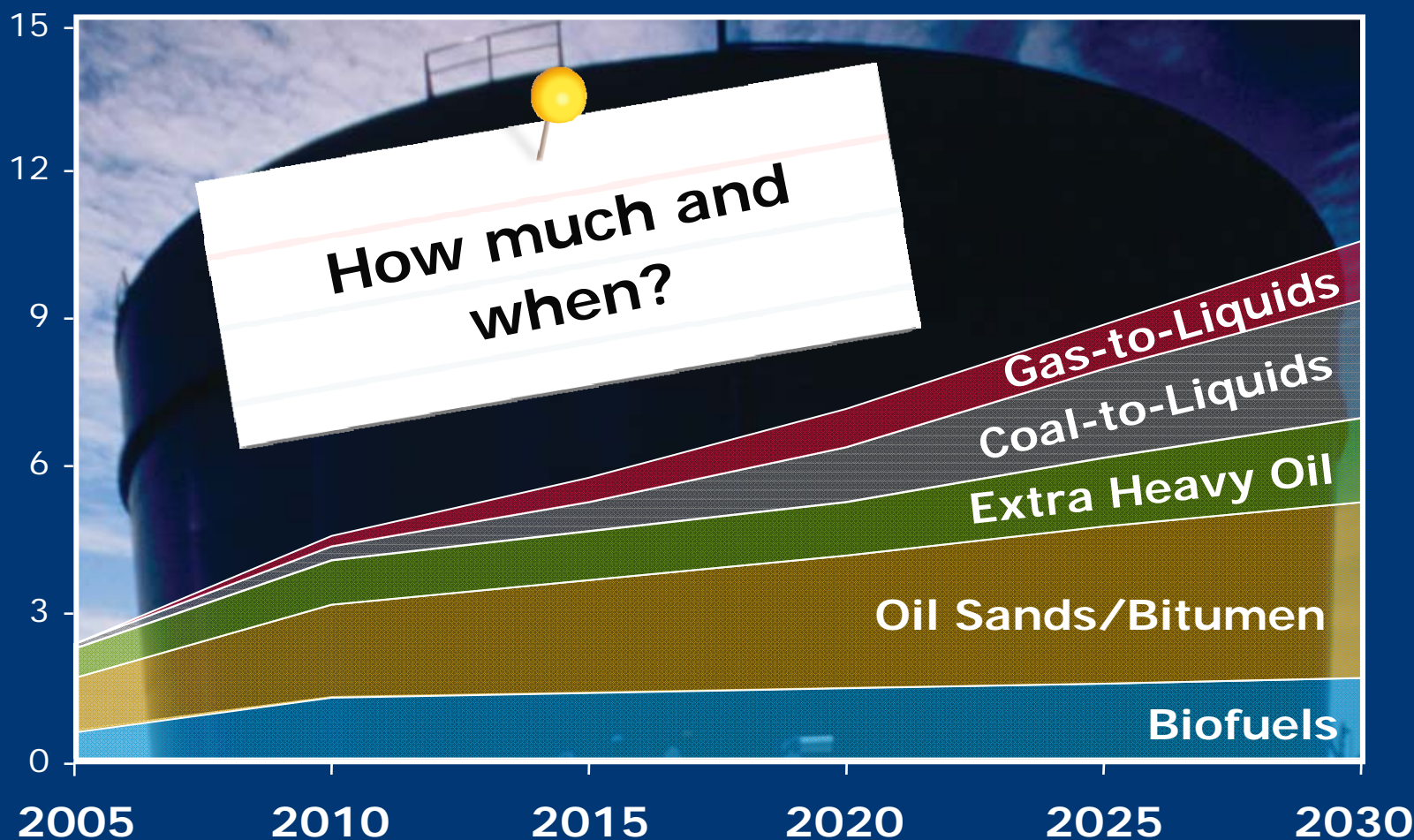
Global Production - Million Barrels Per Day



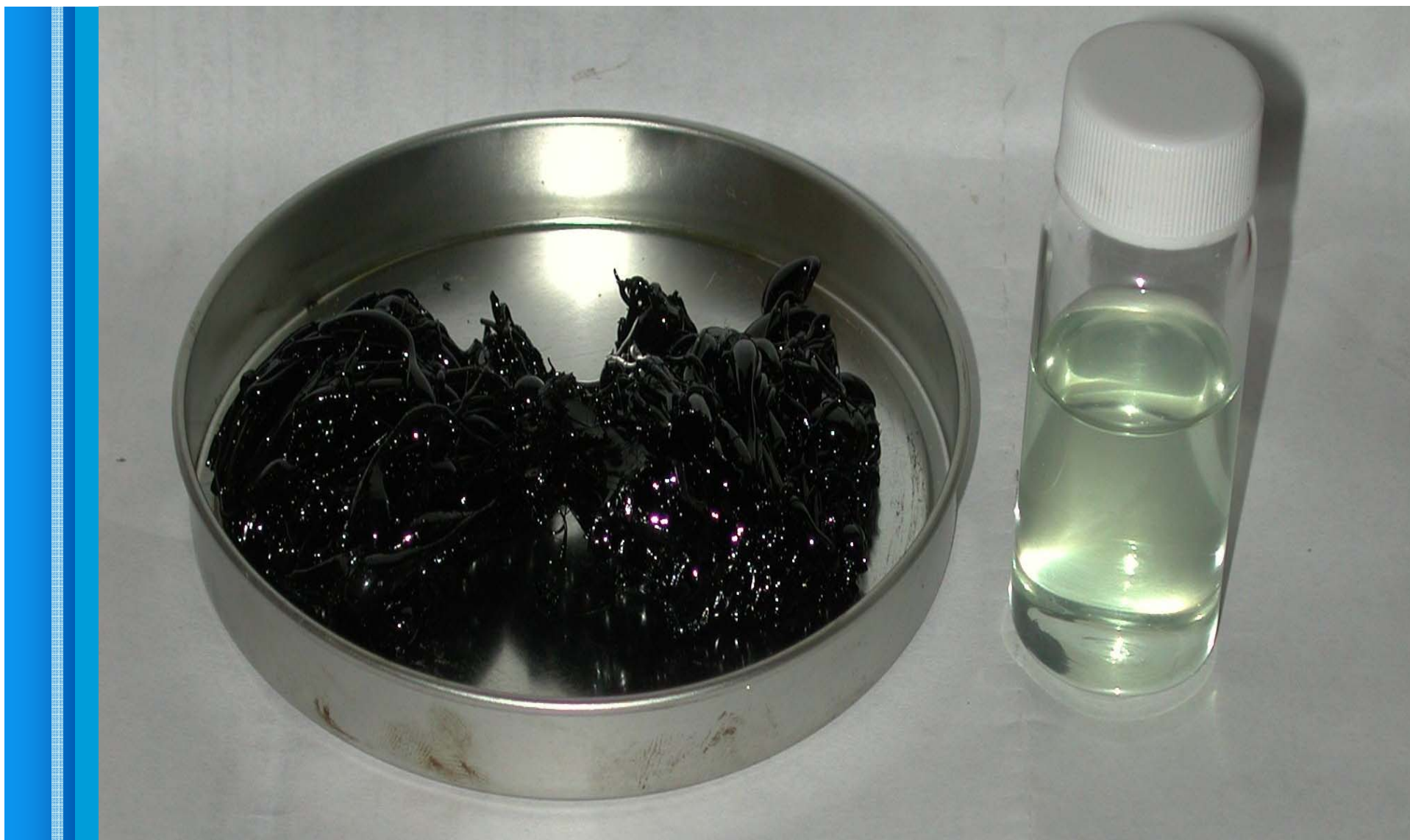
Fuels from Unconventional Resources



Global Production - Million Barrels Per Day



Synthetic Alternative Fuels



Synthetic Alternative Fuels



Advanced Biofuels Development

Industrial-scale
Infrastructure

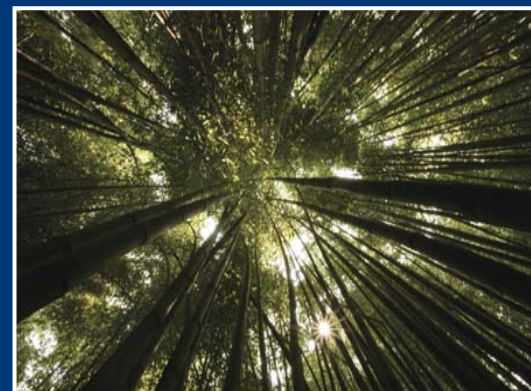


2nd Generation
Technology



Key Components

Large, concentrated
supplies of feedstock





Advanced Biofuels Development

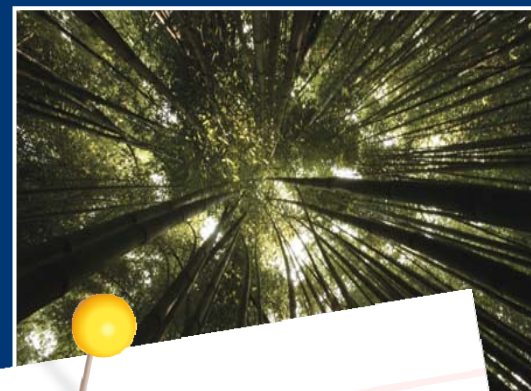
Industrial-scale
Infrastructure



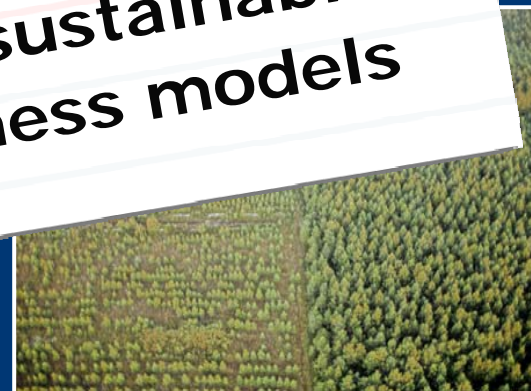
2nd Generation
Technology



Large, concentrated
supplies of feedstock



***Plus sustainable
business models***



Key Components

Feedstock Challenges

Develop cost-advantaged access to scalable feedstock supply to support industrial scale volumes:

- Scale and economic viability
- New vs. existing infrastructure
- Crop threats and seasonality
- Food vs. fuel competition
- Land availability
- Level and persistence of subsidies
- Water supplies
- LCA & LUC

Algae, which require no arable land at all, potentially can produce much more oil per acre than any terrestrial crop.

However, algae is still some years from being a commercially viable feedstock source.

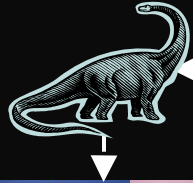


Conventional and Green Crude Process

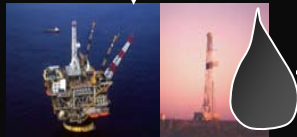


Conventional Crude*

Bury, wait 50 million years



Explore, drill, produce — local infrastructure



*Stable, flowable, energy dense liquid

Pre-treat at refinery site as needed



Distribute regionally through established infrastructure — pipeline, tanker, barge, or rail

Sunshine + water + CO₂ + nutrients + plant life



Green Crude*

Harvest and gather — locally



Produce — local infrastructure



*Stable, flowable, energy dense liquid

Pre-treat at refinery site as needed



Refine into consistent, high-quality liquid fuel products — gasoline, diesel, etc.



Transport over long distances — pipeline, tanker, barge, or rail



Market via established network of service stations



With all the excitement about alternative energy sources ...



Geo-
thermal



Wind



Solar



Biofuels



Hydrogen



... it's important to keep perspective ...





... and we're going to need it all.





Fundamentals of the Energy System

- A complex blend of economics, geopolitics, technology and the environment
- World's largest supply chain
- Highly integrated infrastructures
- Capital- and technology- intensive
- Very long-lived assets

