



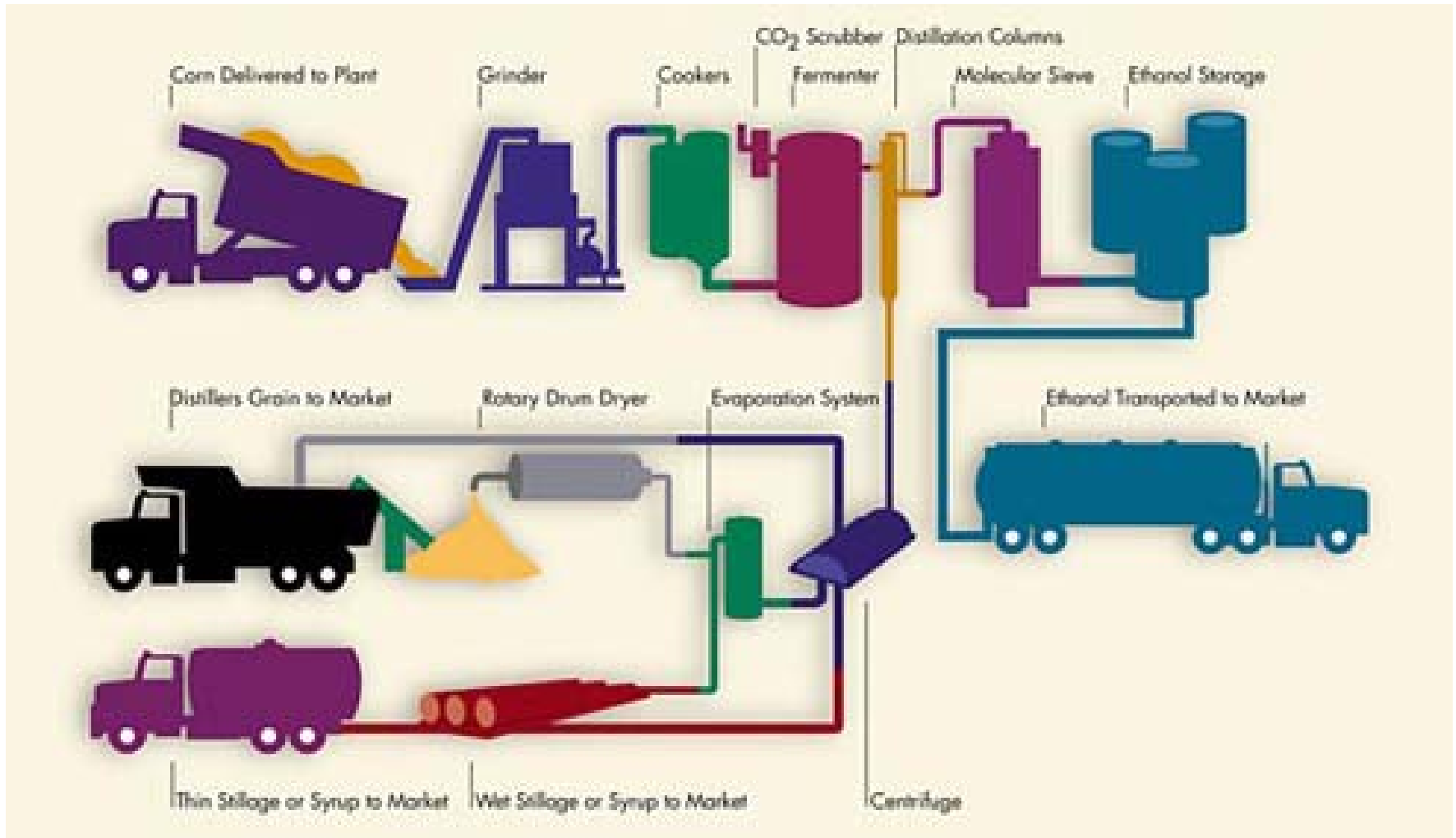
Overview: Current Dry Grind Industry



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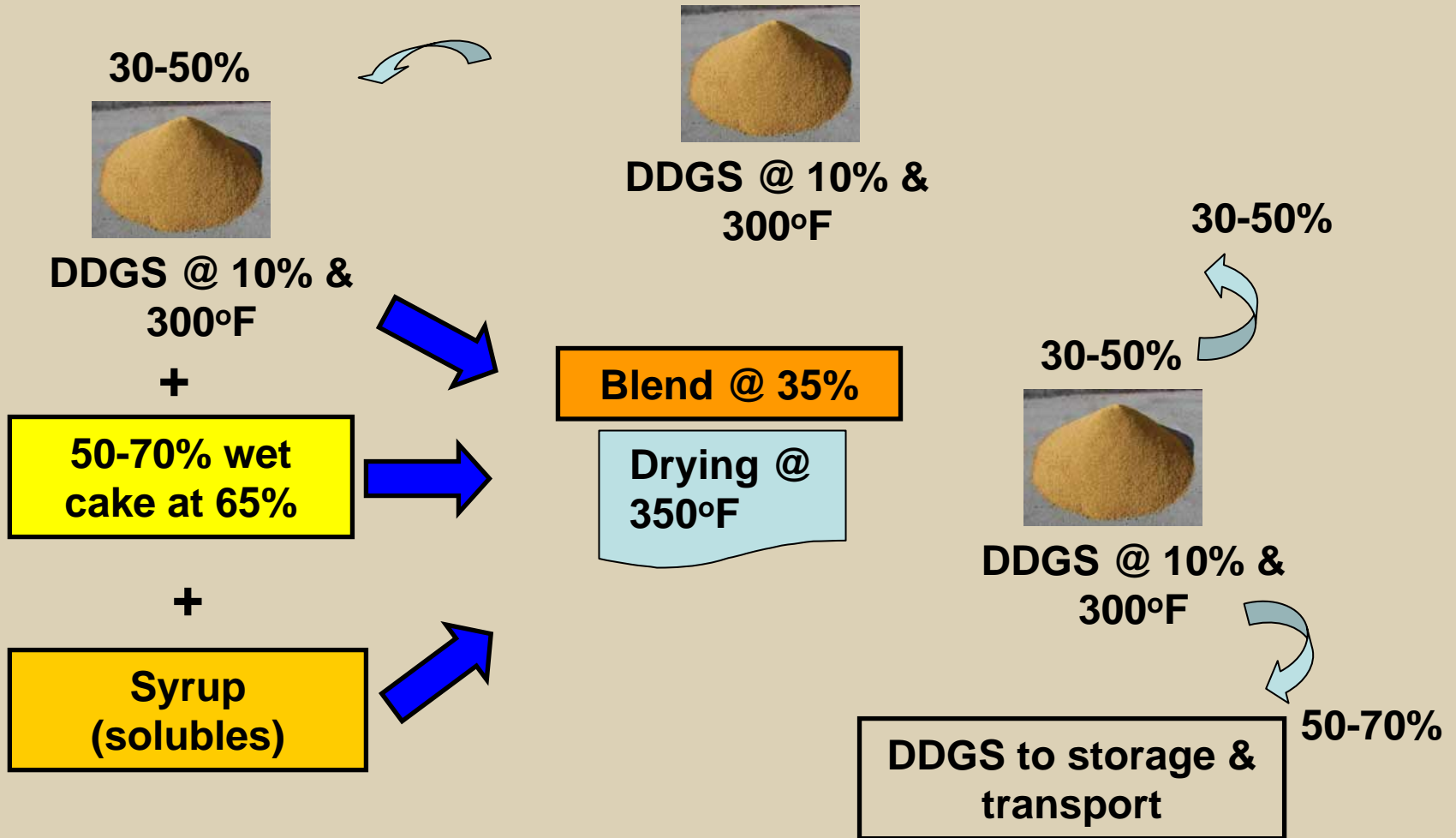
Ethanol Production- Dry Milling



Source: RFA, <http://www.ethanolrfa.org>

Process Flow for DDGS

Drying to 10% may be done by multiple passes through the drum dryer



Corn Ethanol Industry Expansion

Year	Total Plants	Ethanol Production Capacity (Million gal / yr)	DDGS million tons	Plants Under Construction	Farmer Owned (million gal / yr)
2000	54	1748	5.0	6	340
2001	56	1922	5.5	5	473
2002	61	2347	6.7	13	645
2003	68	2707	7.8	11	797
2004	72	3100	8.9	15	1041
2005	81	3644	10.4	16	1389
2006	95	4336	12.4	31	1677

May, 2006



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Expansion will include corn as feedstock

Current ethanol production is 4.3 billion gallons per year (BGY) from corn

Projected by NCGA to increase to 12.8 to 17.8 billion gallons per year by 2015 from corn

Initiative target is 30% of *current* gasoline consumption met with biofuels

By 2030:

30% of 140 BGY = 42 billion gal / yr gasoline displaced by 60 billion gal / yr of ethanol (energy equivalent basis),

Cellulose conversion important



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Ethanol - Renewable Fuel Standard

On August 8, 2005, President Bush signed the [Energy Policy Act of 2005 \(H.R. 6\)](#) into law. Includes national renewable fuels standard (RFS) that doubles use of ethanol and biodiesel by 2012 to 7.5 billion gallons in 2012.

Beginning in 2013, a minimum of 250 million gallons a year of [cellulose derived ethanol](#) will be included in the RFS.



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Source: RFA, <http://www.ethanolrfa.org>

Current and Future Capacities Billions of Gallons

Total Current Capacity (109 plants)	5.28
Under construction(58)	
/ modification (7)	4.26
	<hr/>
Total Capacity (current and future)	9.58

RFA, Dec, 2006



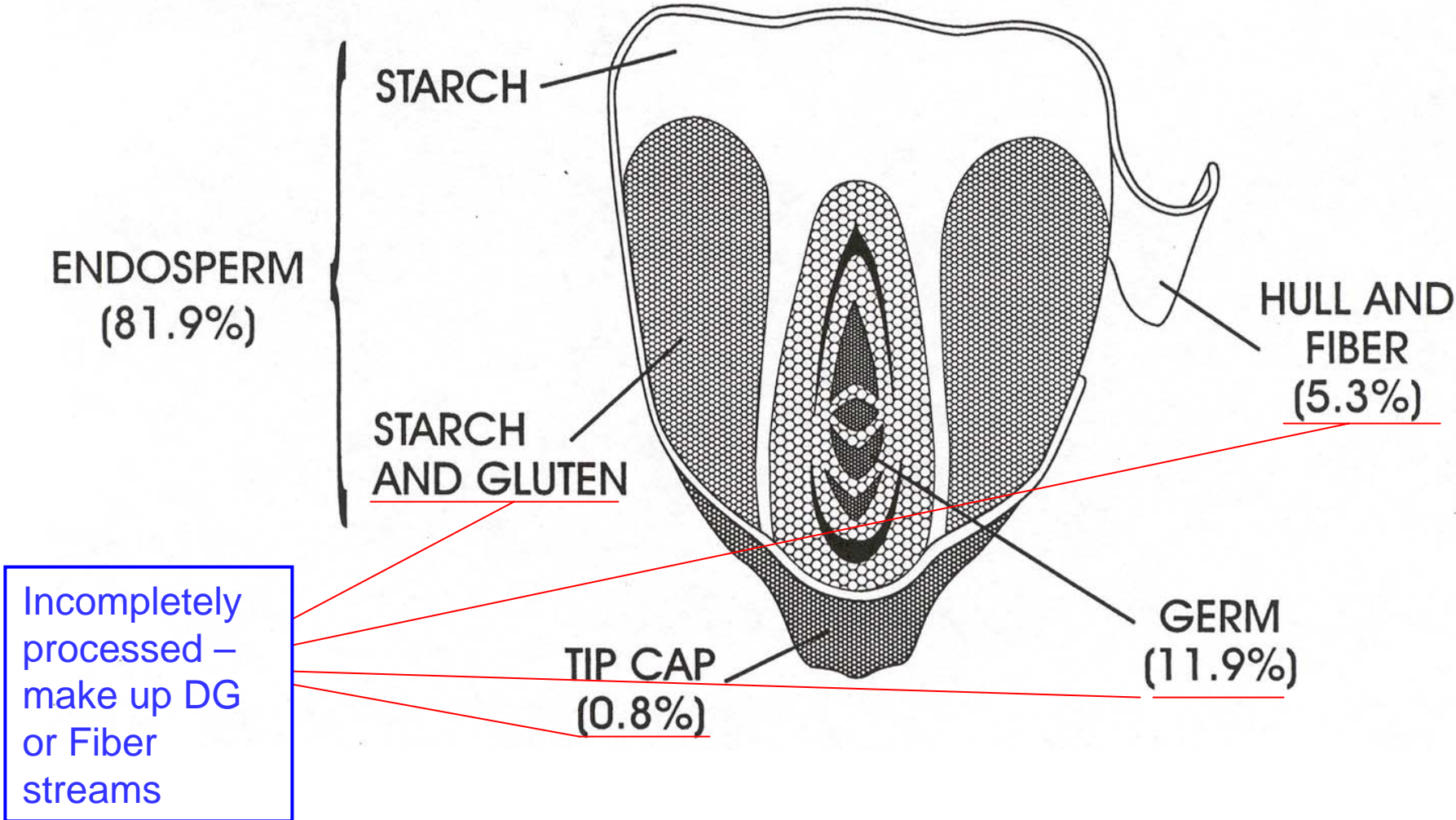
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Kernel of Corn gives co-products when processed to ethanol

Dry grind process: 5 lbs DDGS or 4 lbs DG / gal ethanol

Wet mill: 2.5 lbs fiber / gal ethanol



DDGS from Dry Grind Process

Industry currently produces 5 billion gal ethanol

5 lbs DDGS / gallon ethanol.

12.5 million tons DDGS industry wide in 2006

25 ? million tons DDGS by 2010

Estimated potential additional ethanol from DDGS / gallon of ethanol produced in current dry grind plant:

glucose from starch:	0.017 gal / gal
glucose from cellulose:	0.056
xylose from xylan:	0.035 (future)
arabinose from fiber:	0.0 (yet to be achieved)
Total	0.108 gal / gal (w/ xylose)
	0.0703 gal / gal (without xylose)

Cellulose conversion is important for achieving enhanced yields.



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Composition of Corn Kernels

Components in Corn Kernel (% by weight)	
Starch	71.7%
Soluble sugars	2.6%
Hemicellulose	5.5%
Cellulose	2.4%
Lignin	0.2%
Lipids	4.3%
Proteins	10.3%
Ash	1.4%
Balance	1.6%
Total	100.0%

(Gulati et al, 1996)

DDGS Composition

Gross Matter Composition		Average (95% confidence intervals)
	Moisture Content (% total)	11.2 ± 0.6%
	Dry Matter Content (% total)	88.8 ± 0.6%
Dry Matter Composition		
	Glucan (total) (% dry matter)	20.9 ± 7.1%
	Cellulose (% dry matter)	16.0 ± 6.6%
	Starch (% dry matter)	5.2 ± 1.0%
	Xylan (% dry matter)	8.2 ± 3.3%
	Arabinan (% dry matter)	5.3 ± 0.7%
	Protein (% dry matter)	26 - 34%
	Oil (% dry matter)	10 - 13%



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