ENHANCING FUEL ETHANOL PRODUCTION THROUGH B-HEAVY MOLASSES ROUTE

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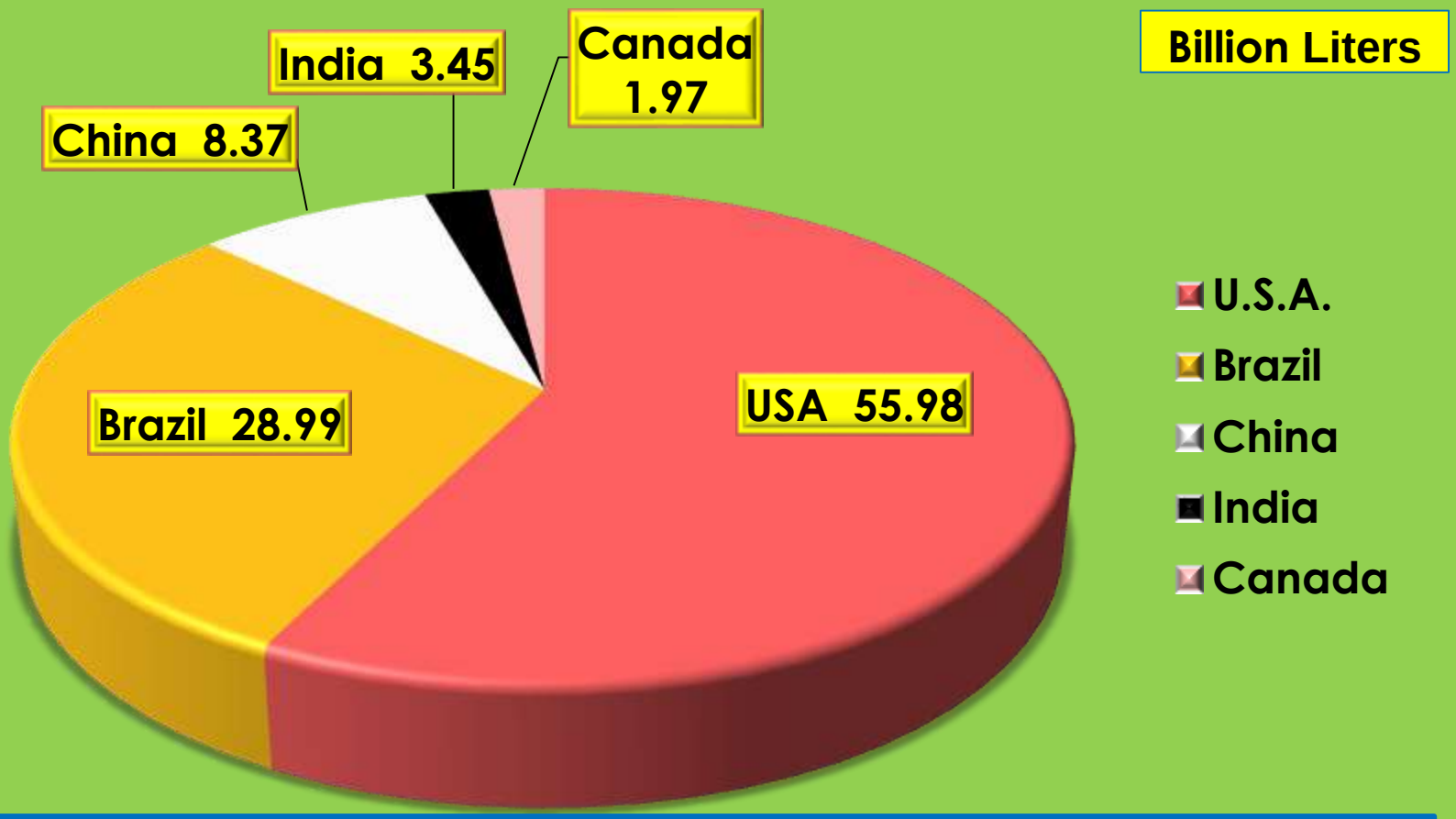
CHALLENGES

- Produce enough ethanol to make 10 % and 20 % EBP successful and sustainable (National Biofuels Policy).
- Continuous growth of liquor industry (10-12 % growth). INCRESING DEMAND FOR ETHANOL IN THE COUNTRY.
- Though world sugar market will be in deficit (5.2 mln tonnes) in 2015/16 for the first time in six years, stocks will still remain high.
- Stock % consumption ratio will be still above the critical level of 35 % indicating less chances of improvement in International sugar price. NO SCOPE FOR EXPORT UNLESS IT IS SUBSIDIESED.
- Even after mandatory export of 4.00 mln tonnes of sugar, ending stocks in India will still remain high.
- Can we overcome this problem with our conventional route of sugar production? WE REQUIRE FLEXIBLE ALTERNATIVES.
- Recent price hike offered by the OMCs in India for fuel ethanol. THIS OFFERS AN INTERNAL OPPORTUNITY.

WORLD'S TOP FIVE ALCOHOL PRODUCING COUNTRIES (2015)



Total World Ethanol production in 2015 was 113.41 Billion liters

Global ethanol production to grow by 4 % and consumption to grow by 6 %

UTILIZATION AND PRODUCTION OF ETHANOL IN INDIA (Million Liters)

Sector	Year				
	2012-13 (5 % EBP)	2013-14 (5 % EBP)	2014-15 (5 % EBP)	2015-16^{E} (10 % EBP)	2020^{E} (10 % EBP)
Liquor Industry	1100.00	1150.00	1200.00	1250.00	1650.00
Chemical Industry	750.00	750.00	750.00	750.00	
Fuel purpose (EBP)	360.00	350.00	800.00	2660.00	4450.00 (ISO)
Export	--	175.00	200.00	200.00	
Total Demand	2210.00	2425.00	2950.00	4860.00	+10000.00 (20 % EBP)
Production from molasses	2587.20	2500.00	2550.00	2600.00	
Production from grains	----	-----	900.00	1000.00	
Total Production	-----	-----	3450.00	3600.00	

ETHANOL: INDIAN SCENARIO

- Final –C molasses to be produced in 2015/16: 11.21 mln MT.
- Maximum Ethanol to be produced from C molasses: 2500-2600 million liters.
- Molasses based installed capacity : + 5.0 bln lit. (Capacity utilization is about 50 %).
- Grain based installed capacity : 1.8 bln lit.
- Total installed capacity: 6.8 bln lit.
- India may import ethanol (ODS) in 2015/16.
- Fuel Ethanol price offered by OMCs **Rs. 45.0-46.0/lit** (From 1st October 2015 (Ex-factory).
- Therefore, we require alternate raw materials for ethanol production.

SUGARCANE PROCESSING ROUTES

- Conventional (C molasses)
- B-Heavy molasses
- Total secondary juice
- Partial secondary juice
- Total mixed juice (Whole cane juice)

CASE STUDY

1. Sugar Mill: 5000 TCD

2. Cogeneration: 22 MW

3. Distillery: 60 KLPD (30+30)

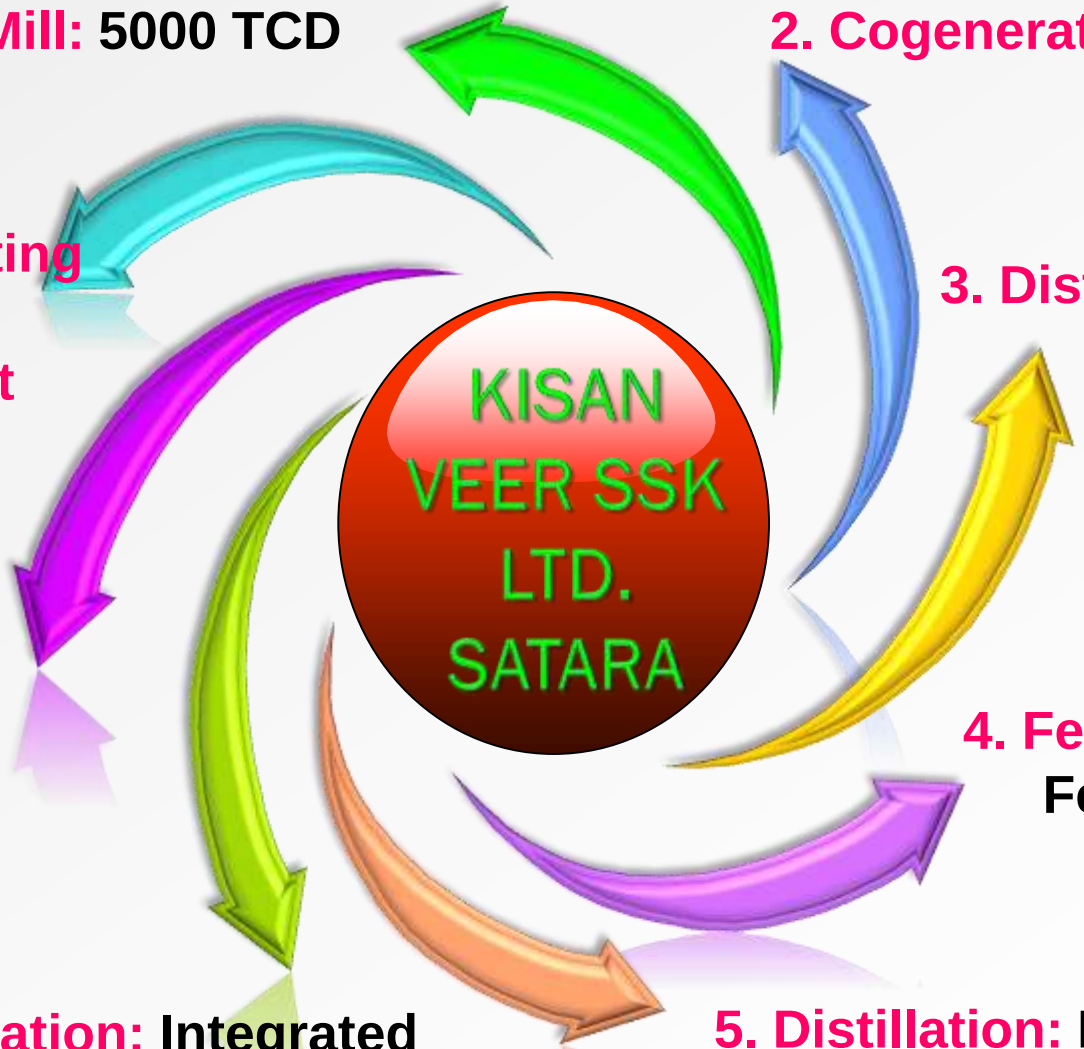
4. Fermentation: Fed-batch

5. Distillation: Multipressure (30)+ Atmospheric (30)

6. Evaporation: Integrated + Stand-alone (for RSW)

7. Biogas

8. Biocomosting with enrichment



CHARACTERISTICS OF BH AND C MOLASSES

Sr. No	Parameters	BH Molasses	C Molasses
1	pH	5.16	5.01
2	Brix	85.0^0	88.0^0
3	Total Reducing Sugars	61.33 %	50.08 %
4	Unfermentable Sugars	4.0 %	5.01 %
5	Fermentable Sugars	57.33 %	45.07
6	F/N	2.07	1.05
7	Total microbial count	8.8×10^1 CFU/gram	5.6×10^3 CFU/gram

COMPARATIVE ADVANTAGES OF BH MOLASSES ROUTE IN DISTILLERY

Sr. No.	Particulars	BH molasses route	C molasses route
1.	Distillery capacity, KLPD-RS	100	70
2.	Final ethanol concentration in fermented broth, % v/v	12.5 to 13.0	9.0 to 9.5
3.	Final residual sugars in fermented broth, % w/v	0.8 to 0.9	1.2 to 1.4
4.	Fermentation efficiency, %	90-91	88-89
5.	Raw spent wash generation, Lit/Lit of ethanol	7.0 to 7.5	9.3 to 9.5
6.	Raw spent wash COD, ppm	85,000	110,000
7.	Concentrated spent wash generation (after evaporation), Lit/Lit of ethanol	4.5	6.5
8.	Steam consumption, Kg/Lit of ethanol	1.75	2.40
9.	Reduction in TRO consumption, Lit/day	75	150

COMPARATIVE ADVANTAGES OF BH MOLASSES ROUTE IN SUGAR MILL AND COGENERATION UNIT

Sr. No.	Particulars	BH molasses route	Final molasses route
1.	Crushing capacity, TCD	5300	5000
2.	Recovery, %	10.72	12.08
3.	Net exportable power due to electricity saving in sugar mill operation, units/day	3,68,400	3,60,000
4.	Steam consumption in sugar mill operation, MT/day	2064	2160
5.	ICUMSA colour of sugar, IU units	130	145

BH Vs C MOLASSES AND DIRECT BENEFITS AT SUGAR PRICE OF Rs. 2800/QTL

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Sr. No.	Particulars	BH Molasses Route	C Molasses Route
1	No. of days	48	51
2	Total Crushing, MT	251851	251851
3	Recovery % Cane, %	10.72	12.08
4	Sugar Production, Qtl	269984.3	304236.0
5	BH Molasses % Cane, %	5.85	3.60
6	BH Molasses Production, MT	14733.3	9066.6
7	Ethanol Recovery, Lit/MT	323	252
8	Ethanol Production, Lit	4758851	2284792
9	Receipt From Ethanol (RS) @ Rs. 45/Lit	2141.48	1028.16
10	Receipt From Sugar @ Rs. 28/Kg	7559.60	8518.60
11	Total Receipt , Rs.	9701.04	9546.76
12	Ethanol Conversion cost, Rs. 6.5-7.5/L	225.4	132. 1
13	Sugar Conversion cost @ Rs.600/Qtl.	1619.9	1825.4
14	Total Conversion cost, Rs.	1845.3	1957.6
15	Total Receipt, Rs.	9701.04	9546.76
16	Net Income, Rs.	7771.81	7549.99
17	Net Profit (Net Income BH – FM) , Rs.	+ 221.82	

(Rs. in Lac)

BH Vs C MOLASSES AND DIRECT BENEFITS AT SUGAR PRICE OF Rs. 3200 /QTL

Sr. No.	Particulars	BH Molasses Route	C Molasses Route
1	No. of days	48	51
2	Total Crushing, MT	251851	251851
3	Recovery % Cane, %	10.72	12.08
4	Sugar Production, Qtl	269984.3	304236.0
5	BH Molasses % Cane, %	5.85	3.60
6	BH Molasses Production, MT	14733.3	9066.6
7	Ethanol Recovery, Lit/MT	323	252
8	Ethanol Production, Lit	4758851	2284792
9	Receipt From Ethanol @ Rs.45 /Lit	2141.48	1028.16
10	Receipt From Sugar @ Rs. 32/Kg	8629.50	9735.60
11	Total Receipt, Rs.	10780.98	10763.71
12	Ethanol Conversion cost, Rs. 6.5-7.5/L	225.4	132.1
13	Sugar Conversion cost @ Rs.600/Qtl.	1619.9	1825.4
14	Total Conversion cost, Rs.	1845.3	1957.6
15	Total Receipt, Rs.	10780.98	10763.71
16	Net Income, Rs.	8851.75	8766.93
17	Net Profit (Net Income BH – FM) , Rs.	+ 84.82	

(Rs. in Lac)

BH Vs C MOLASSES AND DIRECT BENEFITS AT SUGAR PRICE OF Rs. 3500 /QTL

Sr. No.	Particulars	BH Molasses Route	C Molasses Route
1	No. of days	48	51
2	Total Crushing, MT	251851	251851
3	Recovery % Cane, %	10.72	12.08
4	Sugar Production, Qtl	269984.3	304236.0
5	BH Molasses % Cane, %	5.85	3.60
6	BH Molasses Production, MT	14733.3	9066.6
7	Ethanol Recovery, Lit/MT	323	252
8	Ethanol Production, Lit	4758851	2284792
9	Receipt From Ethanol @ Rs.45/Lit	2141.48	1028.16
10	Receipt From Sugar @ Rs. 35/Kg	9449.40	10648.30
11	Total Receipt, Rs.	11590.93	11676.42
12	Ethanol Conversion cost, Rs. 6.5-7.5/L	309.33	171.36
13	Sugar Conversion cost @ Rs.600/Qtl.	1619.91	1825.42
14	Total Conversion cost, Rs.	1929.23	1996.78
15	Total Receipt, Rs.	11590.93	11676.42
16	Net Income, Rs.	9661.70	9679.64
17	Net Profit (Net Income BH – FM), Rs.	-17.94	

(Rs. in Lac)

SUGAR MILL, COGEN & DISTILLERY INDIRECT BENEFITS

Sr. No.	Particulars	BH Molasses Route	C Molasses Route
1	Savings from gunny bag @ Rs. 50/bag	34252 X 50	17.1
2	Additional Electricity (Co-gen) Revenue, Rs.	350 X 24 X 5.69 X 48	22.9
3	Saving in Molasses transport cost Rs.	9836.4 X 500	49.2
4	Addition Revenue from Bolder grain, Rs.	269984 X 20% X 40	21.6
5	Savings due to Extra Crushing, Rs.	3 day seasonal labour x 2 lac	6.0
6	Steam saving, Rs.	4 ton X 24 X 48 days	46.1
7	Saving in Interest Burden, Rs.	34252 X 99	33.9
8	Total Income from Indirect Benefits, Rs.		196.8

(Rs. in Lac)

NET PROFIT/MT FOR BH MOLASSES ROUTE AT DIFFERENT SUGAR PRICES AND FIXED PRICE OF ETHANOL (Rs. 45/Liter) (5000 TCD, 100 KL & 22 MW)

Sr. No.	Particulars	At Rs. 2800/Qtl	At Rs. 3000/Qtl	At Rs. 3200/Qtl	At Rs. 3400/Qtl	At Rs. 3500/Qtl
1	Income from Direct benefits, Rs. Lac	221.8	153.3	84.8	16.3	-17.9
2	Income from Indirect benefits, Rs. Lac	196.8	196.8	196.8	196.8	196.8
3	Total Income, Rs. Lac	418.6	350.1	281.6	213.1	178.9
4	Net Profit/MT Crushing, Rs.	166.2	139.0	111.8	84.6	71.0

B-HEAVY MOLASSES ADVANTAGES

- Switch over from (C) final molasses to BH molasses is fast.
- Increase in distillery capacity (70 KLPD ⟶ 100KLPD)
- Production of BH molasses will reduce steam consumption in sugar mill and distillery that will results in bagasse saving.
- Sugar colour and size can be improved.
- Increased export of power from cogeneration unit.
- Saving in gunny bags because of reduced sugar production.
- Reduction in interest burden on sugar stock with sugar mill.
- Reduction in transport cost of purchased molasses.
- Saving in working days of sugar mill because of additional crushing capacity.
- Reduction in per liter effluent treatment cost in distillery.

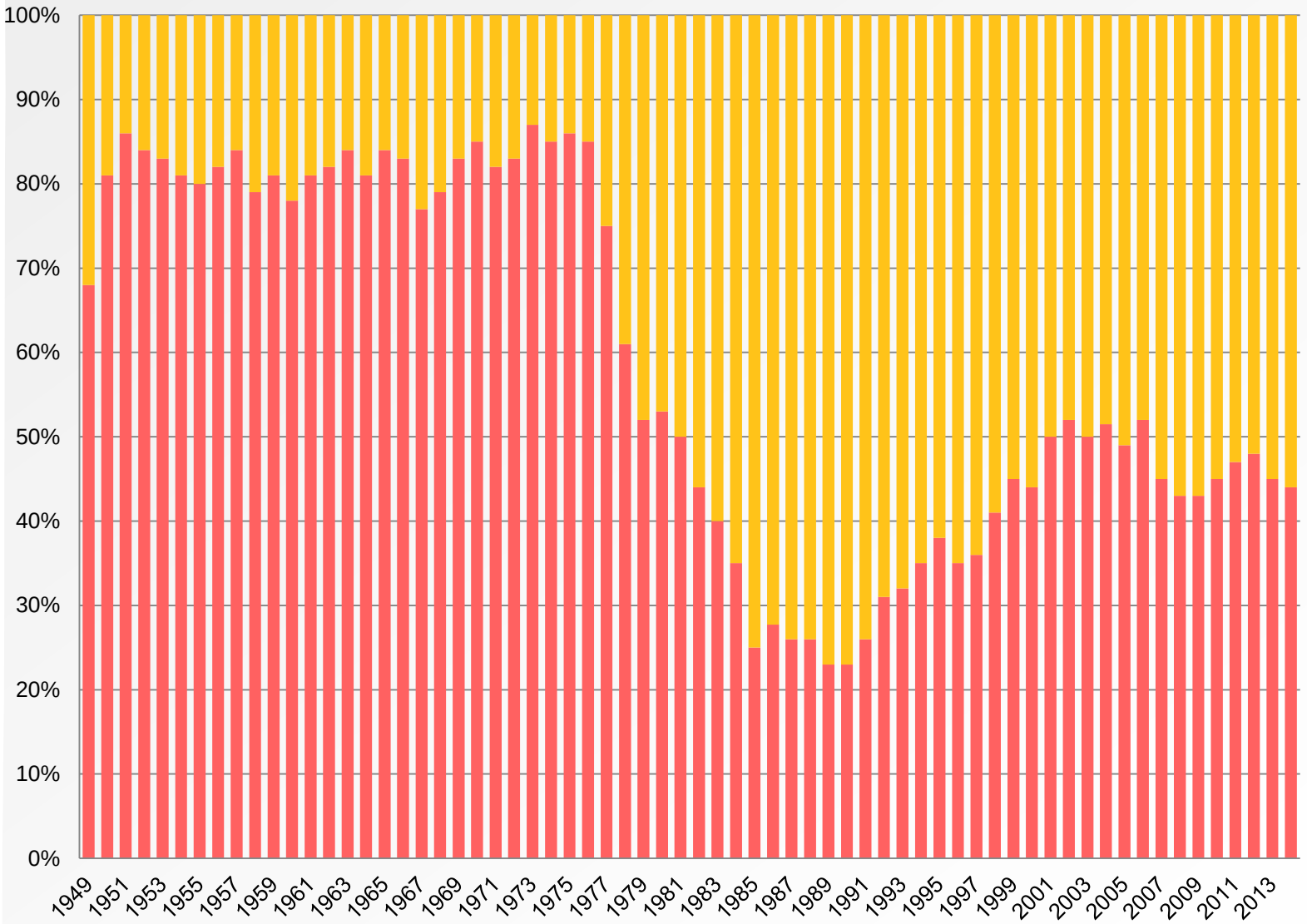
SECONDARY JUICE/RAW JUICE

1. SJ or WCJ cannot be stored as it is perishable.
2. Requires additional investment for pretreatment.
3. Generally, all SJ or WCJ can't be used in typical Indian distilleries (small capacities) attached to sugar mills.
4. Therefore, we will have to adopt partial SJ or WCJ route (depending on the capacity of the attached distillery).
5. Spent wash characteristics will change (Lower COD/BOD) and therefore may not suit to the existing ETP of the distilleries.
6. Partial SJ becomes the next choice after BH molasses route.

REDUCTION IN SUGAR PRODUCTION AND INCREASE IN ETHANOL PRODUCTION

Particulars	Recovery (%)	Sugar Production Reduction (%)	Ethanol Production Increase (Times)	Advantages/ Drawbacks
Conventional	11.49	---	---	
BH	10.14	11.0-20.0	1.72-2.21	No investment
Total SJ	6.97	40.0	3.37	Additional investment
Partial SJ	10.41	09.3	1.59	Additional investment
WCJ	--	--	6.84	No sugar

Brazil- Sugar vs. Ethanol in % of the cane crop



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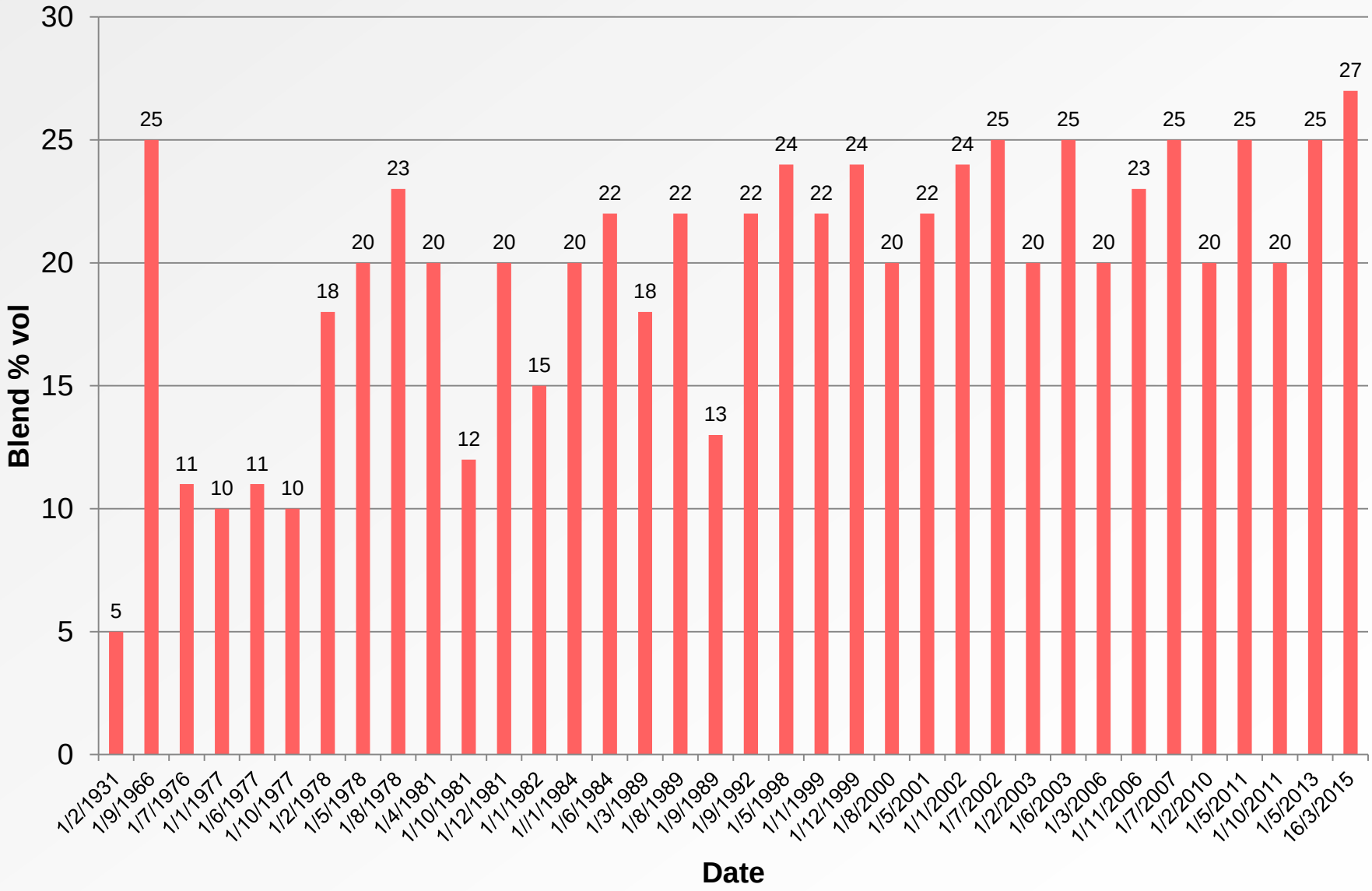
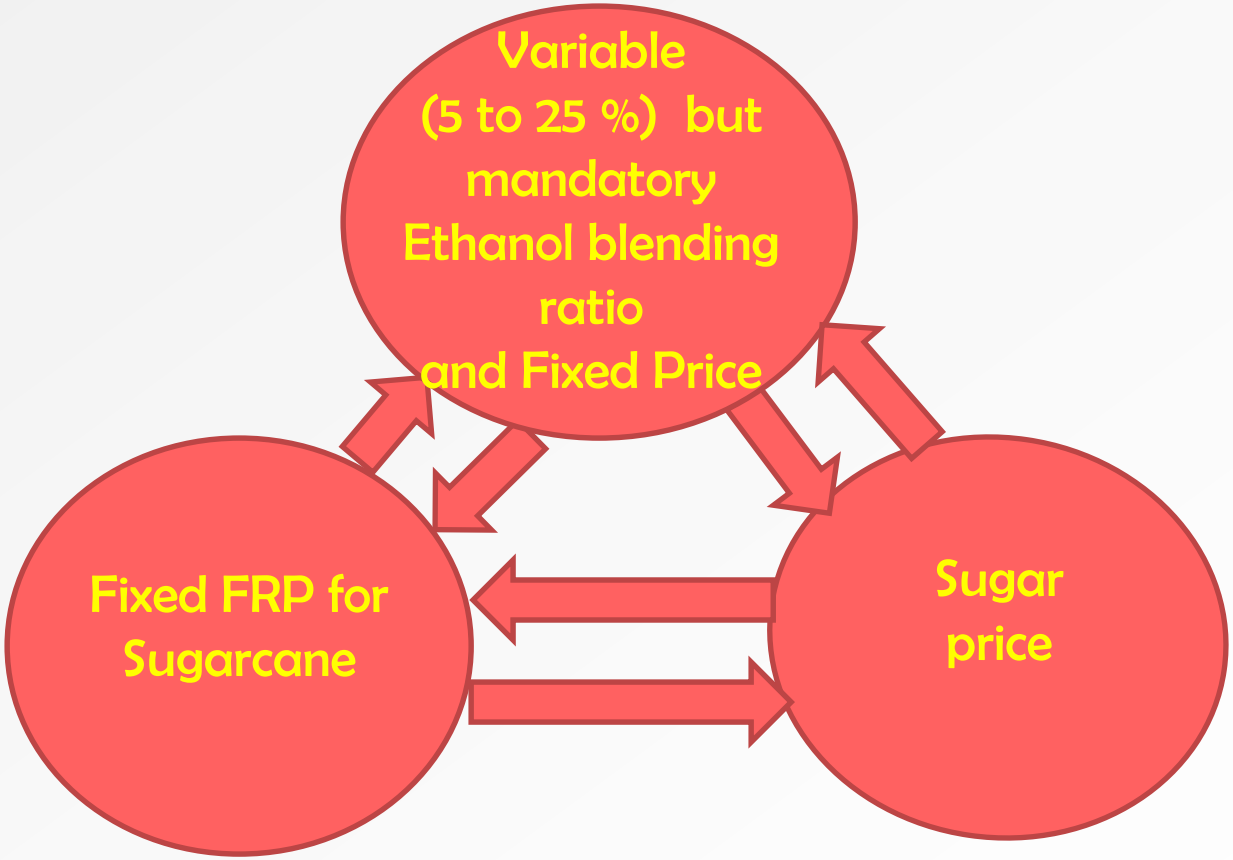
Brazil Ethanol Blends



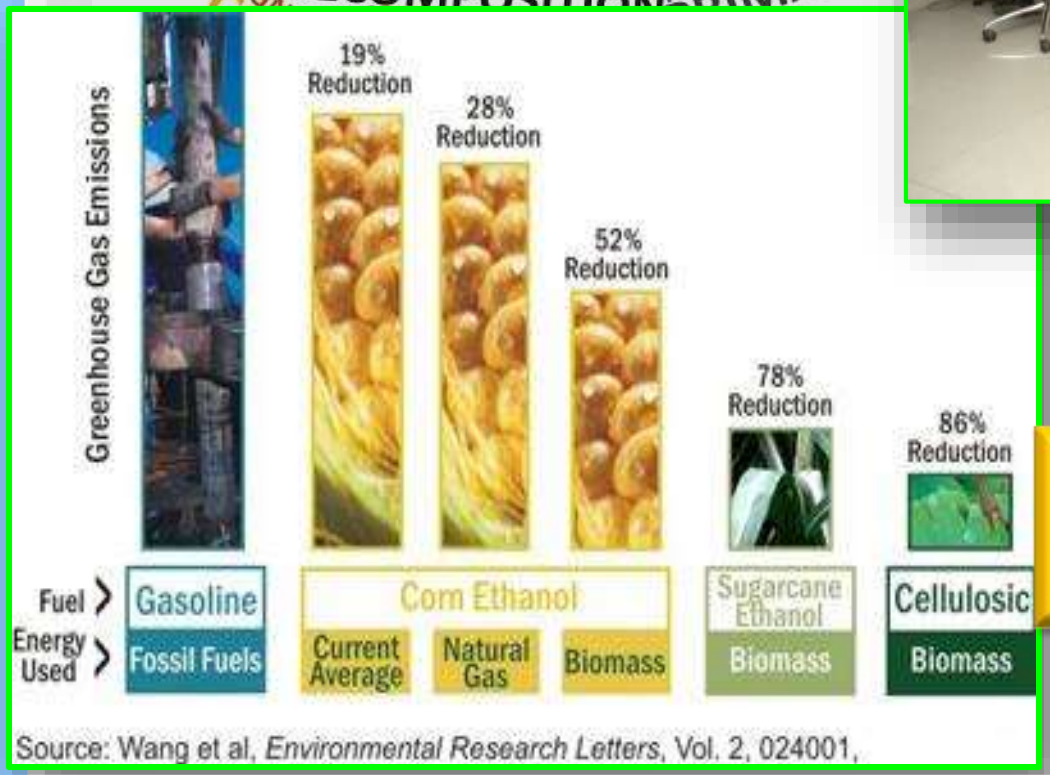
MODEL TO STABILIZE SUGARCANE, SUGAR AND ETHANOL PRICES



CONCLUSIONS

1. B-Heavy molasses route can fulfill the increasing ethanol demand of the country. It is also necessary to reduce the increasing sugar stocks.
2. B-Heavy molasses route will be the next choice after conventional route as switch over is fast with better sugar quality (bolder grain) and no capital investment.
3. There can be variation from case to case depending on configuration of sugar mill, distillery and cogeneration units.
4. Indian sugar mills need to develop flexible approach to shift from sugar to ethanol or vice-versa as per the market demand.
5. Ethanol is sold against spot payment whereas sugar sale is dependent on market conditions and invites interest burden during storage.
6. Success of Ethanol Blending Programme (EBP) is now a key factor for survival of sugar industry in the country.
7. Molasses ethanol can preferably go for fuel and industrial use and grain ethanol can preferably go for potable purpose.


HYDROCARBON
ANTHRACITE
ORGANIC
BURNING
WARMING
PRODUCTION
POLLUTION
SOURCE
RESERVE
BOILING
PROVED
NATURAL
OXIDES
PETROLEUM
WATER
EMISSION
BILLION
GASOLINE
RENEWABLE
ENERGY
FOSSIL FUEL
METHANE
CARBON
MATERIAL
WATERMILLS
GEOTHERMAL
ORGANISMS
HYDROELECTRIC
PETROCHEMICAL
FUEL
DECOMPOSITION
PRIMARY


Greenhouse Gas Emissions
19% Reduction
28% Reduction
52% Reduction
78% Reduction
86% Reduction
Fuel
Energy Used
Gasoline
Fossil Fuels
Corn Ethanol
Current Average
Natural Gas
Biomass
Sugarcane Ethanol
Biomass
Cellulosic
Biomass
Source: Wang et al, Environmental Research Letters, Vol. 2, 024001,

THANK YOU