Potential for sugar industries in augmenting energy supply

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Bioenergy in DCs and LDCs

Enormous potential for bioenergy development in DCs and LDCs:

- Agriculture based economies;
- Agro-industries: potential energy conversion from solid and liquid bio-residues.

Agro-industrial biomass residues

Rice mills

Palm oil mills

Sugar mills

Experience from some sugar leading countries: India

Installed power capacity in cogen plants in Indian sugar mills

- 2005-06: 500 MW
- 2009-10: 1,250 MW
- 2012-13: 2,332 MW
- 2015-16: 3,050 MW
- 2020-21: 7,562 MW (as of June 30, 2021)

Drivers:

- Political will (MNRE)
- Conducive policy & regulatory framework

RE & EE Policy Framework in India

- Started in the 1980's with **Sugar Development Act** (soft loans for development of sugar industry, including cogen)
- **National Electricity Act** (2003), including **RE Purchase Obligation**
- **Feed-in-tariff (FiT)** & **long term PPAs**
- **RE Certificate** Issuance and Trading
- **Promotion of bagasse-based cogen** (capital & interest subsidy, accelerated depreciation, income tax holiday,…)
- **Promotion of grid interactive bagasse cogen** in sugar mills
- **Central Financial Assistance:** for biomass cogen plants

Bioethanol and biogas in India

Bioethanol from molasses

- Annual potential: 2.5 to 2.6 billion liters of bioethanol
- More than half sugar mills are equipped with bioethanol production units

Biogas from vinasse (spent wash)

- Annual potential: +/- 500 MW
- Still very much untapped

Experience from some sugar leading countries: Thailand

Installed power capacity in cogen plants in Thai sugar mills

- 2002: 500 MW
- 2008: 1,250 MW
- 2014: 1,203 MW
- 2019: 1,851 MW

Drivers:

- Energy Policy and Planning Office (EPPO)
- Department of Alternative Energy Development and Planning (DEDE)
- Conducive RE & EE policies

RE & EE Policy Framework in Thailand

- **Energy Conservation (ENCON) Act & ENCON Fund** (1992/2007)

(support to EE and RE implementation in industries: energy audits, tax incentives, soft loans (EE Revolving Fund) and ESCO Fund)

Objective: Introduce EE & C in process and promote HP cogen

- **Small Power Producer (SPP) Programme** (1992)

Objective: Allow SPPs using RE or Cogen to sell excess power to the grid a fixed rate, with possible adder through bidding

- **Feed-in Tariff (FiT) for SPP**
- **ESCO Fund** (2008) for SMEs (support to equity, venture capital, leasing, credit guarantees, …)

Bioethanol and biogas in Thailand

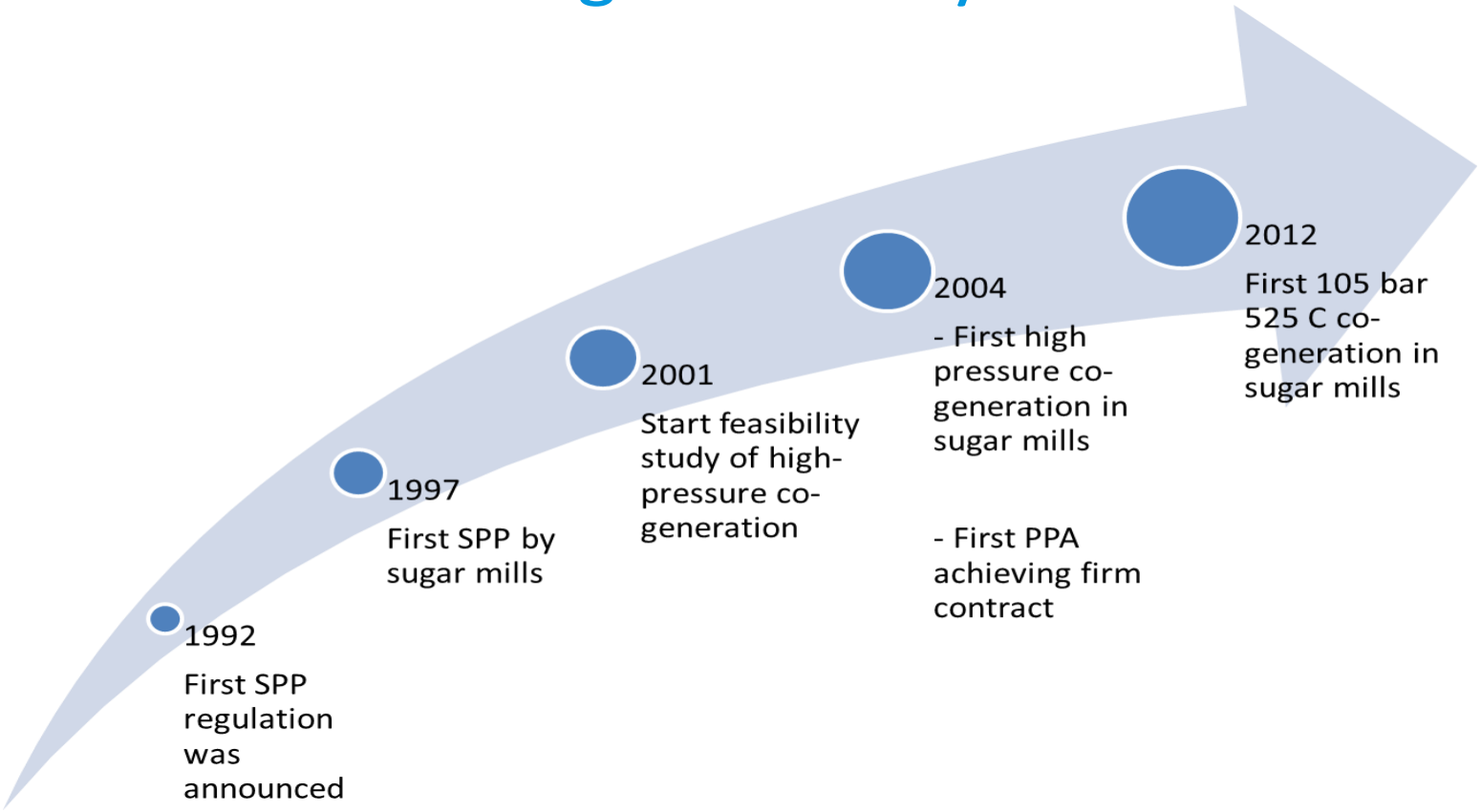
Bioethanol from molasses

- Annual production: +/- 1 billion liters (2018)
- Steady growth for fuel blending

Biogas from molasses-based distilleries

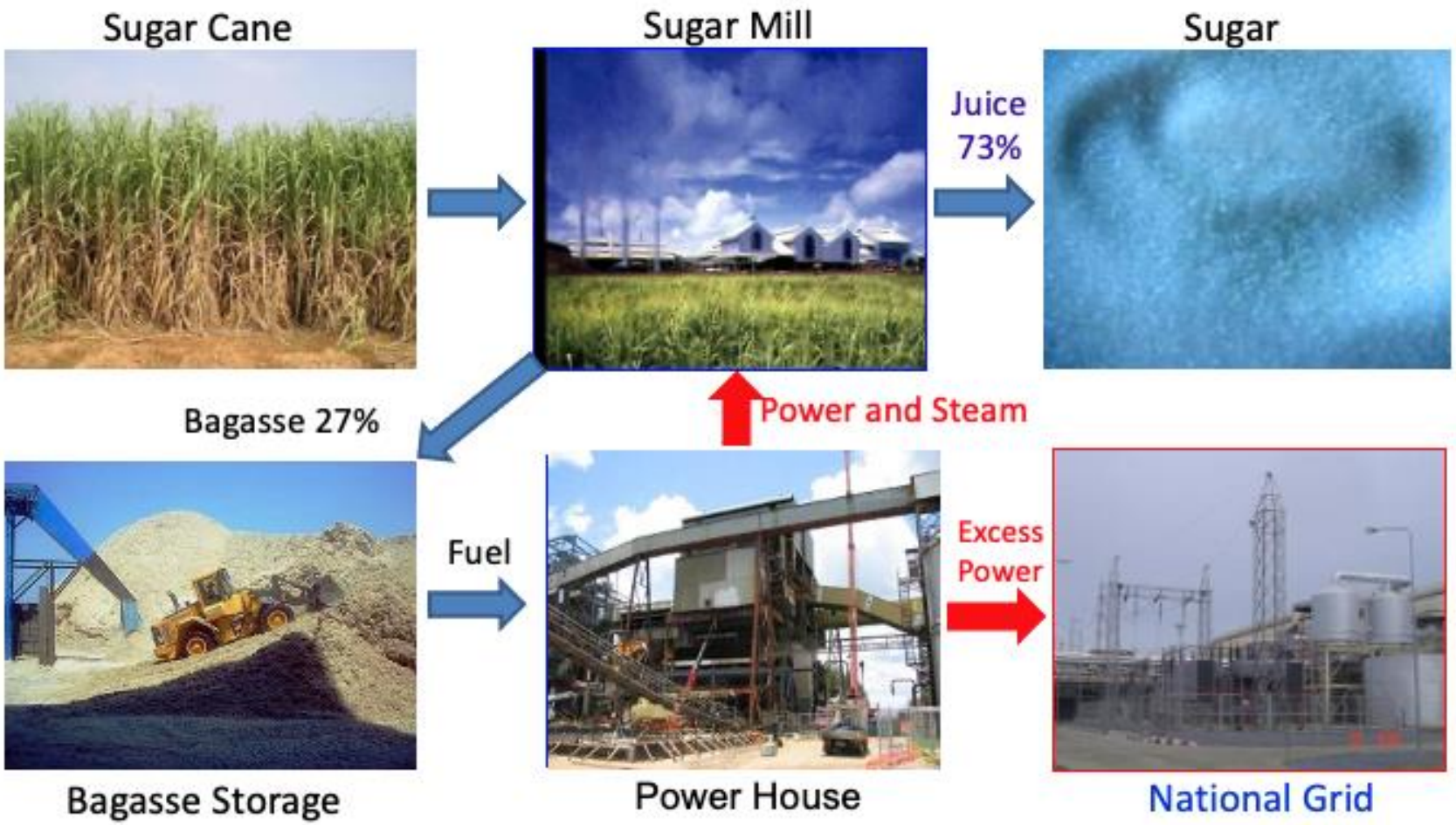
- Data not available

Development of Cogeneration in Thailand's Sugar Industry



Source: Mitr Phol Sugar

Cogeneration in Sugar Mills



Source: Mitr Phol Sugar

Favorable Environmental Impacts

Stack emission: Cleaner air

		(COAL)
• Particulate	20 - 50 ppm	(120)
• NOx	120 - 160 ppm	(350)
• SOx	0 - 8 ppm	(320)

Solid waste: Recycle back to farm

ashes from boiler can be used as soil improvement substance.

Global Warming: Reduce green house gas

Source: Mitr Phol Sugar

Socio-Economic Benefits

Increased business activities in the local community

More jobs have been created

Created value added to many agricultural waste

New technology transfer to the industry

Reduction of the nation's import of fossil fuel for power generation

Source: Mitr Phol Sugar

The sugar sector in Nigeria

National Sugar Master Plan 2012:

- reference document for the development of the sugar sector in Nigeria. Its main objective was to lead the country to self-sufficiency in sugar production 2020;
- includes bioenergy issues, i.e., use of sugar milling residues (bagasse, molasses, wastewater) for the **production of ethanol and generation of electricity**";
- helps electrify the country and creates jobs, especially in rural areas.

RE & EE Policy framework in Nigeria (biomass)

National Bio-fuel Policy and Incentives (2007)

- Reduce dependence on fossil fuels via fuel blending

Draft National RE & EE Policy (2014)

- Best use of biomass residues & fuel blending

Draft National Energy Policy (2018)

- Efficient and safe use of biomass residues for energy

National Policy on Solid Waste Management (2020)

- Biomass residues to cover energy needs of agro-industries and contribute to biogas and bioethanol production for blending and clean cooking.

Bagasse cogeneration in Nigerian sugar mills

Two case studies:

- Cumulative energy potential for the 28 NSMP mills
- Energy potential for a 10,000 TCD mill

Two cogeneration options:

- Medium pressure steam boiler (45 bar/315 C) with back pressure turbo-generator (BPST) (milling season only)
- High pressure steam boiler (65 bar/490 C) with extraction condensing turbo-generator (ECST) (all year round).

Results of the study of the implementation of HP Cogen (ECST) in the 28 NSMP sugar mills

- Total implemented capacity: 716 MW
- Total net annual electricity production: 4.85 million GWh
- Total annual electricity export to the grid: 4.17 million GWh (86%)
- Production of 170 million liters of bioethanol from 680,000 tonnes of molasses
- Production of an additional 127,000 GWh of electricity from the 56 million Nm^3 of biogas from the wastewater of the fermentation process.

Results of the study of the implementation of HP Cogen (ECST) in a 10000 TCD sugar mill

- Total implemented capacity: 56 MW
- Total annual electricity production: 385,000 GWh
- Total annual electricity export to the grid: 331,000 GWh (86%)
- Production of 13 million litres of bioethanol from 53,200 tonnes of molasses
- Production of an additional 10,000 GWh of electricity from the 4.4 million Nm^3 of biogas from the wastewater of the fermentation process.

Environmental Impact

The implementation of the NSMP target would have a significant environmental impact thanks to the mitigation of CO_2 emission of **2,258,000 t CO_2-eq,** via:

- export of surplus electricity to the grid with ESCT systems

  1,829,000 t CO_2-eq

- blending of bioethanol with gasoline

  373,000 t CO_2-eq

- biogas use for electricity generation

  56,000 t CO_2-eq

Social Impact

Besides its environmental benefits, the implementation of the NSMP would have positive social impact, as it would create over **117,000 jobs in rural areas**, all along the sugar sector supply chain, at farmer level (planting and harvesting), and at factory level (crushing, cogen, refining, bioethanol & biogas production).

According to the NSMP, close to **19,000 permanent jobs** and **73,000 seasonal jobs** would be generated at farming level, while **11,000 admin jobs**, **7200 permanent** and over **6500 seasonal jobs** would be created at factory level.

Recommendations for effective support to bioenergy development in the sugar sector

Based on the Indian and Thai experiences, it is recommended to support policy makers of African countries to develop:

- a **Revolving Fund** to support the implementation of efficient cogen and bioethanol systems (soft loans, …). It could be fed from levies on consumption of fossil fuels;
- a **Renewable Energy Purchase Obligation** (RPO);
- an attractive **Feed-in-Tariff** (FiT) for sugar mills to export their excess power to the grid;
- financial and fiscal **incentives** for implementation of high efficiency technologies;
- mechanisms for supporting **technology transfer**.

Thank you!