

/ DRYING : BEET SUGAR PLANT ↔ DRYING UNIT

ENERGY CONSUMPTION REDUCTION

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I SITUATION TODAY

- ▶ Pulp drying energy cost is high compared to juice concentration by evaporation in a multiple effect.
- ▶ Coupling with sugar plant are in operation.
- ▶ Energy savings are higher when sugar plant and drying unit are fully coupled.
- ▶ More sugar groups are studying to rise energy savings through pulp pressing increasing, extraction optimization, energy production scheme and renewable energies.

Lets make an overview of some of these points

/ SITUATION TODAY : Coupling examples

- ▶ Steam dryer well known in US.
- ▶ Low temperature Belt Dryer with low temperature heating steam or water from sugar plant :
 - Hot condenser water (about 122 °F),
 - Condensate water (about 194 °F)
 - Steam bleeding from effect N°2 or 3
 - Exhaust steam eventually
 - Flue gases eventually

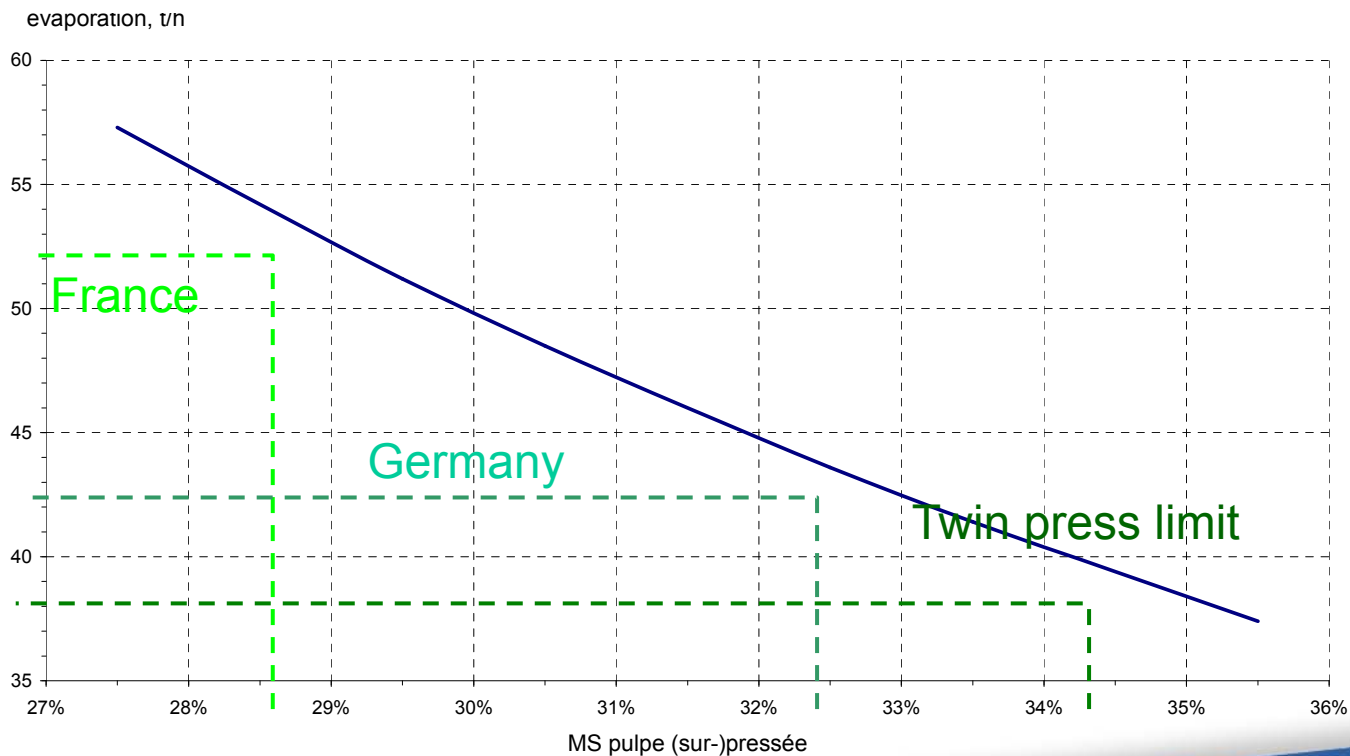
Finned tubes exchangers are arranged in series to gradually rise fresh air temperature up to about 230 °F.
- ▶ Drum dryers coupling with boiler flue gases.

/ SITUATION TODAY : FUEL

- ▶ In many projects fuel selection is considered to reduce energy cost. Here after some of them used in beet pulp drying units :
 - Fuel Oil
 - Natural gas
 - Coal, pulverized coal
 - Lignite
 - Wood
 - Biogas
- ▶ Wood is considered half price than natural gas in Europe. Biogas produced in sugar plant digesters can be used directly in the drying unit without purifying process.

TODAY SITUATION : PULP MECHANICAL DEWATERING REMAINS ATTRACTIVE

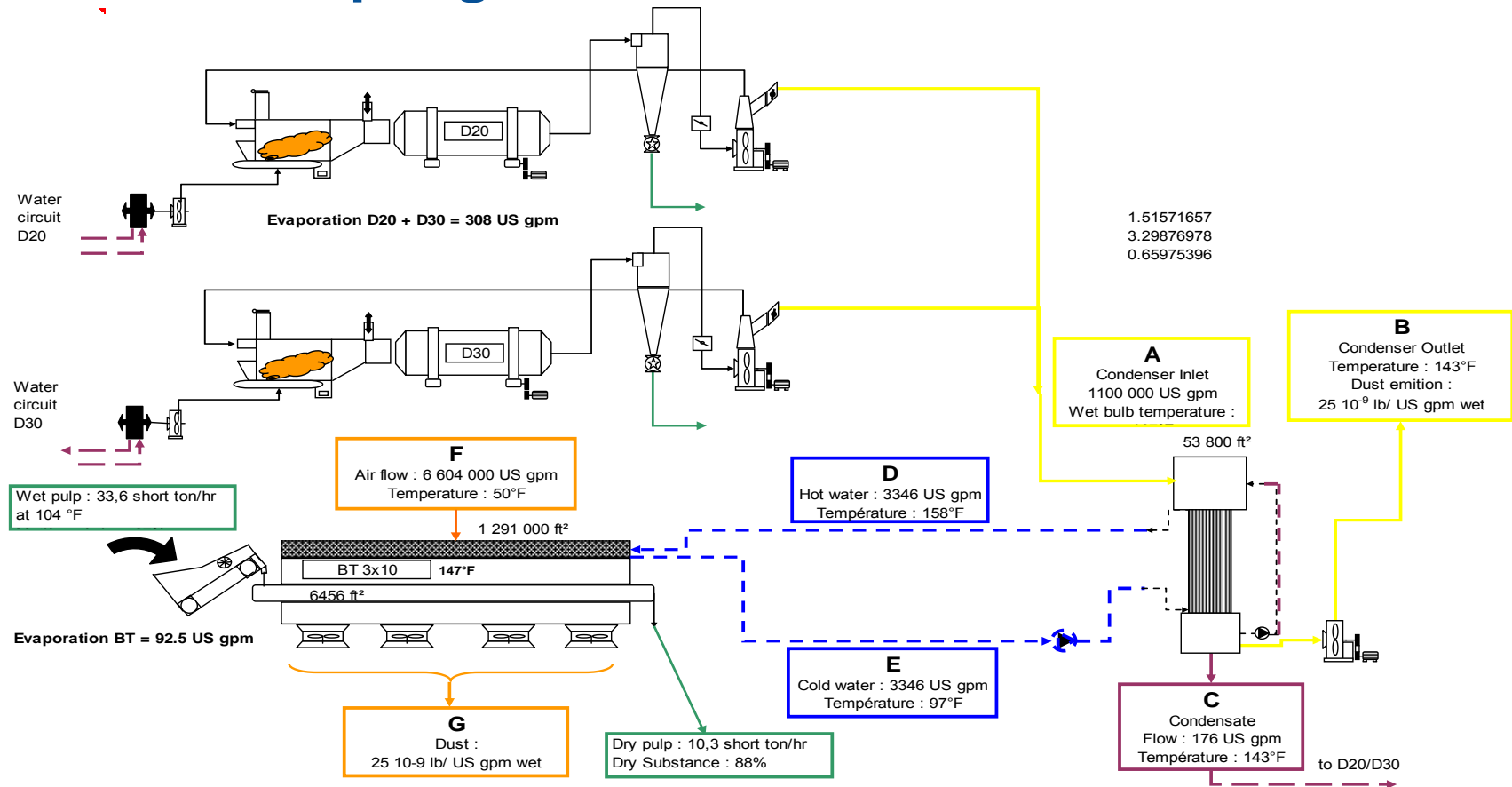
- ▶ Twin beet pulp press technology allows to reach 35 % DS
- ▶ Evaluation in metric tons/hr of water evaporation need after beet pulp press according to DM content :



/ TODAY SITUATION : Research in progress.

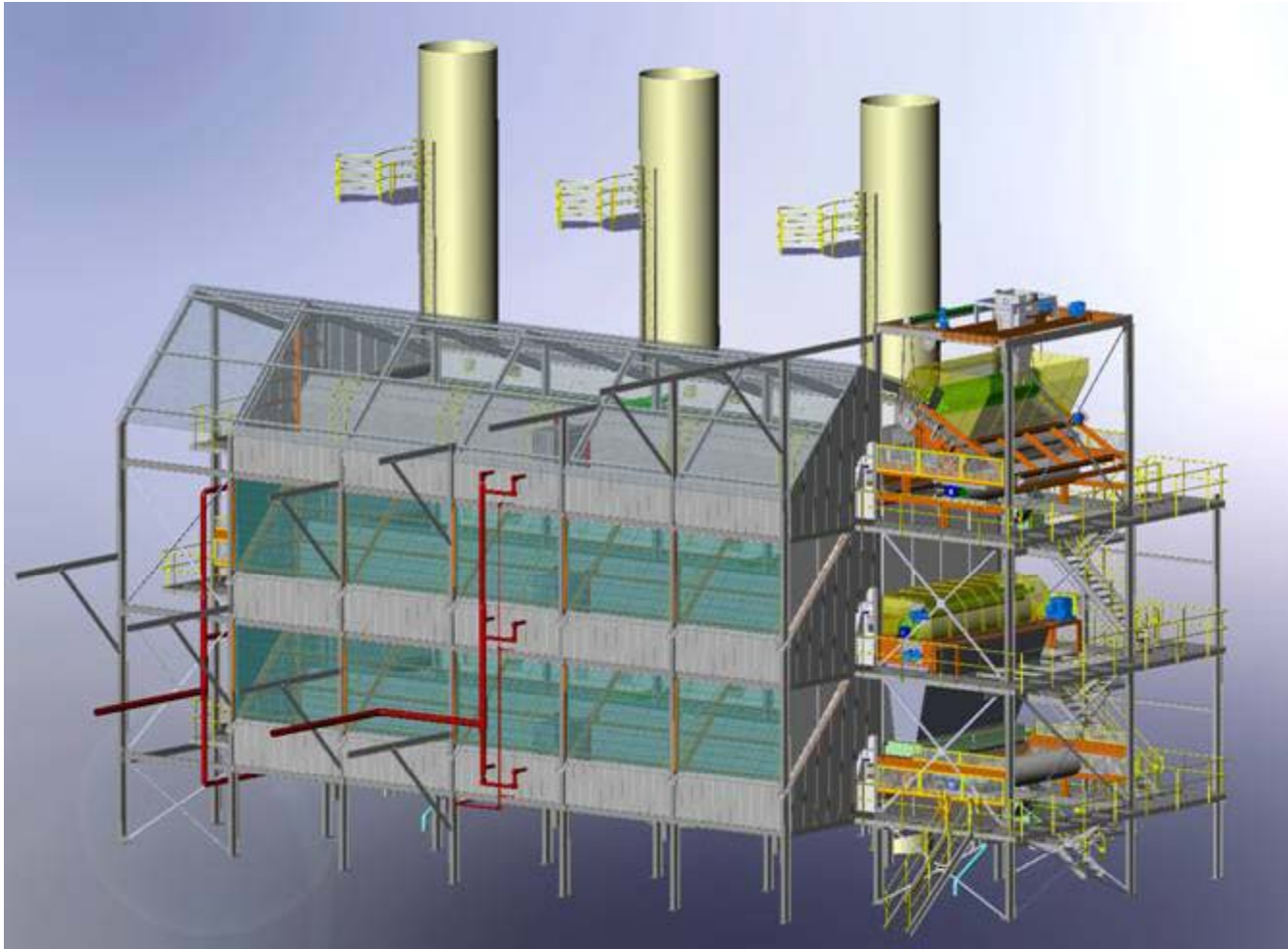
- ▶ Mechanical dewatering energy cost is about one percent compared to single pass drying drum technology.
- ▶ PEF, Pulsed Electric Fields technology applied to juice extraction can also help rising pulp DM after press.
- ▶ Combined pressing technology are also a possibility. SNFS (National French Sugar Society) is launching a program to press over 40 % DM.
- ▶ Besides energy savings, sugar recovery is an important issue.

MAGUIN coupling 3 PASS DRYER and BELT DRYER.



EVAPORATION RATIO : BELT DRYER 23%, 3 PASS DRYER 77%

MAGUIN BELT DRYER



/ MAGUIN BELT DRYER : CONDENSER

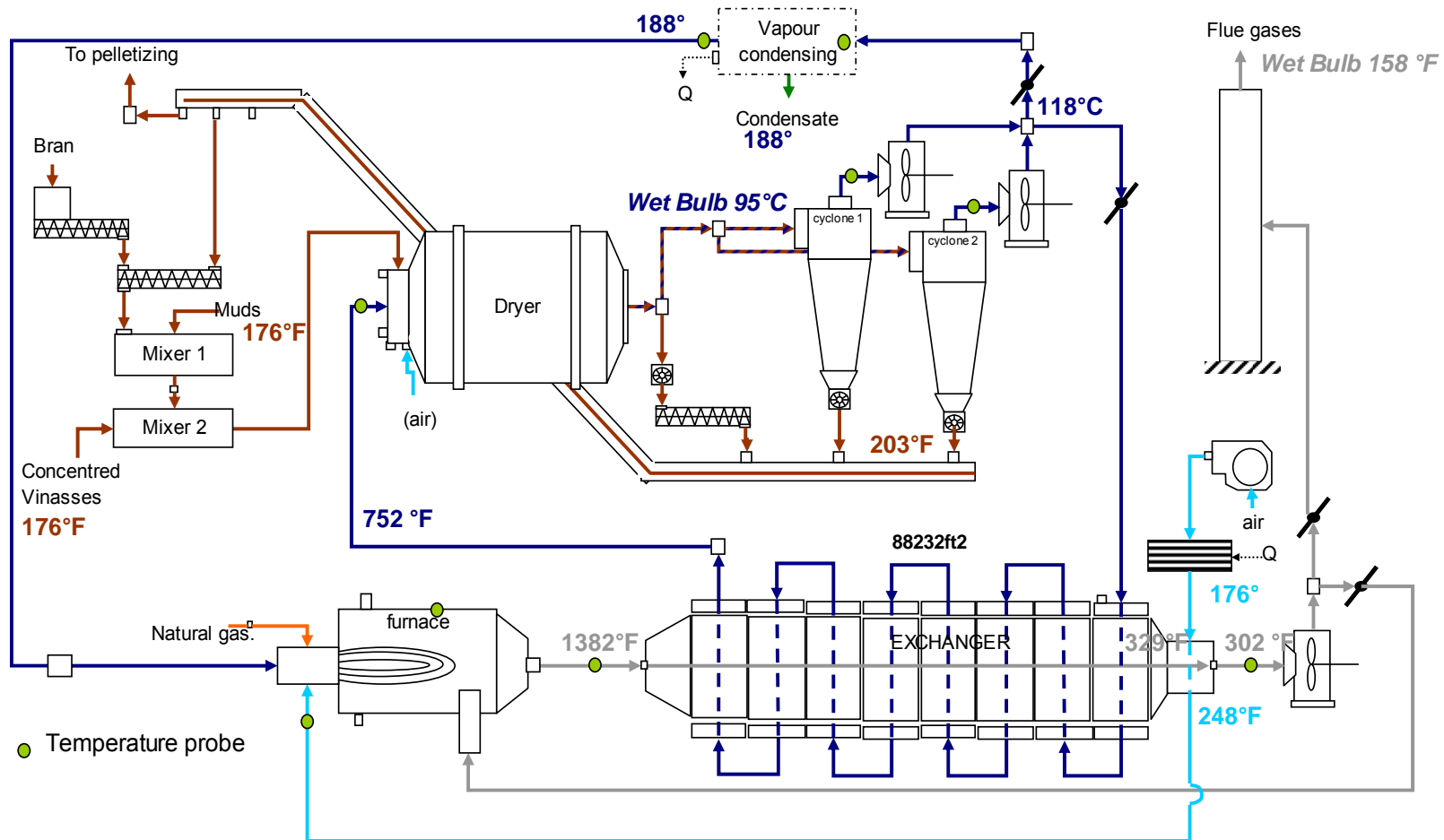


MAGUIN BELT DRYER



MAGUIN 3 PASS DRYER

(FOR D'DGS)



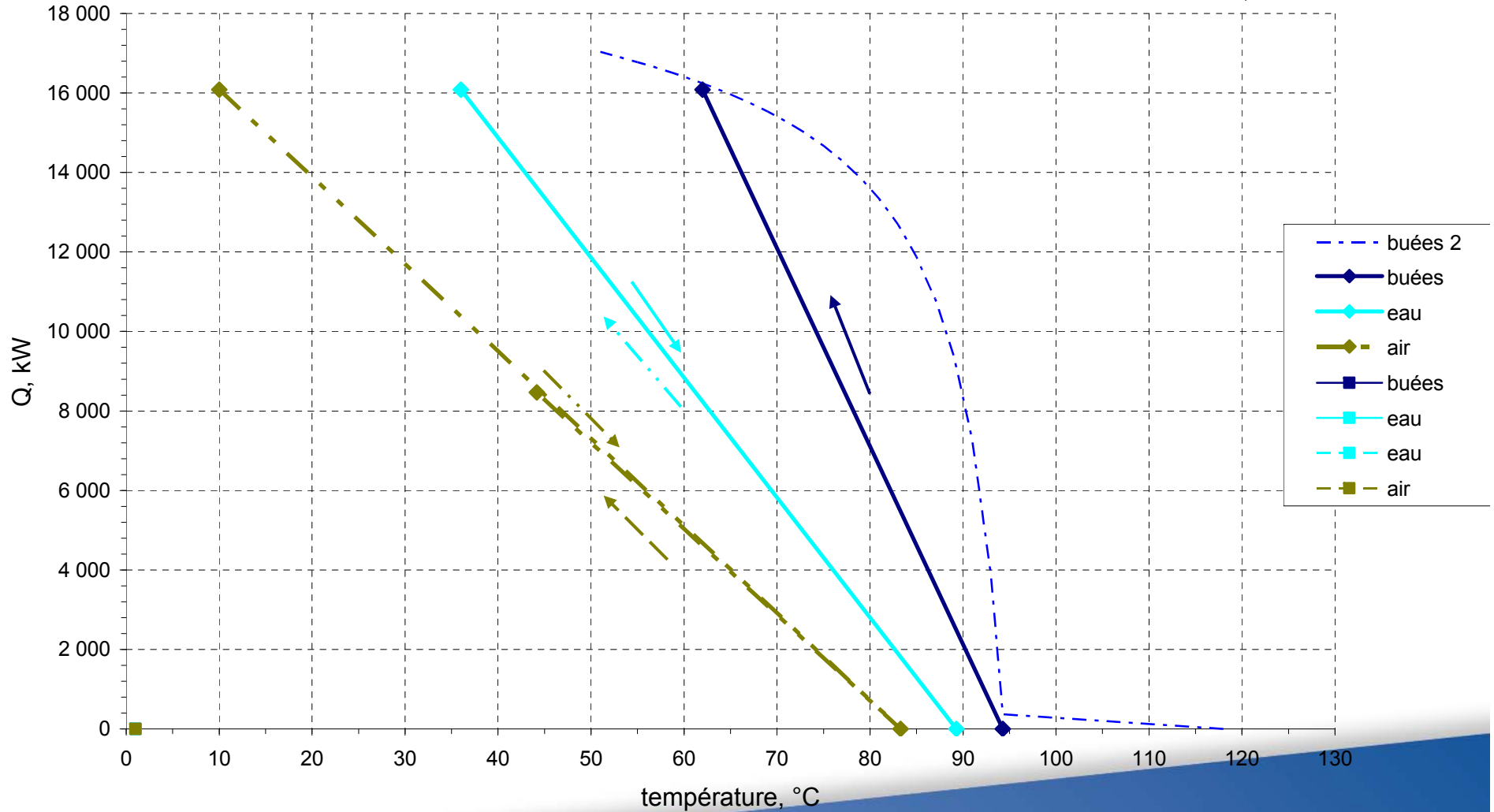
MAGUIN 3 PASS DRYER



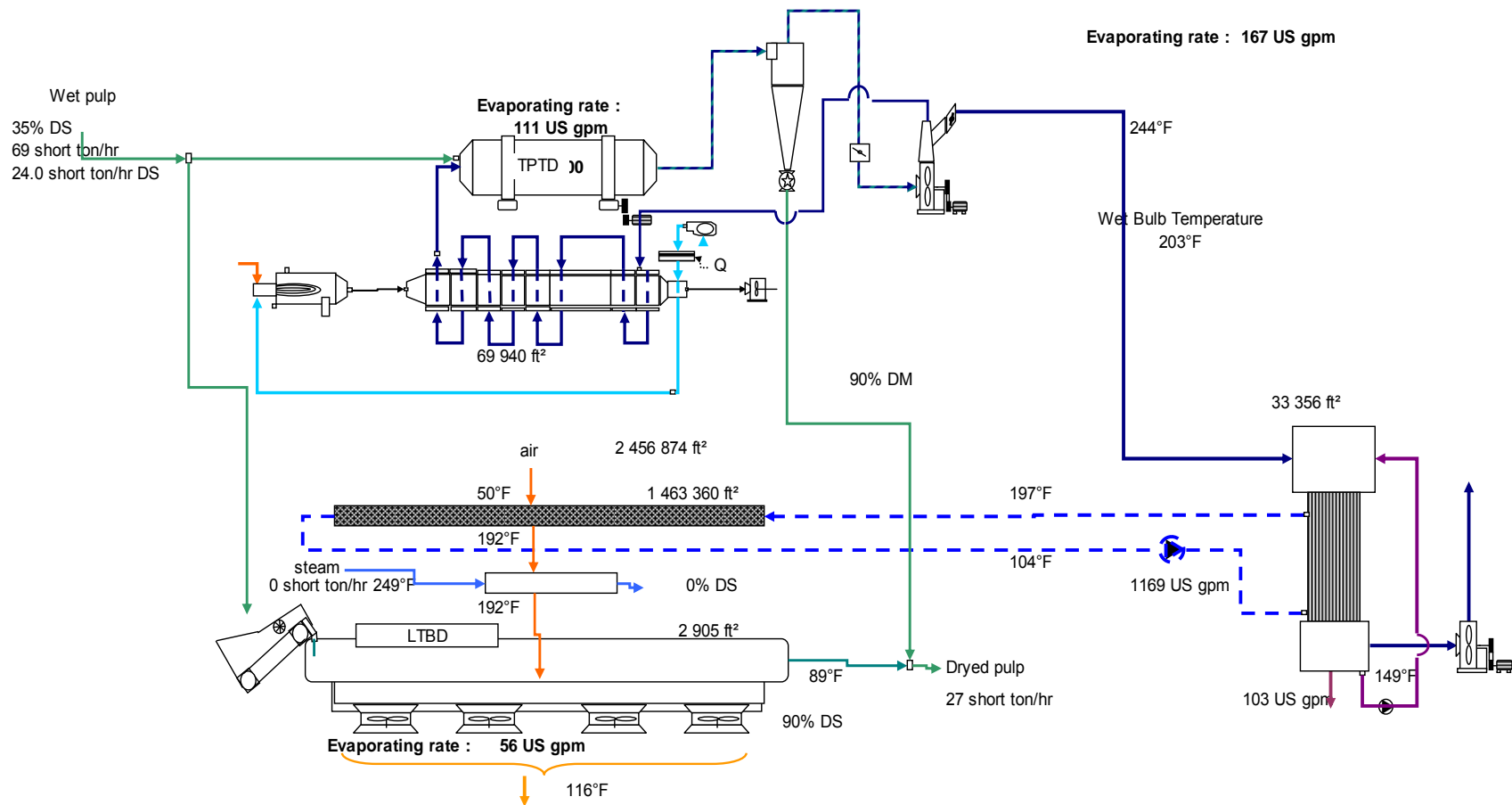
COUPLING : 3 PASS DRYER AND BELT DRYER

sécheur BT avec couplage sècheurs tambours

—→ condenseur
-.-→ eau-air
- - -→ tapis



COUPLING : 3 PASS DRYER AND BELT DRYER



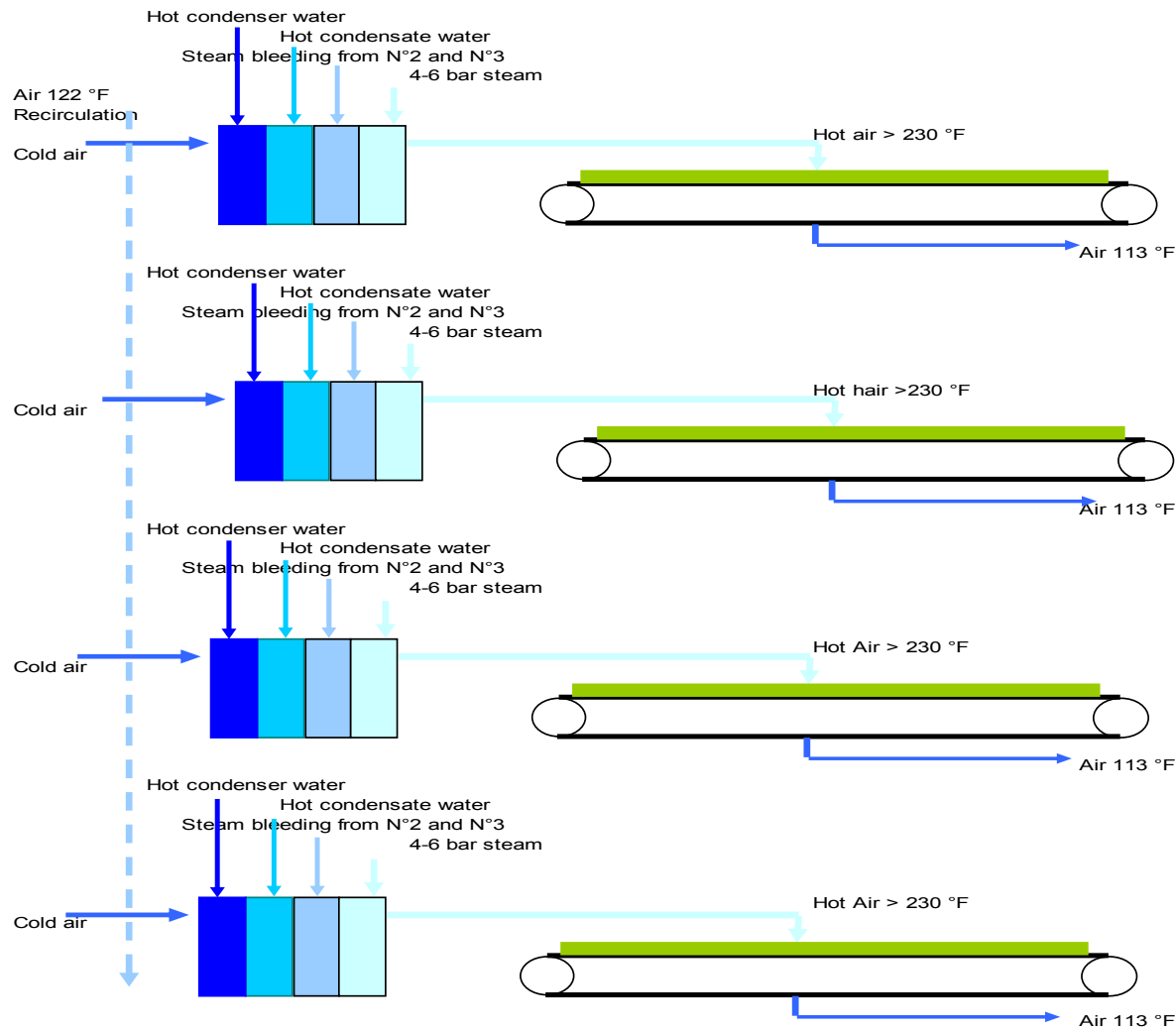
EVAPORATION RATIO : BELT DRYER 34 %, 3 PASS DRYER 66 %

/ FULL COUPLING BELT DRYER <-> SUGAR PLANT

FONTENOY plant in Belgium developed a unique scheme. With BELT DRYER using mostly low temperature water and steam. The whole plant consumption were about 28.6 lb fuel oil per metric ton of sugar beet including, drying, 3 strikes crystallization and no syrup storage.

- ▶ Hot air can be heated up to 230 °F to 250 °F.
- ▶ Several finned tubes exchangers in tandem are heating gradually fresh air using for example : hot water (hot condenser water, condensate water), low temperature steam and finally exhausted steam to boost air temperature.
- ▶ Exhaust air is about 113 °F and a part from last drying stage is recirculated to air pre heating.

FULL COUPLING BELT DRYER <-> SUGAR PLANT



/ FULL COUPLING BELT DRYER <-> SUGAR PLANT

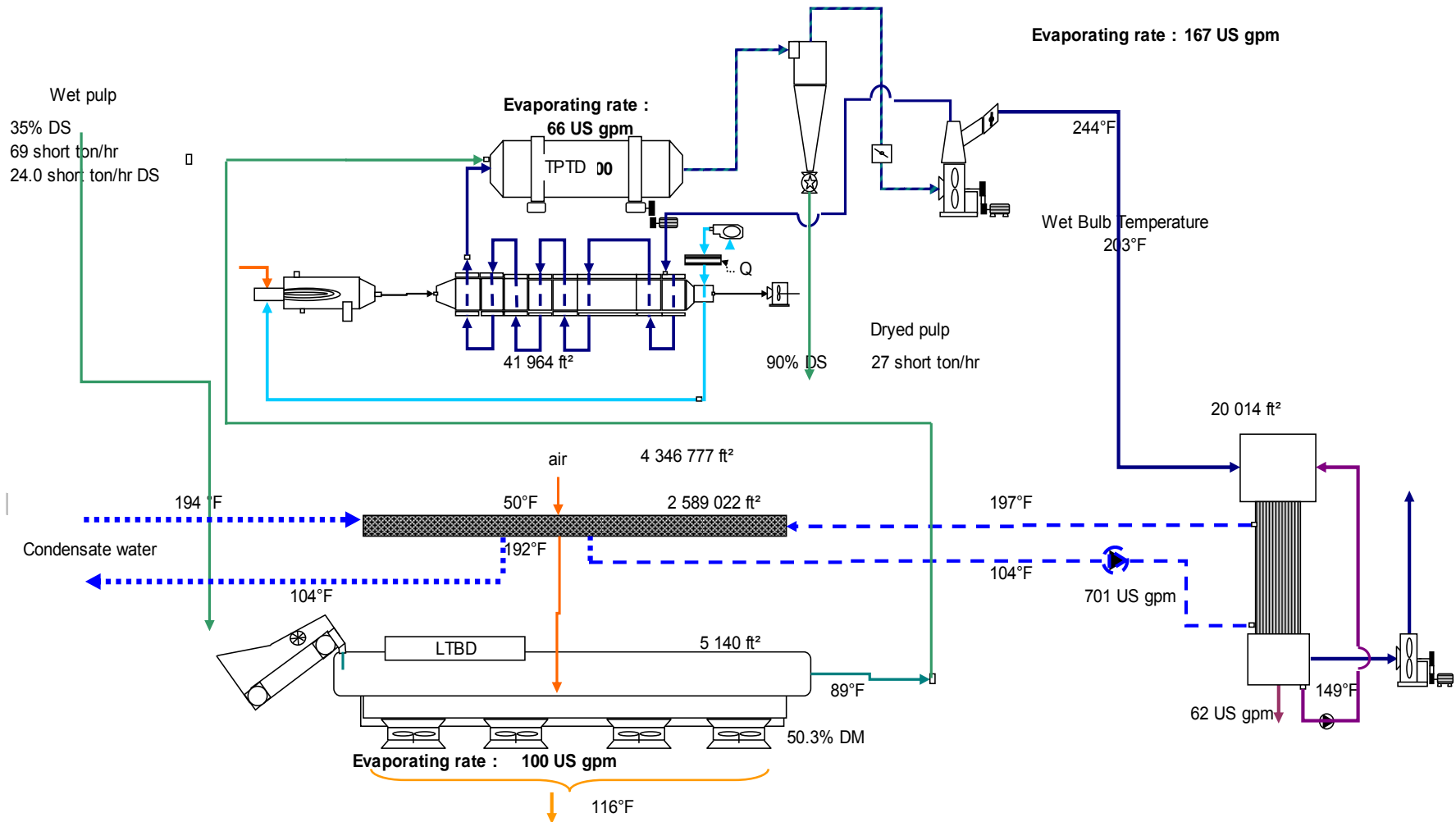
▶ **Strong points :**

1. Energy bleeding limited to a 113 °F air flow .
2. No needs to change energy production scheme.
3. kW consumed in the range of other known solutions.
4. Easy maintenance on standard mechanical equipment.
5. Pulp quality preserved.
6. Low dust emissions, in compliance with US emissions standards
7. No VOC.

/ MAGUIN COUPLING BELT DRYER - 3 PASS DRYER <-> SUGAR PLANT

- ▶ Pulp pressing is upgraded approaching 35 % DM. In Germany 32.5 % is achieved and investments are in progress in French sugar beet plant too.
- ▶ 3 PASS DRYER is designed to supply BELT DRYER through a vapour condenser.
- ▶ Sugar plant provides most of the condensate water 194 °F. Water is easy to pump to enough distance to most of the sugar beet plant drying unit.
- ▶ BELT DRYER is first evaporating water from pulp press DS content to about 50 % DS content.
- ▶ 3 PASS DRYER is then dimensioned as a finisher to evaporate water from 50 % DS to 90 % DS.

MAGUIN COUPLING BELT DRYER - 3 PASS DRYER <-> SUGAR PLANT



EVAPORATION RATIO BELT DRYER 60 %, 3 PASS DRYER 40 %

■ MAGUIN COUPLING BELT DRYER - 3 PASS DRYER <-> SUGAR PLANT

- ▶ **Options**
- ▶ **Besides condensate water, hot condenser water can be used.**
- ▶ **Vapour from 3 PASS DRYER can be compressed trough steam ejector to be used to concentrate juice and/or syrup and supply low grade steam to crystallization workshop.**
- ▶ **If the sugar plant is close to a distillery hot vinasses can be sent to BELT DRYER hot air heat exchanger.**
- ▶ **In some cases use of boiler flue gases depending on quality can be considered.**

Conclusion

- ▶ The concept allows to reduce fossil fuel use to remove water from beet pulp from 245 US gpm (55 m³/h) to 66 US gpm (15 m³/h). And depending on sites less is still possible. In that case. Fuel usage reduced to 27 % of original.
- ▶ The concept brings possibility to use renewable energy, to benefit carbon credit as the 3 PASS DRYER furnace can be designed for biogas or wood or other fuels. In that case energy cost reduction is over 80 %.
- ▶ The coupling is made in a way that a drying unit short stoppage does not stop sugar plant or reduces its capacity.
- ▶ The concept allows to dry other product during inter season (alfalfa).
- ▶ The concept is in line with maximizing sugar recovery.
- ▶ The concept reduce dust and VOC emissions.
- ▶ The concept keeps beet pulp quality for livestock.