Existing retail stores from R22 to CO_2

Energy saving and economic efficiency of CO_2UEI system case study

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Company profile YAMATO Co. Ltd.

1. Founding : 1945
2. Capital stock : 5 billion yen
3. Employee(full-time) : 800

（March, 2016）

4. Main business

- Design and installation for air-conditioning and refrigeration facilities
- Development of environmental technology such as thermal storage and so on
- Operation management and maintenance of facilities

Headquarter (Maebashi, Gunma)

Background

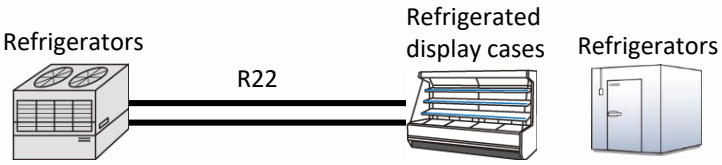
Using R22 at more than about 50% supermarkets in Japan
Changing to CO_2 is one of the business challenges

Changing R22 to CO_2 by partial remodeling of existing display cases

Changing evaporator header of existing display cases for brine

Current situation

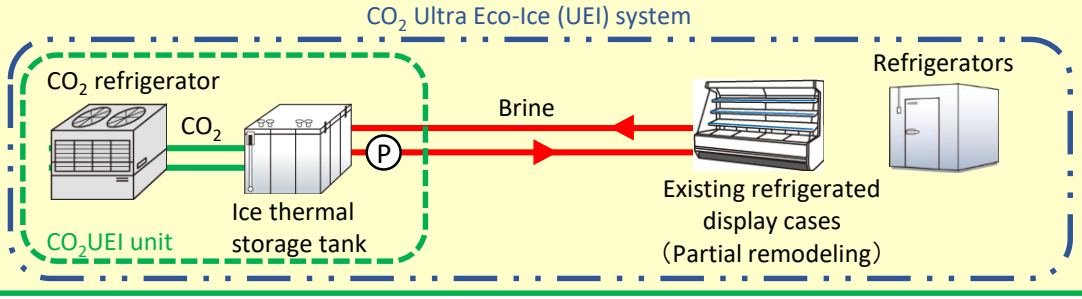
Protecting ozone layer : ×
Preventing warming : ×



Reusing existing display cases !
1 STEP without double investment !

R22 to CO_2

Protecting ozone layer : ◎
Preventing warming : ◎
Economic efficiency : ◎
Safety performance : ◎



Development purposes of CO_2 Ultra Eco-Ice(UEI) unit

Development of Brine-ice thermal storage equipment with CO_2 refrigeration "CO_2UEI unit" in "CO_2UEI system"

<required performance>

- Quality and performance guarantee as thermal storage equipment (Management of production, test run and so on at own factory)
- Uniform management of CO_2UEI system control
- Acceleration of legal process
- Shortening of system installation period
- Reduction of installation space and so on

Simulating "CO_2UEI system" operation at assumed retail store using R22,based on the results of "CO_2UEI unit" operation

⇒ Evaluating energy saving and economic efficiency, compared to "CO_2 DX cooling system"

CO_2UEI unit

Main instruments

- CO_2 refrigerator(Panasonic)
- Ice thermal storage tank
- CO_2 ice-maker
- Filter dryer
- Heat exchanger
- Accumulator
- Suction filter
- Brine feed pomp
- Power and control board

(Optimum operation management controller)

CO_2UEI unit（10HP CO_2 refrigerator ）

Field test at almost 40℃ outdoor temperature in summer

⇒Establishment of operation technique and resolution of issues as Brine-ice thermal storage refrigerator

Quality and performance guarantee as thermal storage equipment by management of production, test run and so on at own factory

Connecting brine pipe to the showcases after the installation of the unit

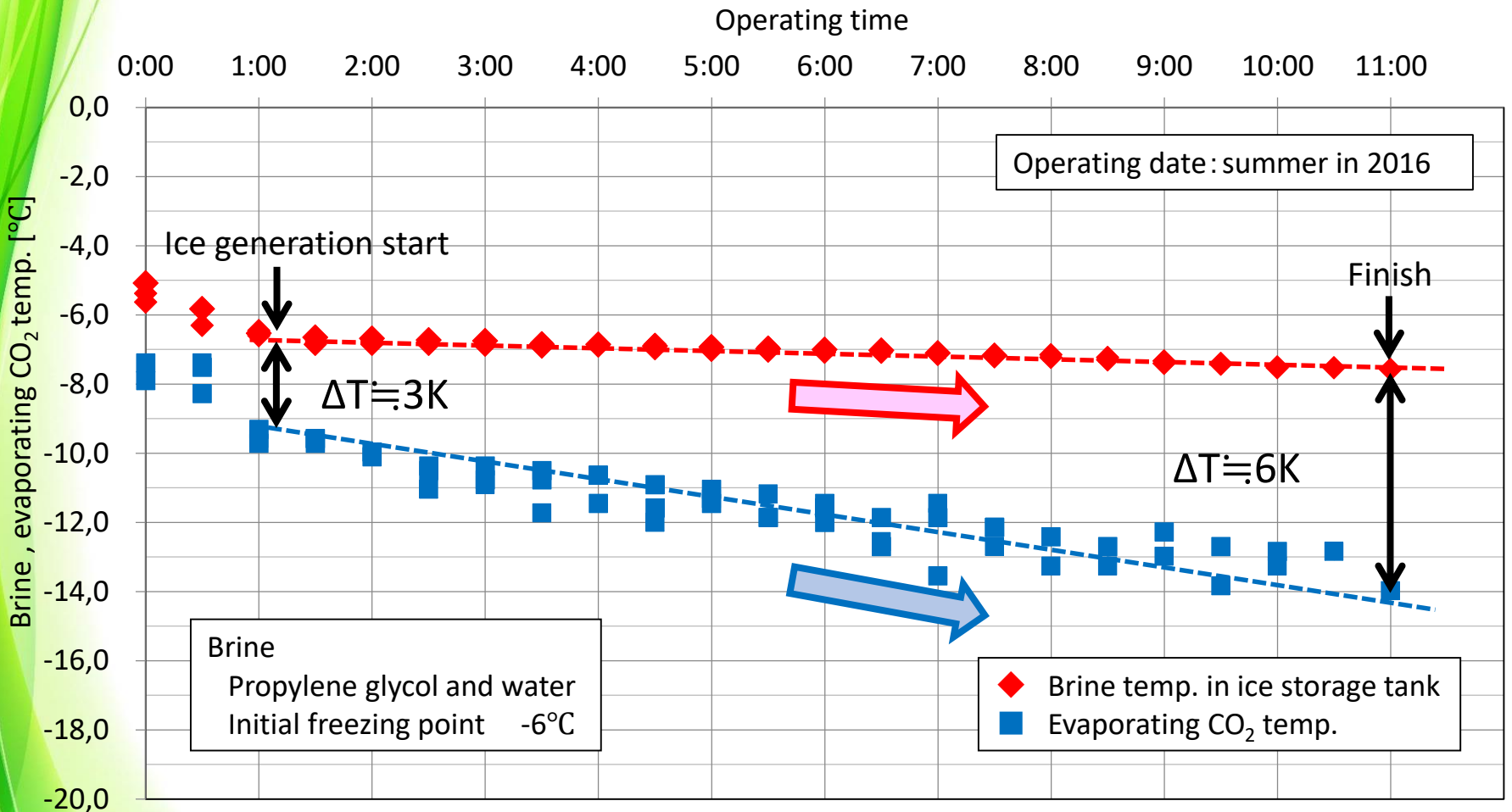
CO_2UEI unit operation for the simulation

Brine-ice thermal storage operation

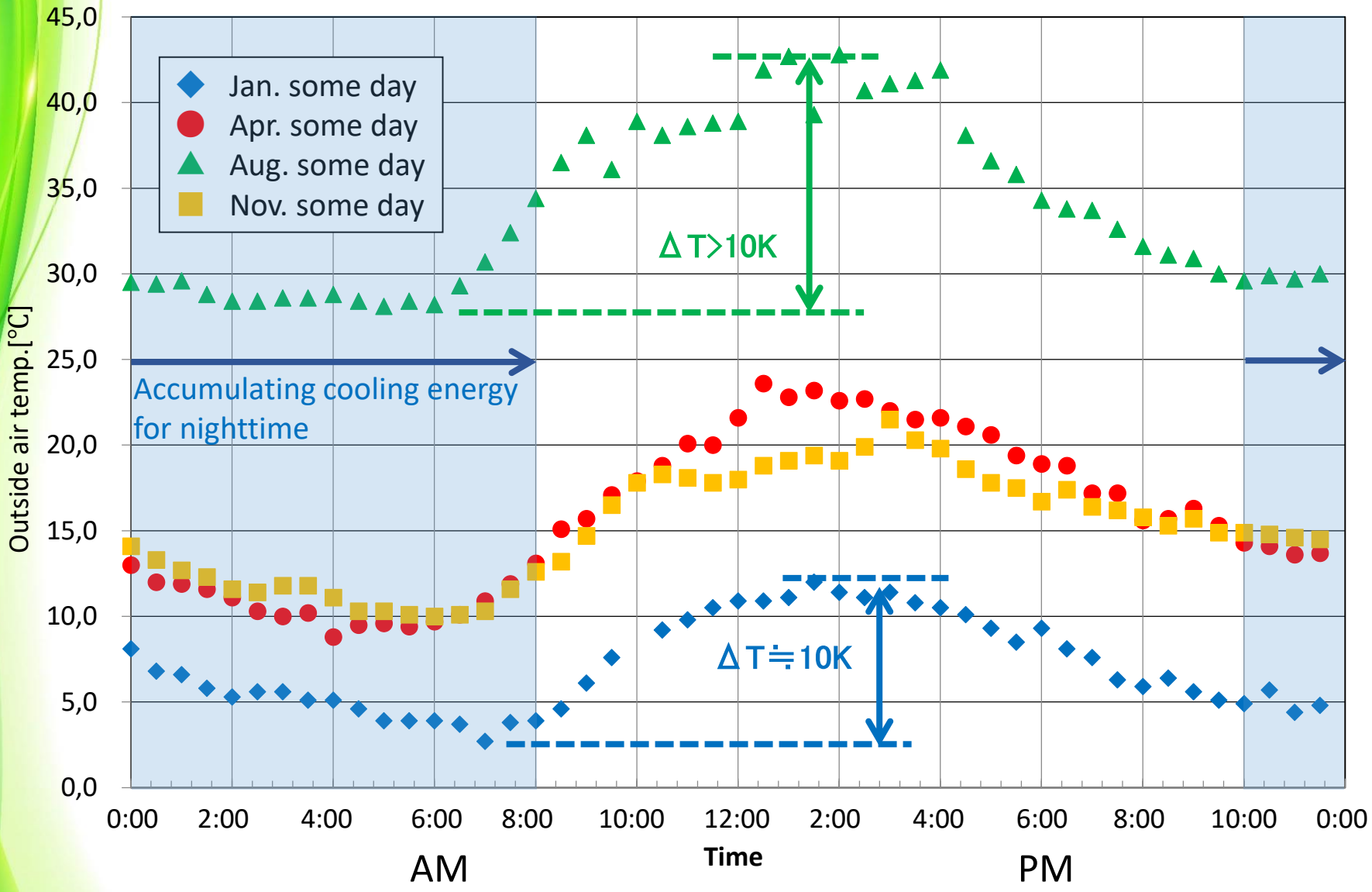
- Increasing of PG conc. and decreasing of brine freezing point by ice generation
- Decreasing of heat transfer performance between brine and CO_2 by ice generation

⇒Brine and CO_2 temp. curves are almost constant throughout the year

COP increasing by continuous refrigerators operation during nighttime at low temp.



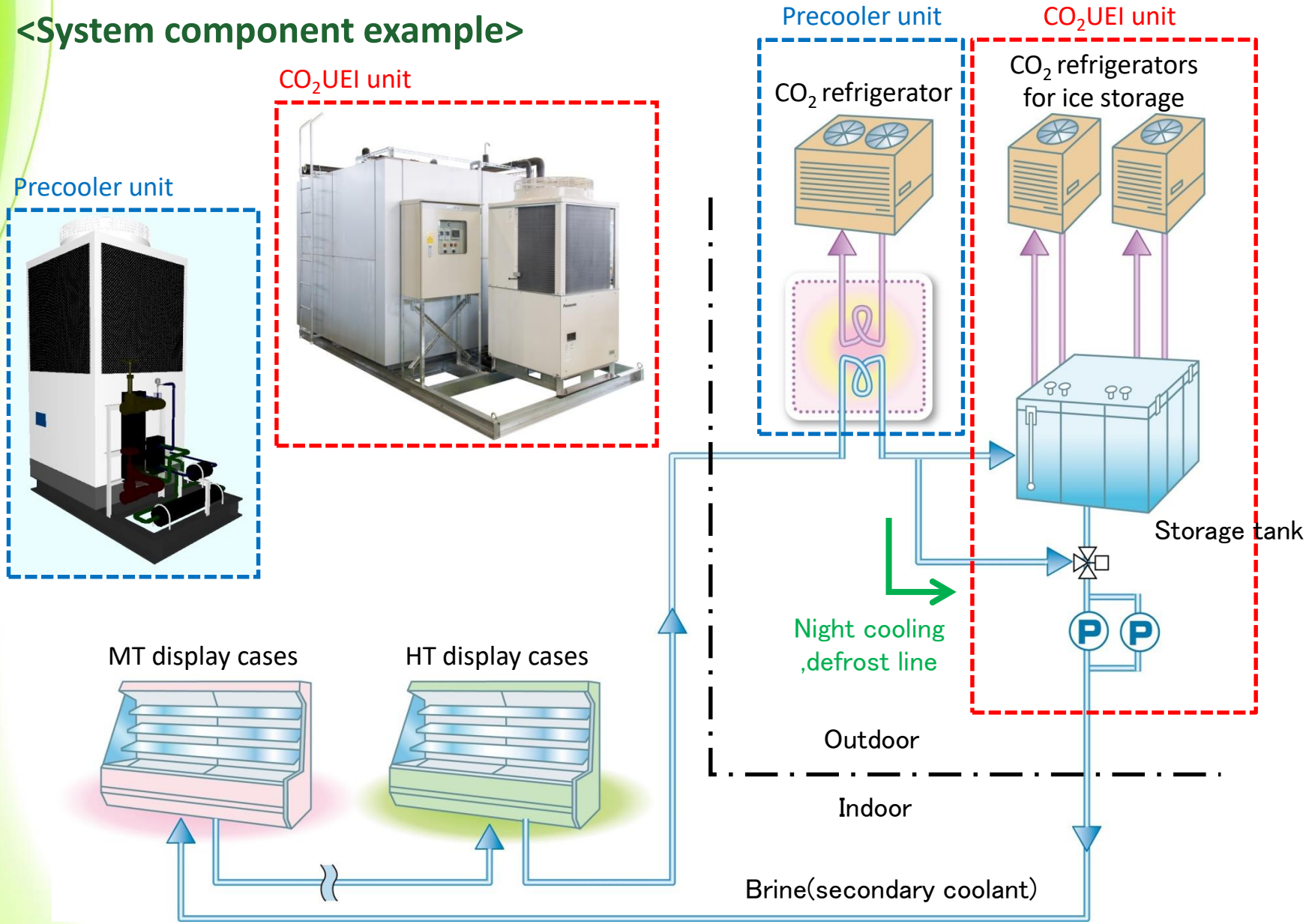
Actual outside air temp. for the simulation



(Date: Kanto region 365 days per 30 minutes in certain year)

CO_2UEI system component

<System component example>



Characteristics of CO_2UEI system (thermal storage system)

No.	Energy saving	Economic efficiency	
		Running cost	Initial cost
1	Continuous refrigerators operation during nighttime at low temp. Refrigerators COP increasing		
2	Defrost with higher temperature brine by cooling load in the system		
3		Using cooling energy accumulated during nighttime Reducing refrigerator capacity during daytime	
4			Reducing necessary refrigeration capacity during daytime
5			Reusing partial remodeling existing display cases, refrigerators
6			Cost up by ice thermal storage tank and unit installation

<Other characteristics>

- CO_2UEI and precooler unit with CO_2 pipe is installed outside

  Refrigerant leakages by any possibility have no influence on the inside of building

- Backup by installation of plural refrigerators for thermal storage

Simulation conditions

<Existing retail store conditions>

- Floor space : 2,000 m^2
- Store hours : AM9:00 – PM9:00
- Cooling target : refrigerated display cases, refrigerators (except freezing display cases, freezers)
- Cooling load : 140kW (indoor condition 25℃, 60%)
- Installation region : Kanto region

Conditions	CO_2 DX cooling system	CO_2 UEI system
CO_2 refrigerator	120HP	80HP
Ice thermal storage tank	-	25m^3
Brine feed pomp	-	3.7kW × 1
Display cases refrigerators	**New** CO_2 display cases, refrigerators	**Existing remodeled** Freon display cases, refrigerators
Outdoor air temp.	Actual outdoor air temp.	

Evaluation results of CO_2 UEI system energy saving and economic efficiency

	CO_2 DX cooling system	**CO_2 UEI system**
Electricity usage	100%	80～90%
Running cost	100%	75～80%
Initial cost	100% **New** CO_2 display cases, refrigerators	75～85% **Existing remodeled** Freon display cases, refrigerators

Using CO_2DX cooling system as the base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Thank you very much!