



XI WORLD WATER CONGRESS

WATER RESOURCES MANAGEMENT IN THE 21st CENTURY

Madrid 5-9/October/2003



XI WORLD CONGRESS

Focuss Session 11:

DESALINATION AS AN ALTERNATIVE IN WATER SORTAGE SITUATIONS

**Title: ENERGY AND SEA WATER
DESALINATION**

By Juan M. Sanchez





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Distillation process

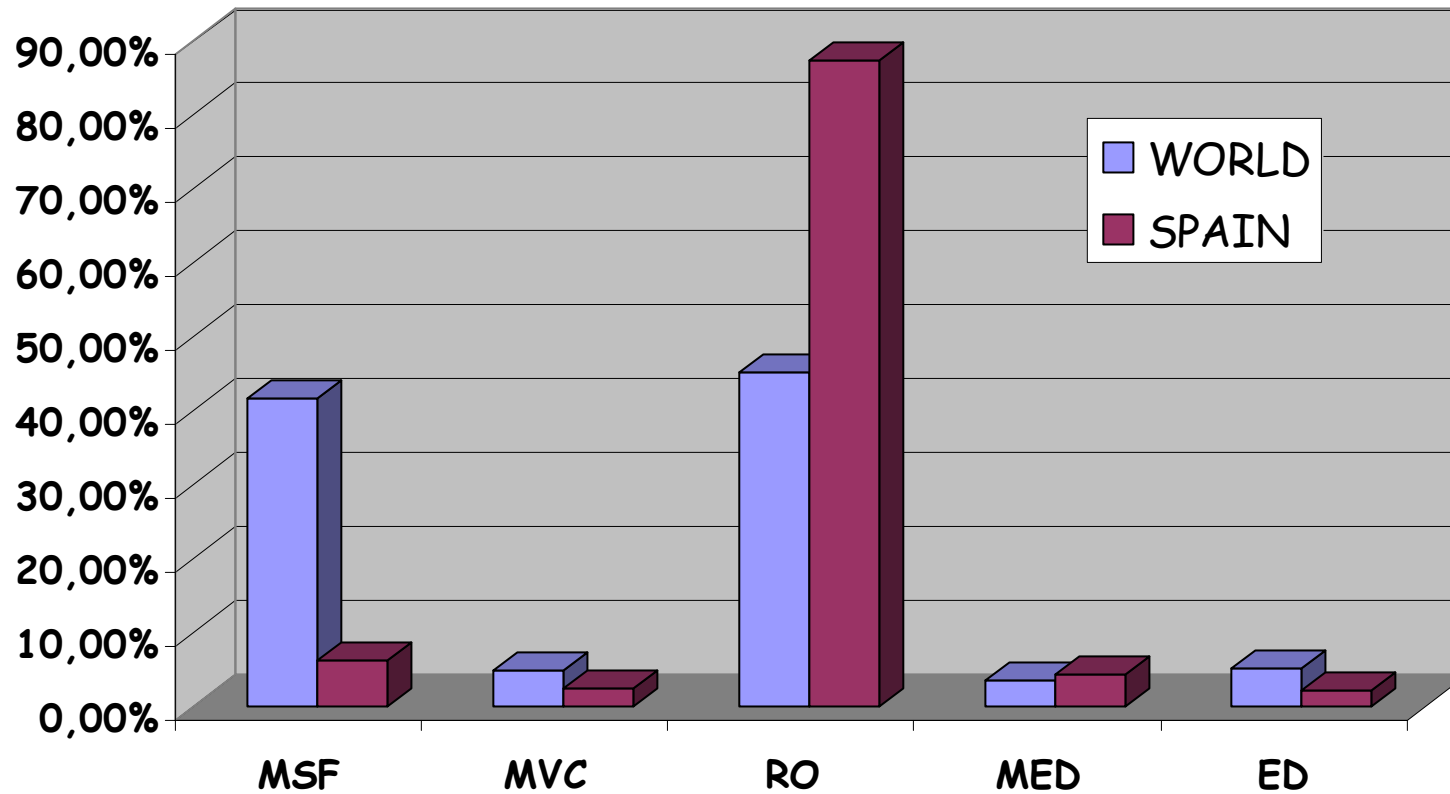
- **Multistage Flash Evaporation** (MSF)
- **Multiefect Distillation** (MED)
- **Mechanical Vapour Compression** (MVC)

Membranes Process

- **Reverse Osmosis** (RO)
- **Electrodialysis** (ED)

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PROCESS SHARE





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ENERGY USED IN DESALINATION PROCESS

	THERMAL ENERGY	ELECTRICAL ENERGY
	(Kcal/m³)	(Kwh/m³)
M.S.F.....	55.556	6,25
M.E.D.....	55.556	1,64
V.C.....	*****	8,66
R.O.....	*****	3,50



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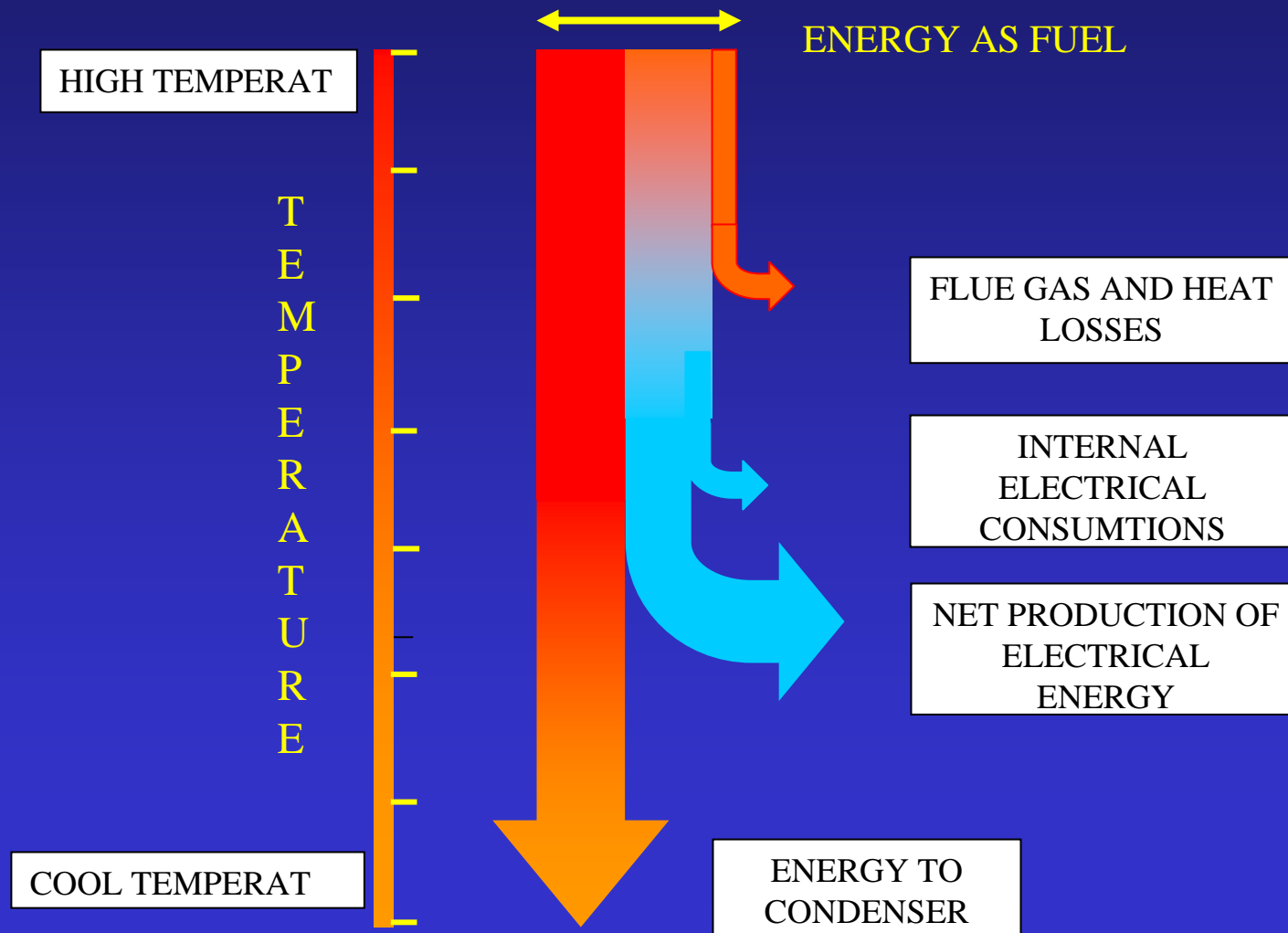
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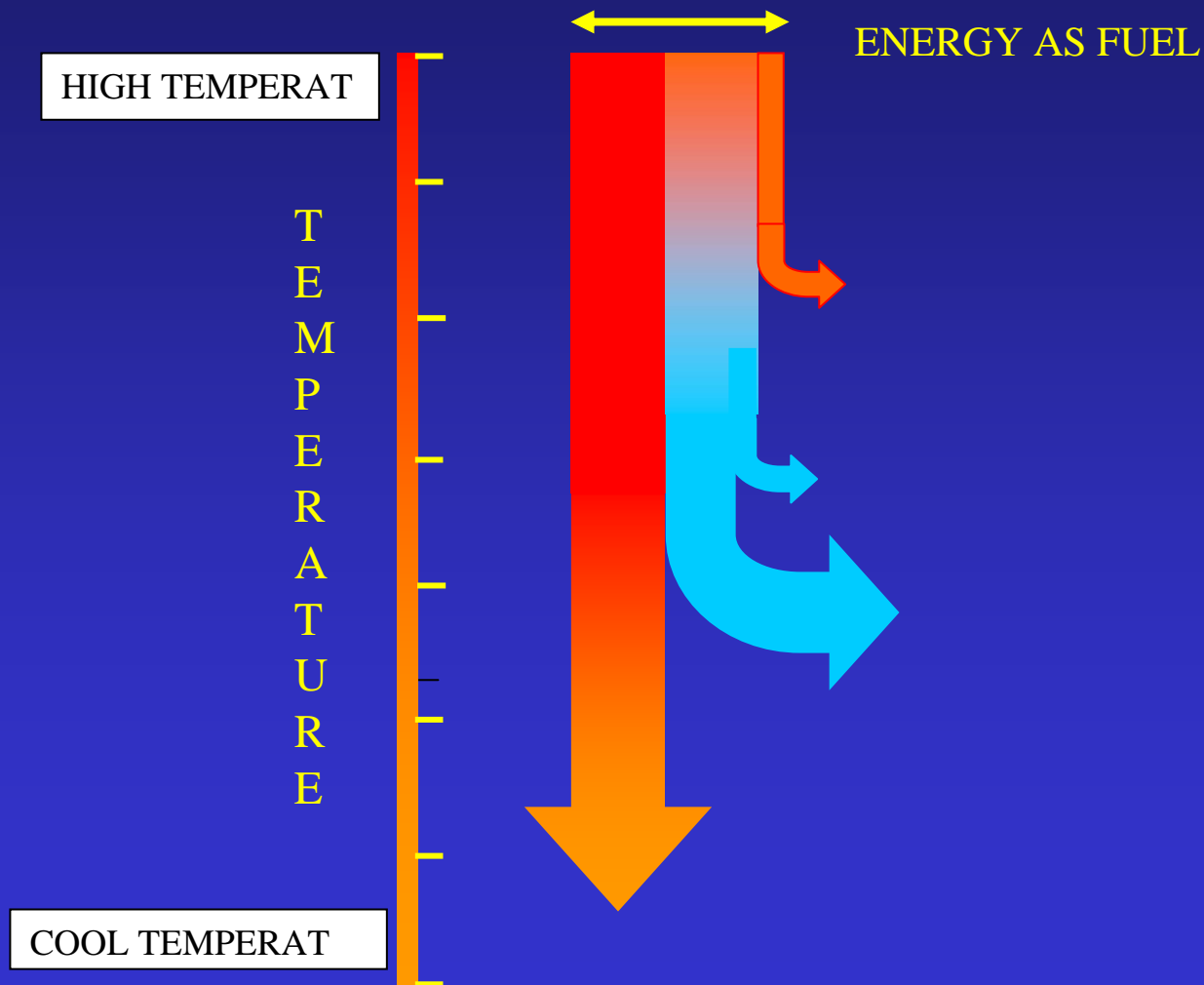
THERMODYNAMICS CYCLE OF POWER STATION





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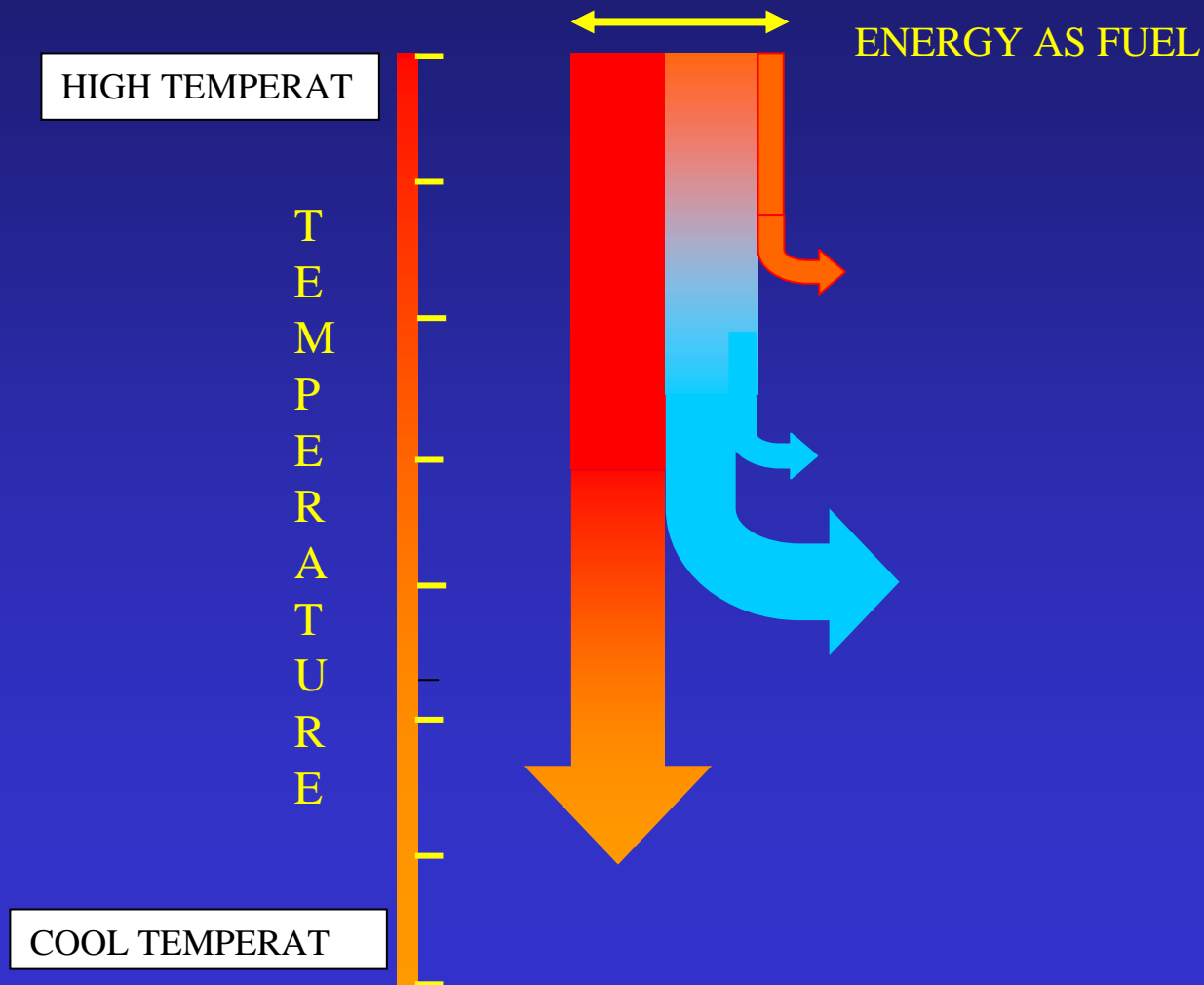
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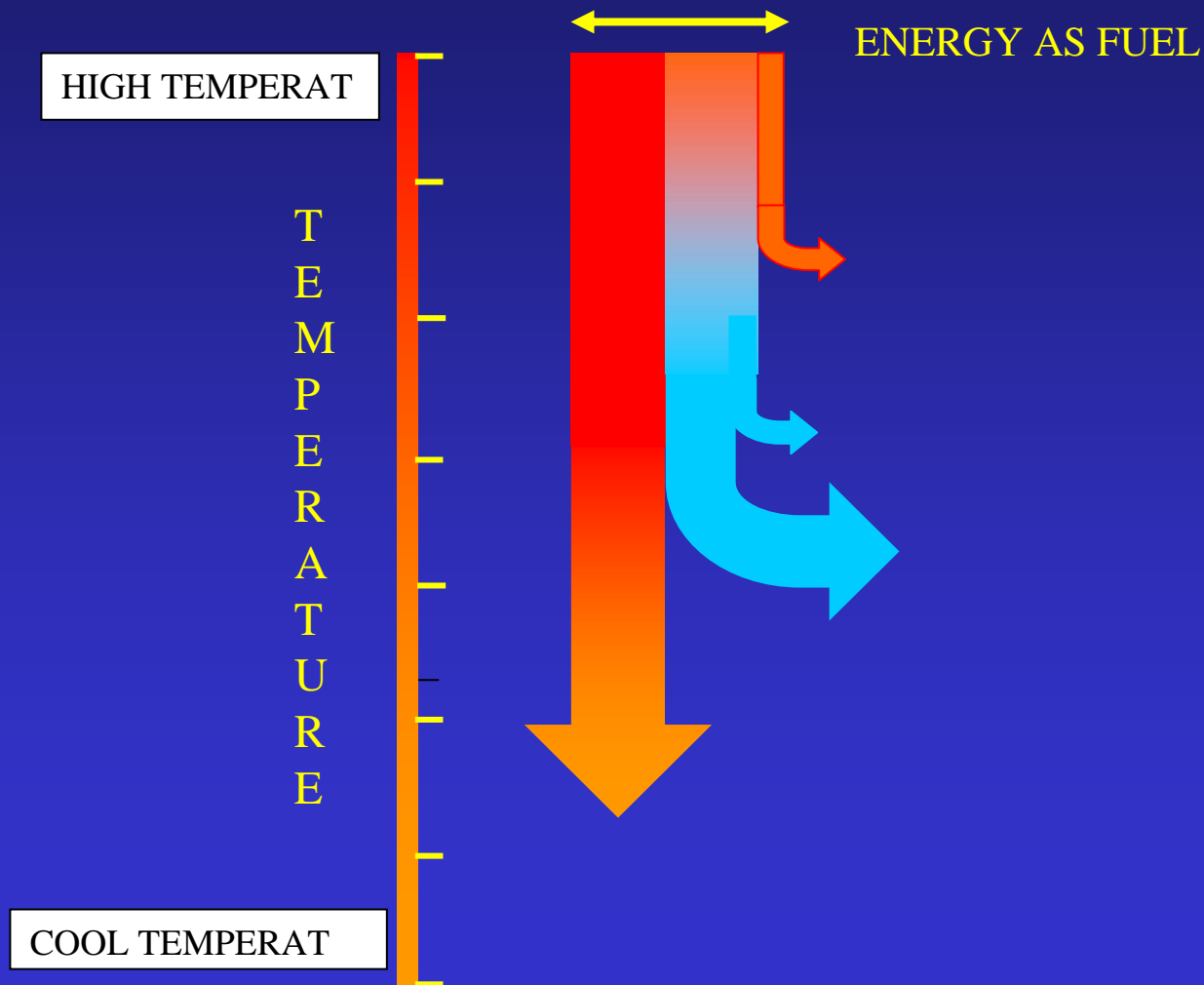
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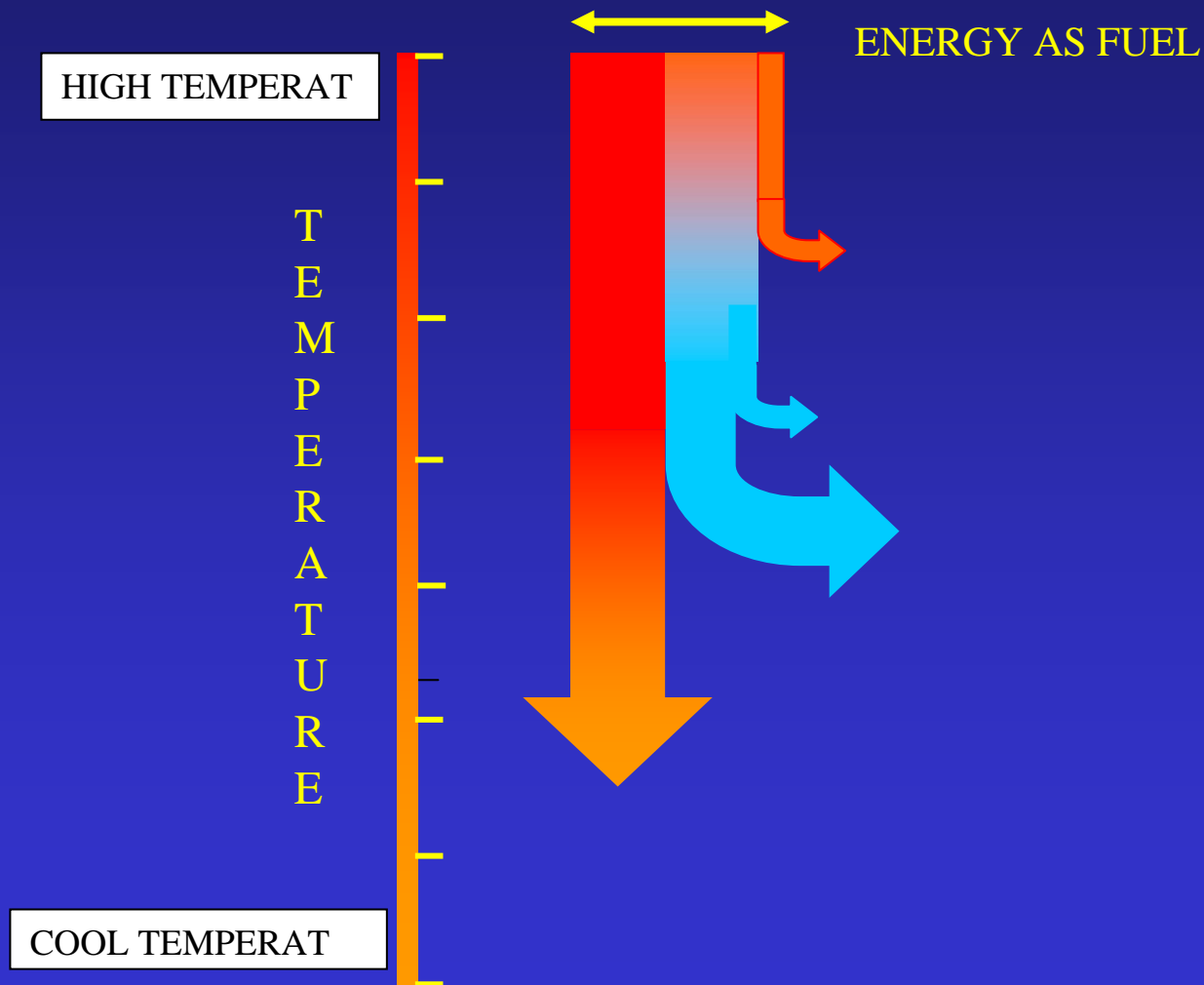
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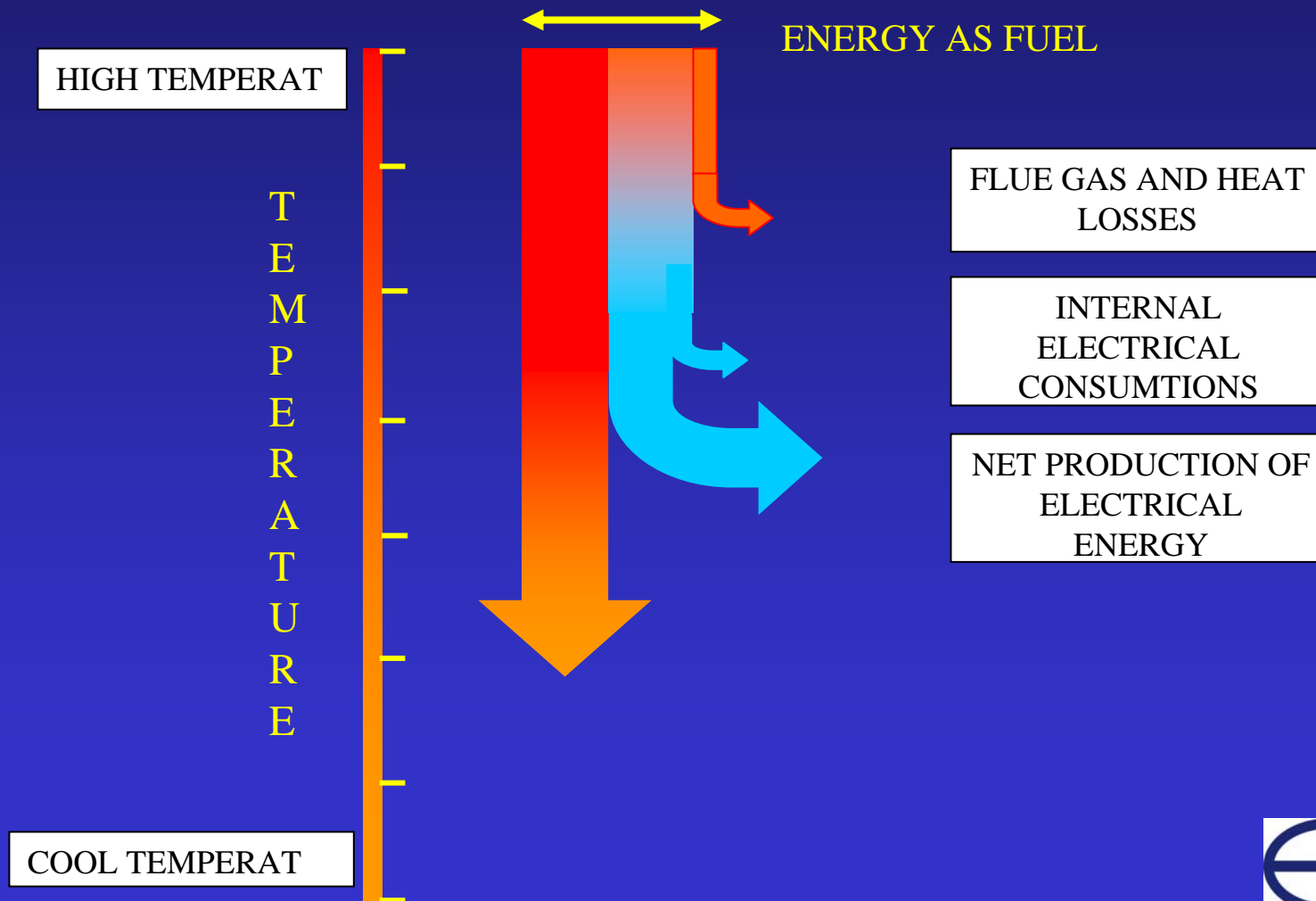
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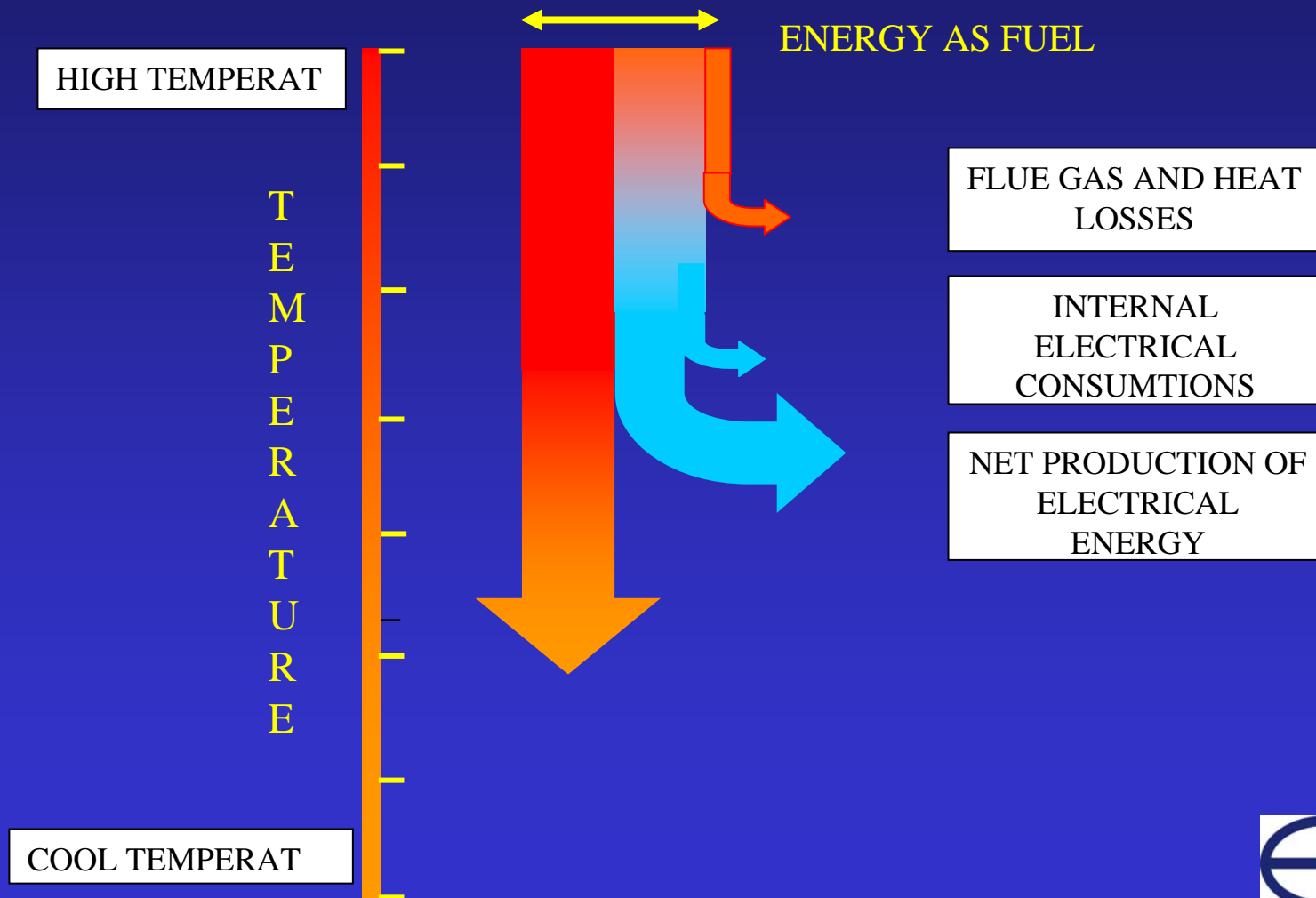
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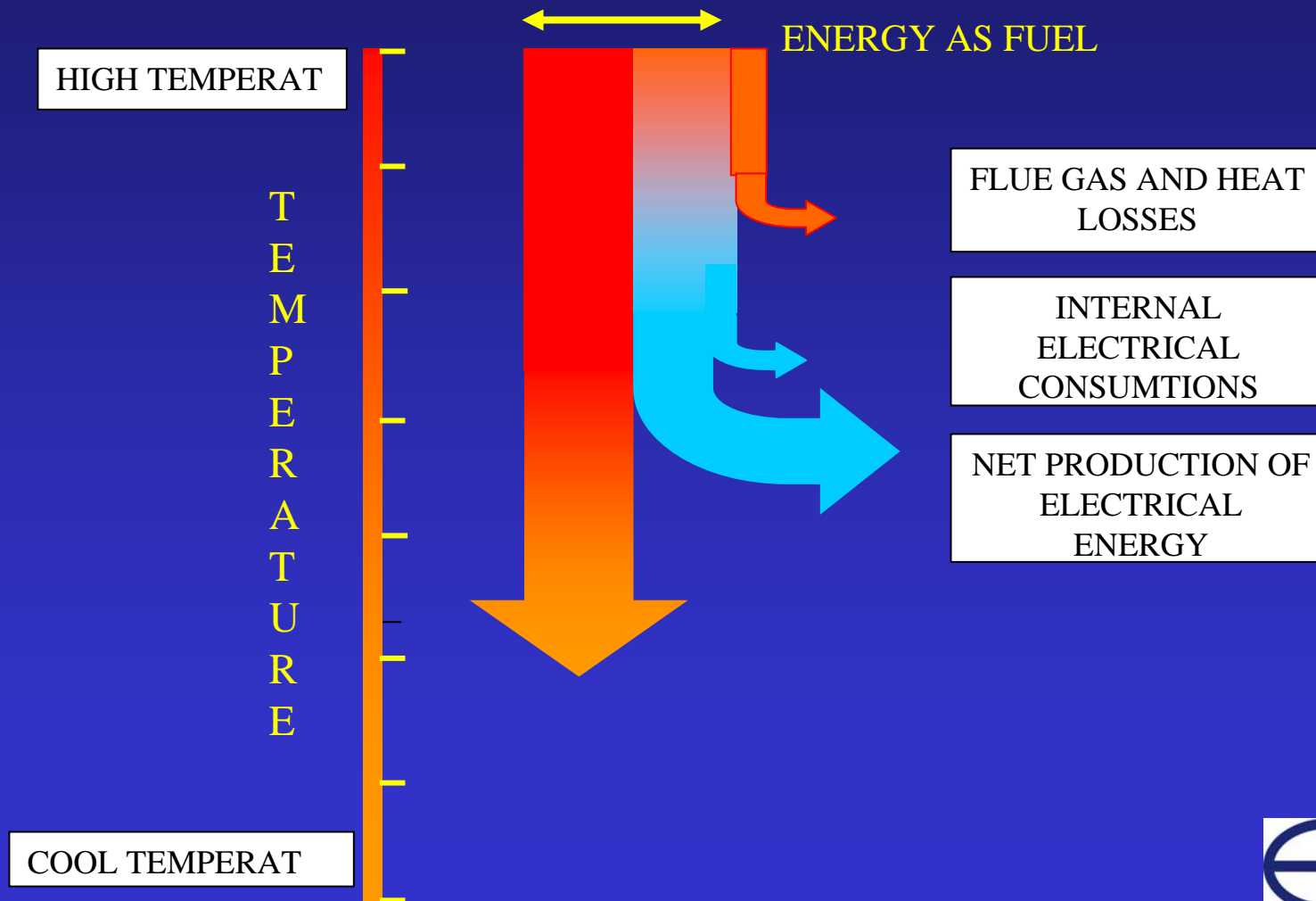
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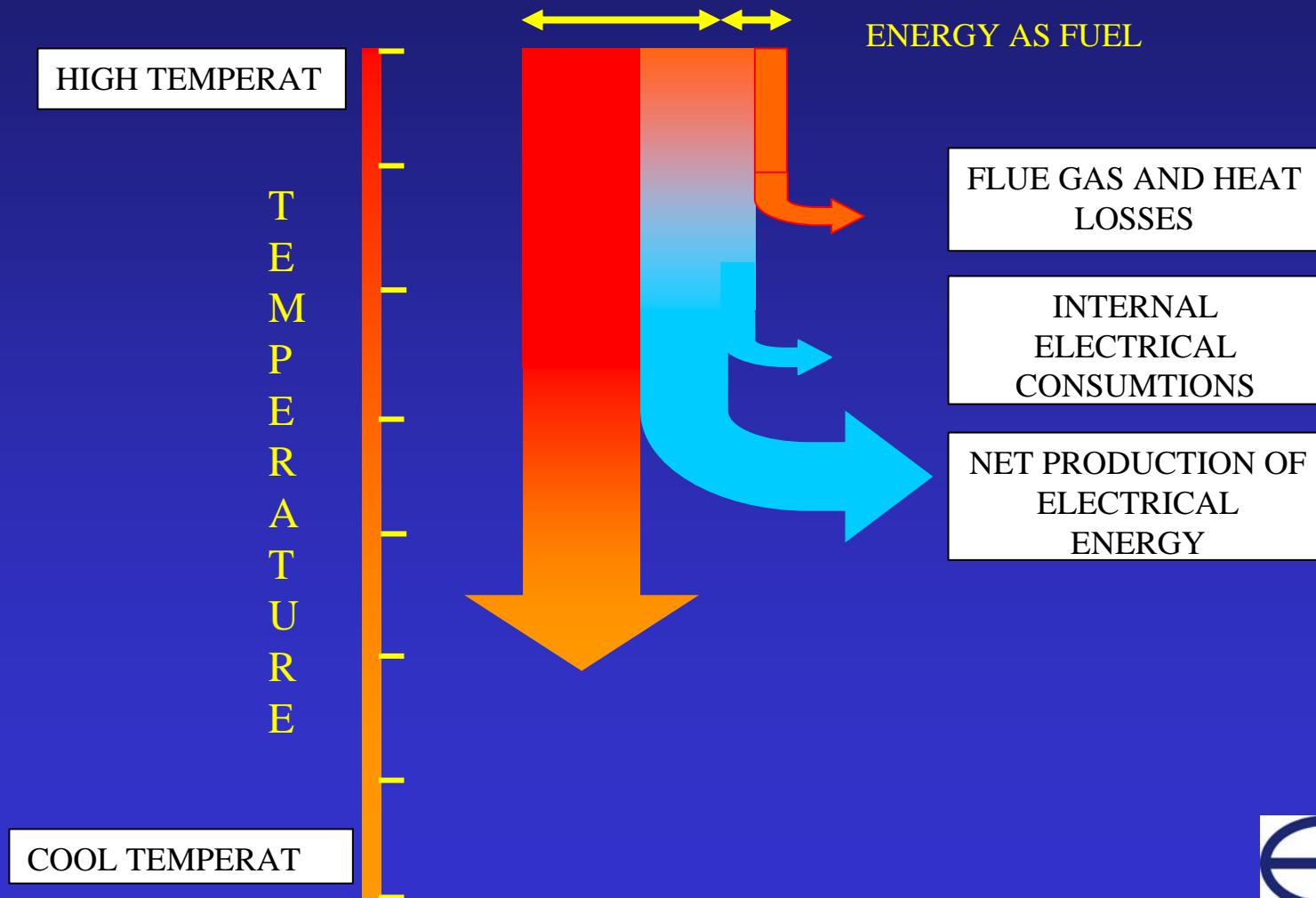
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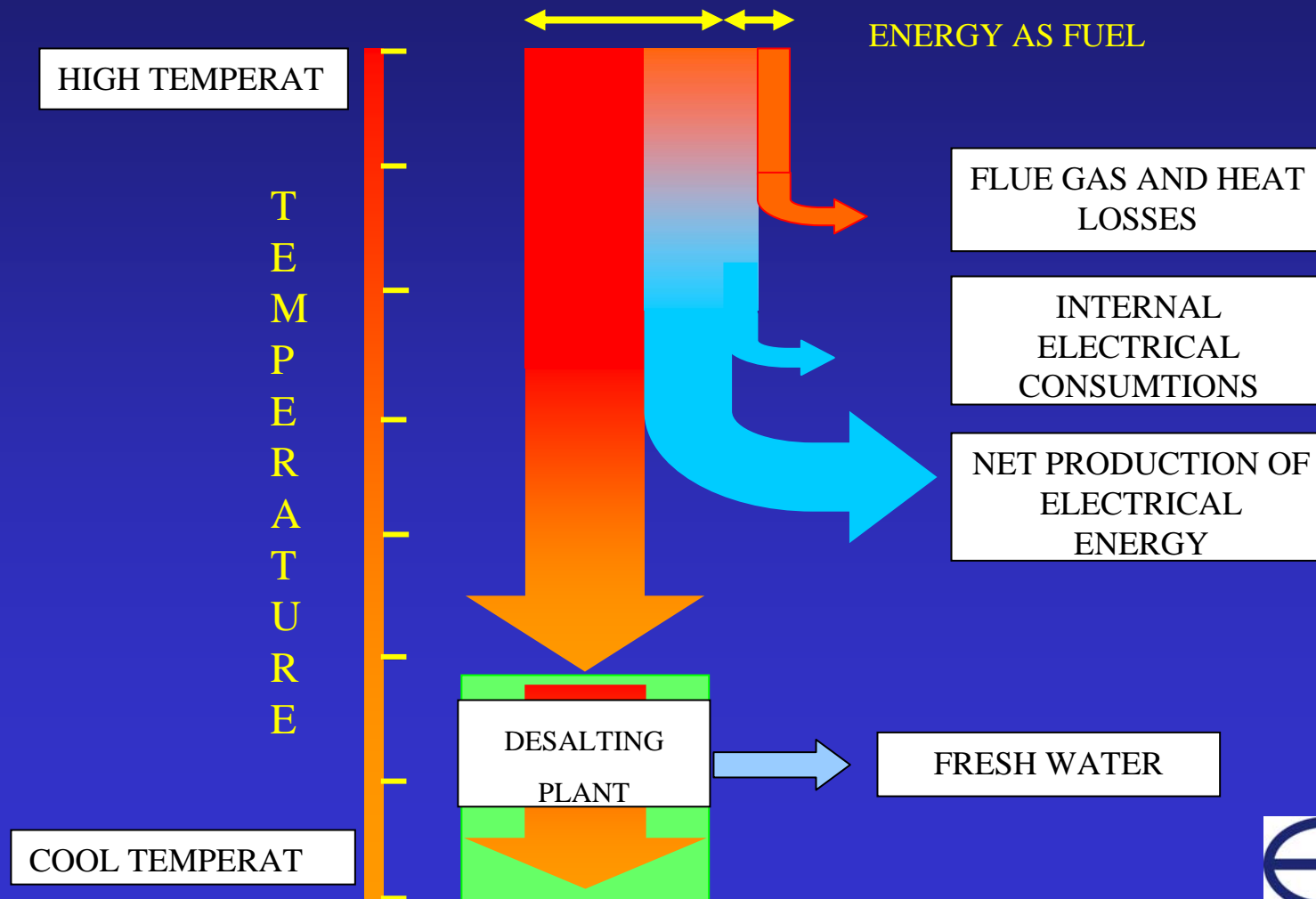
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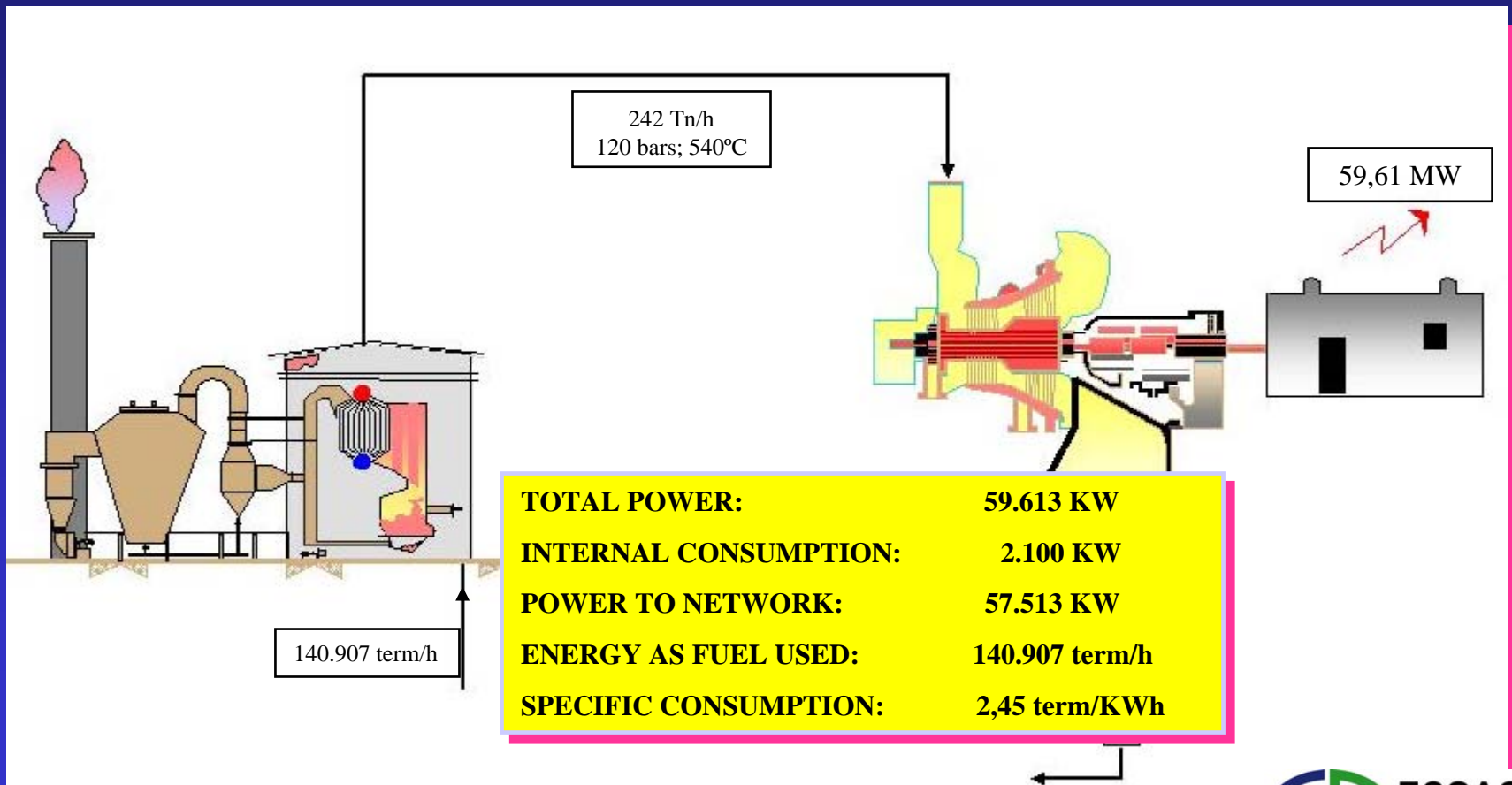
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THERMODYNAMICS CYCLE OF POWER STATION



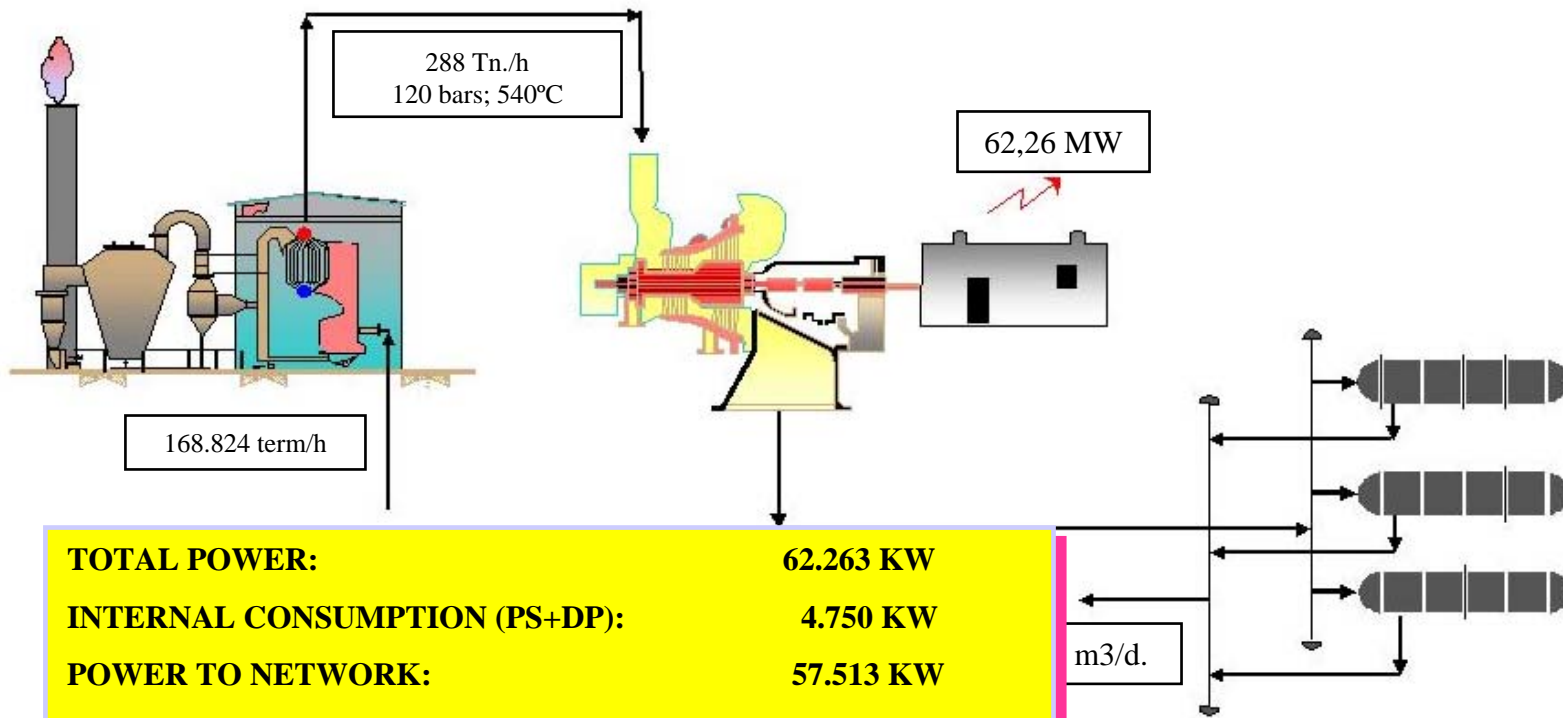
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THERMODYNAMICS CYCLE FOR CONDENSATION TURBINE



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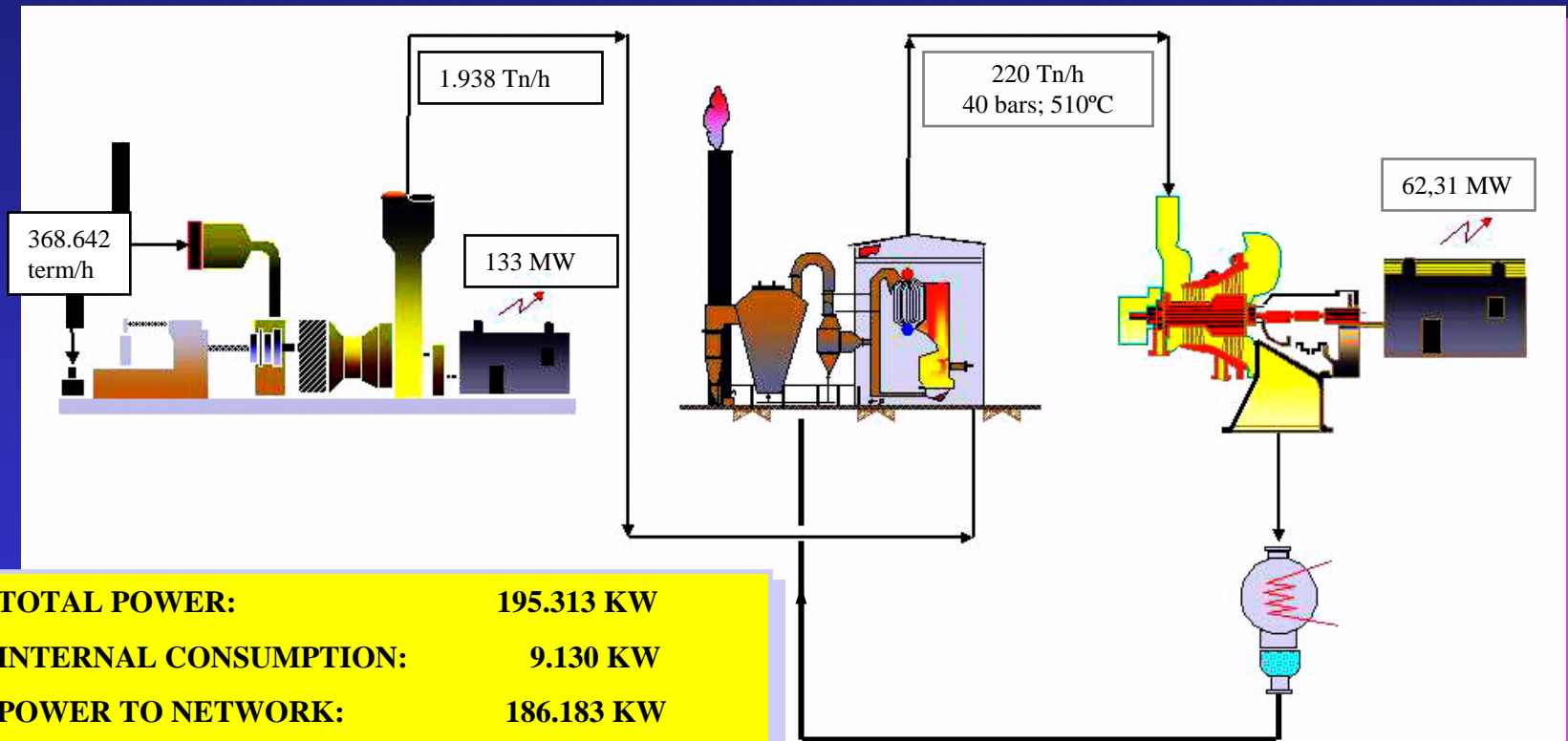
DUAL PURPOSE PLANT WITH A CONVENTIONAL CYCLE



TOTAL POWER:	62.263 KW
INTERNAL CONSUMPTION (PS+DP):	4.750 KW
POWER TO NETWORK:	57.513 KW
ENERGY AS FUEL USED:	168.824 term/h
ENERGY CONSUMED BY WATER PROD:	27.917 term/h
WATER PRODUCED:	2.083,33 m3/h
SPECIFIC ENERGY CONSUM FOR WATER:	13,40 term/m3

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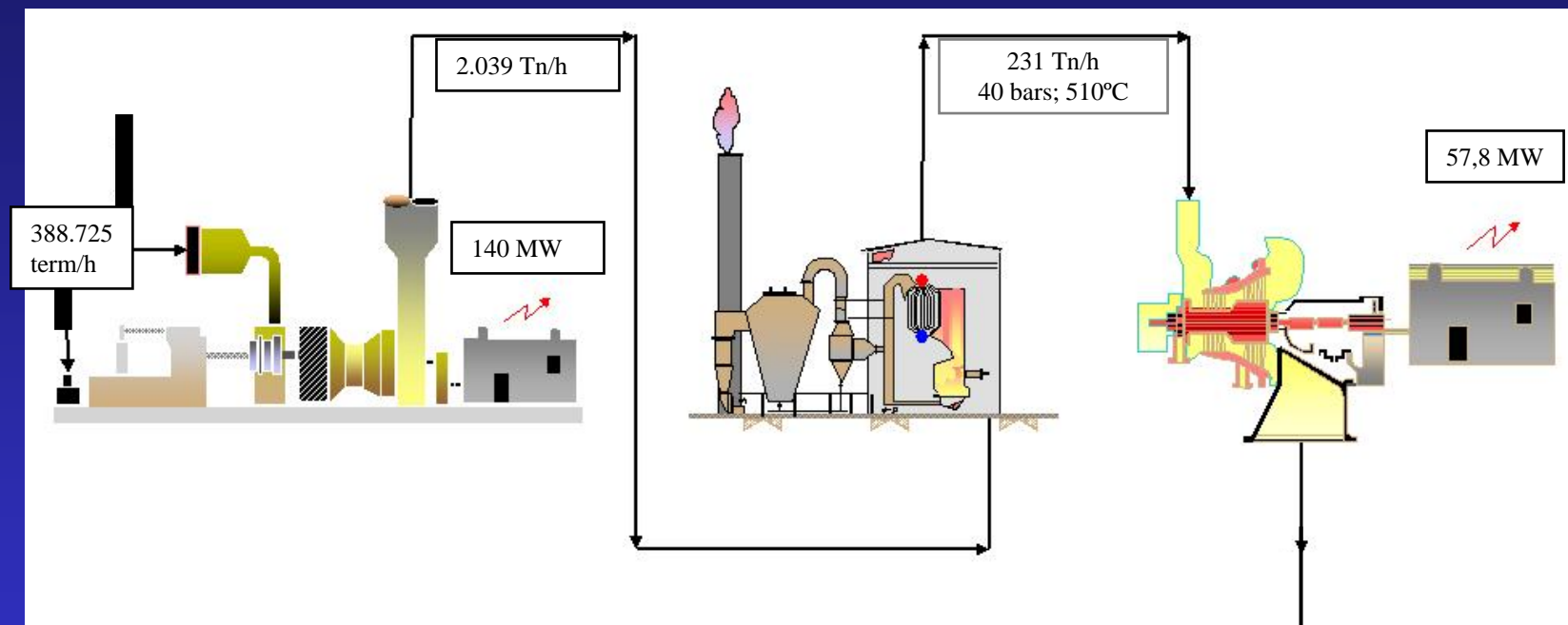
COMBINED CYCLE WITH GAS TURBINE



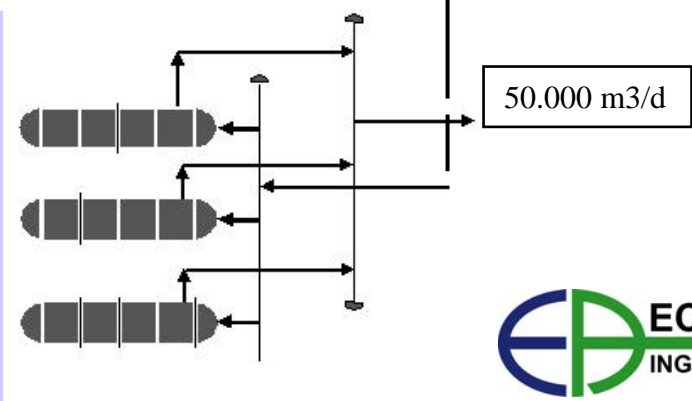
TOTAL POWER:	195.313 KW
INTERNAL CONSUMPTION:	9.130 KW
POWER TO NETWORK:	186.183 KW
ENERGY AS FUEL USED:	368.642 term/h
SPECIFIC CONSUMPTION:	1,98 term/KWh

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DUAL PURPOSE PLANT WITH COMBINED CYCLE



TOTAL POWER:	197.746 KW
INTERNAL CONSUMPTION (PS+DP):	11.563 KW
POWER TO NETWORK:	186.183 KW
ENERGY AS FUEL USED:	388.725 term/h
ENERGY CONSUMED BY WATER PROD:	20.083 term/h
WATER PRODUCED:	2.083,33 m3/h
SPECIFIC ENERGY CONSUM FOR WATER:	9,64 term/m3





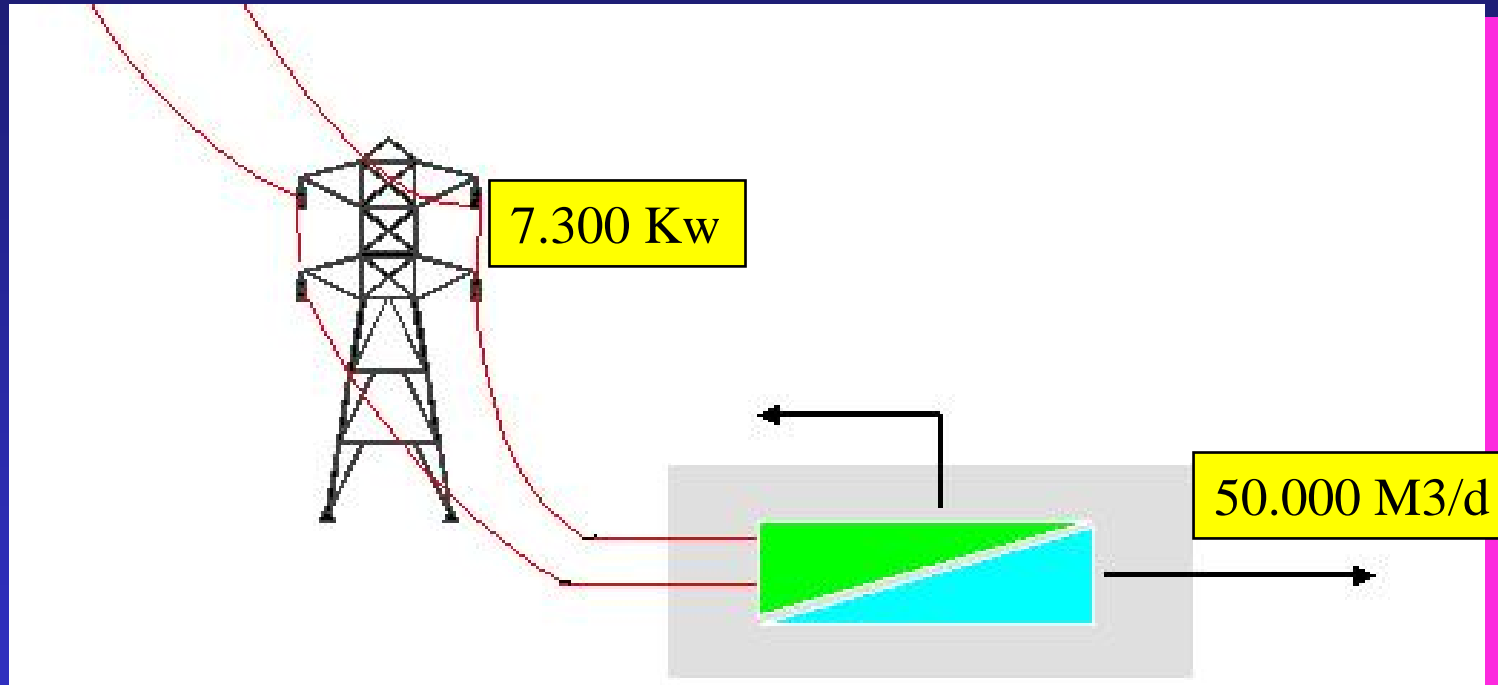
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VAPOUR COMPRESSION PROCESS

- **SPECIFIC CONSUMPTION OF ENERGY IN DESALINATION PROCESS.....8,66 Kwh/m³**
- **SPECIFIC CONSUMPTION OF PRIMARY ENERGY IN ELECTICITY PRODUCTION..... 2,45 term/Kwh**
- **SPECIFIC CONSUMPTION OF PRIMARY ENERGY IN WATER PRODUCTION.....21,22 term/m³**

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REVERSE OSMOSIS PROCESS



SPECIFIC ENERGY CONSUMPTION IN DESALINATION PROCESS:	3,50 Kwh/m³
SPECIFIC PRIMARY ENERGY CONSUMPTION IN ELECTRICITY CYCLE:	2,45 Term/Kwh
SPECIFIC PRIMARY ENERGY CONSUMPTION IN WATER PRODUCTION	8,58 Term/m³



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RESUMEN DEL CONSUMO ESPECÍFICO DE PRODUCCIÓN DE AGUA

- DUAL PURPOSE PLANTS WITH WATER PRODUCTION BY MULTIEFFECT PROCESS
 - ✓ Combined cycle..... 9,66 term/m³
 - ✓ Conventional cycle..... 13,40 term/m³
- SEA WATER DESALINATION PLANT CONECTED AT ELECTRICITY NETWORK
 - ✓ Reverse Osmosis plants..... 8,58 term/m³
 - ✓ Vapour Compression plants..... 21,22 term/m³