



**USAID**  
FROM THE AMERICAN PEOPLE

## *Import and Export of Electrical Energy*

By:- NK BHATI  
Yadav Measurements , Udaipur.

A specifically designed programme for  
Da Afghanistan Breshna Sherkat (DABS)  
Afghanistan



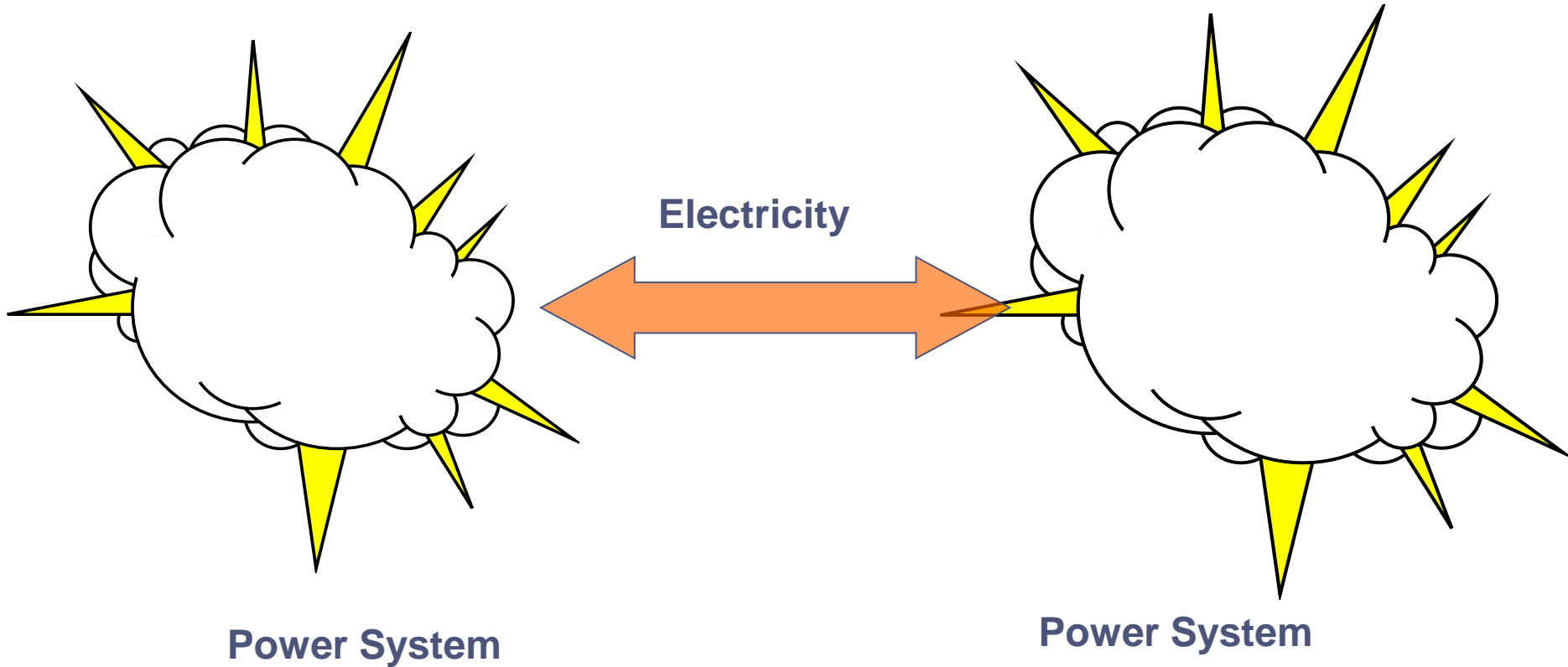
**USAID**  
FROM THE AMERICAN PEOPLE

## **Areas Covered Under this Module**

- Power flow principles
- Import and export of power
- Metering point and energy flow
- Power flow quadrants and power factor
- Reactive and apparent energy flow
- Various energy registers in energy measurement

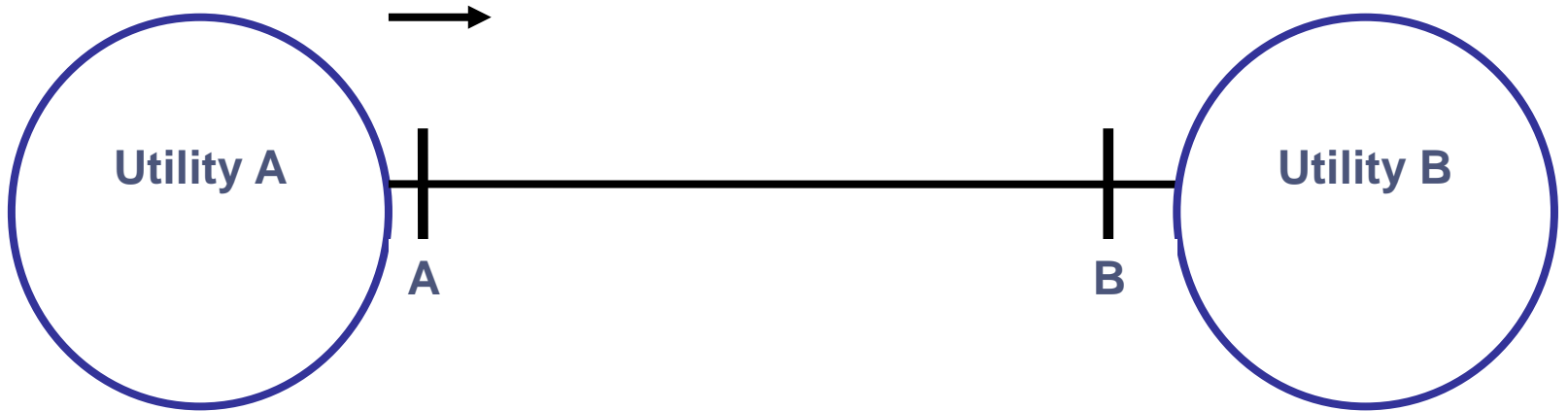


# Power Flow

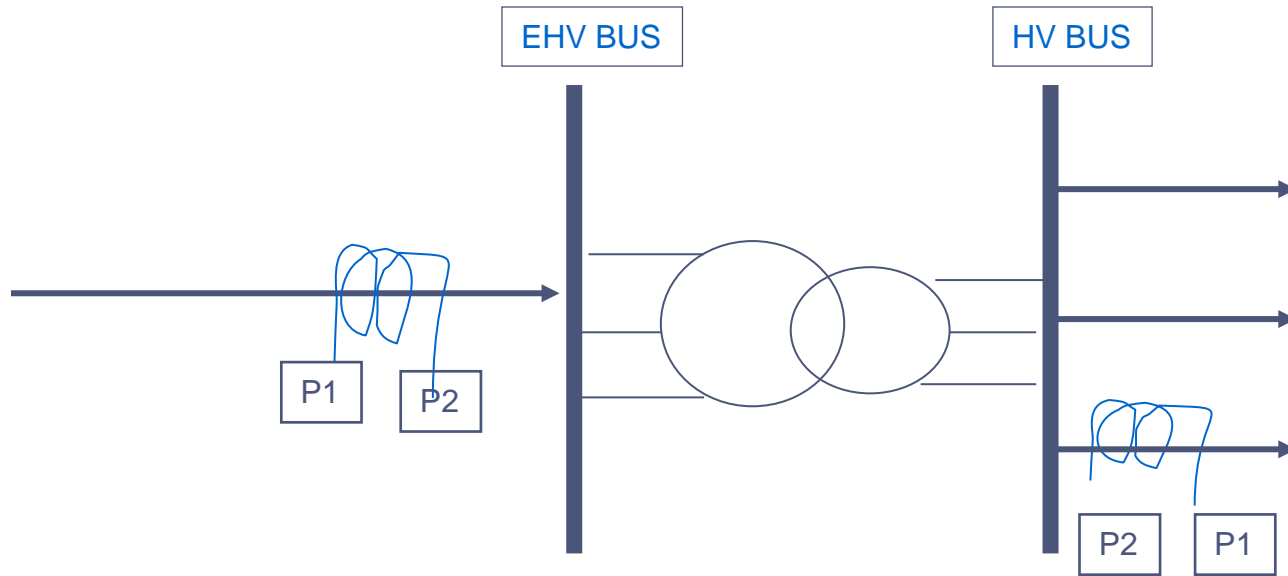




# Measurement Reference



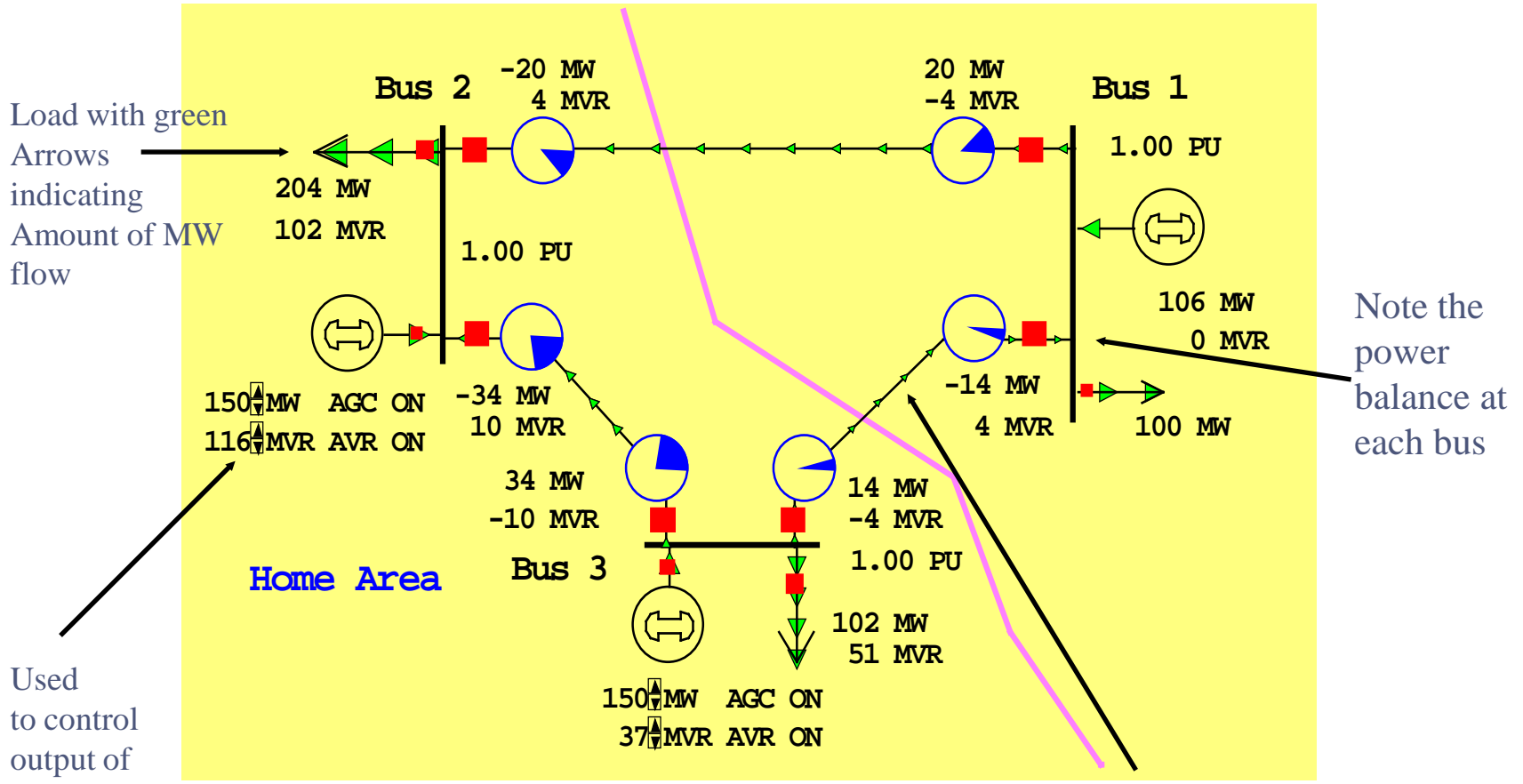
- Current transformer connection polarity



- Power flow to Voltage bus is taken positive (import)
- Current transformer connection polarity (p2 to bus side)

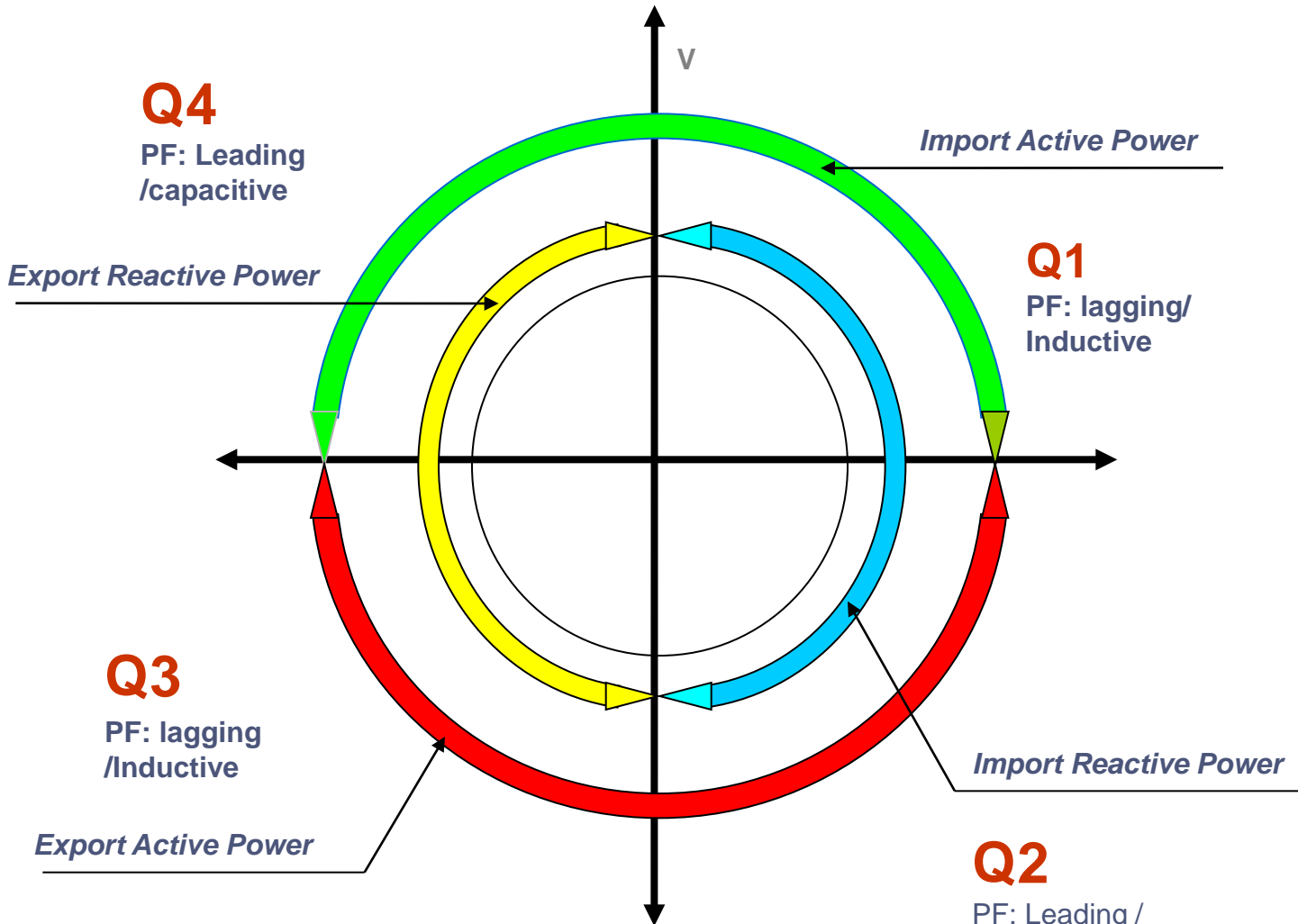


## Example of small tie line



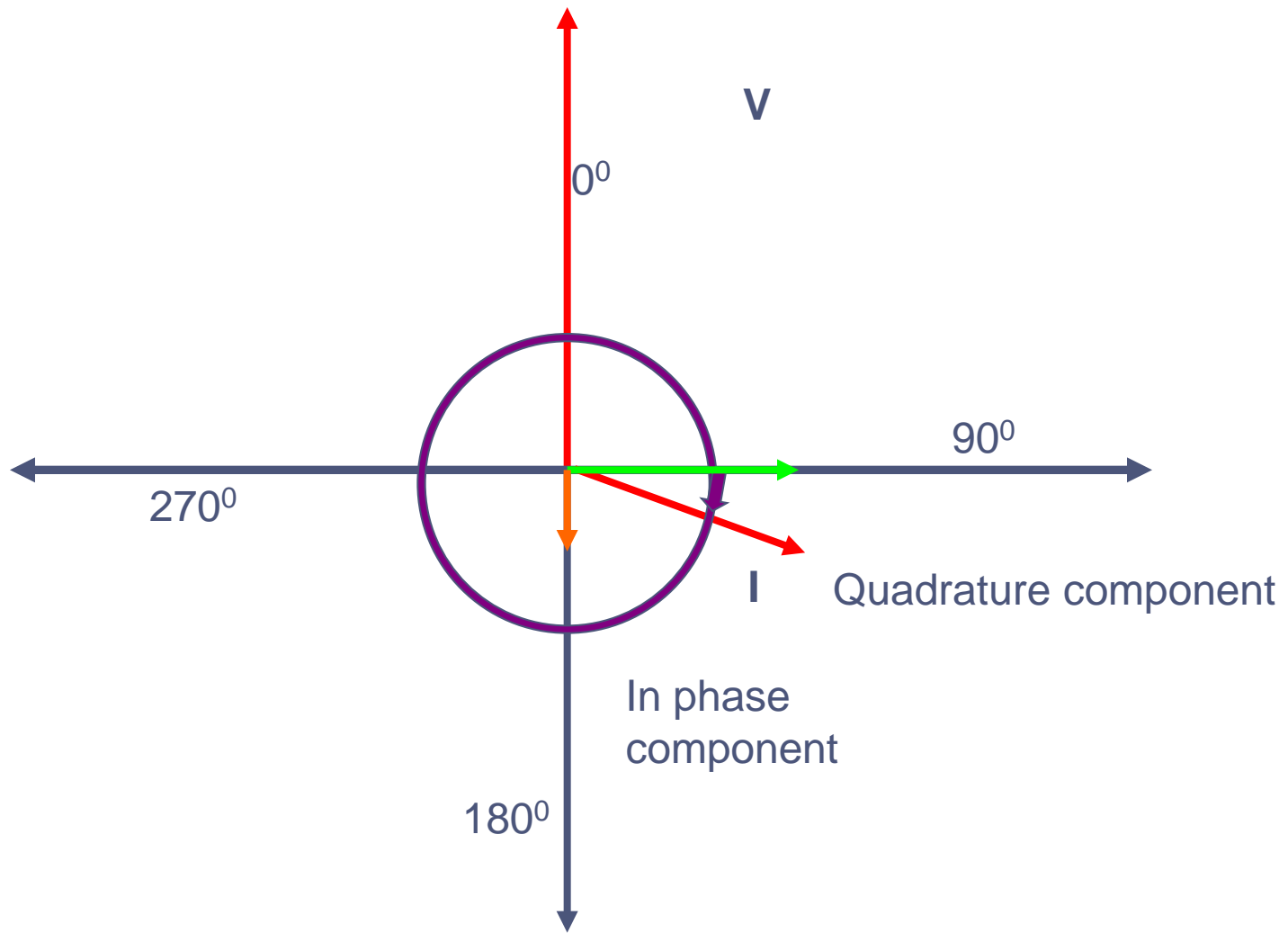


## Power Flow Quadrants: IEC62053-23





# Power Components





# Power Flow Quadrants

*Voltage vector*

## **Quadrant 4**

*kW Import*

*kVAr (capacitive) Export*

*kW + à*

*kVAr - ß*

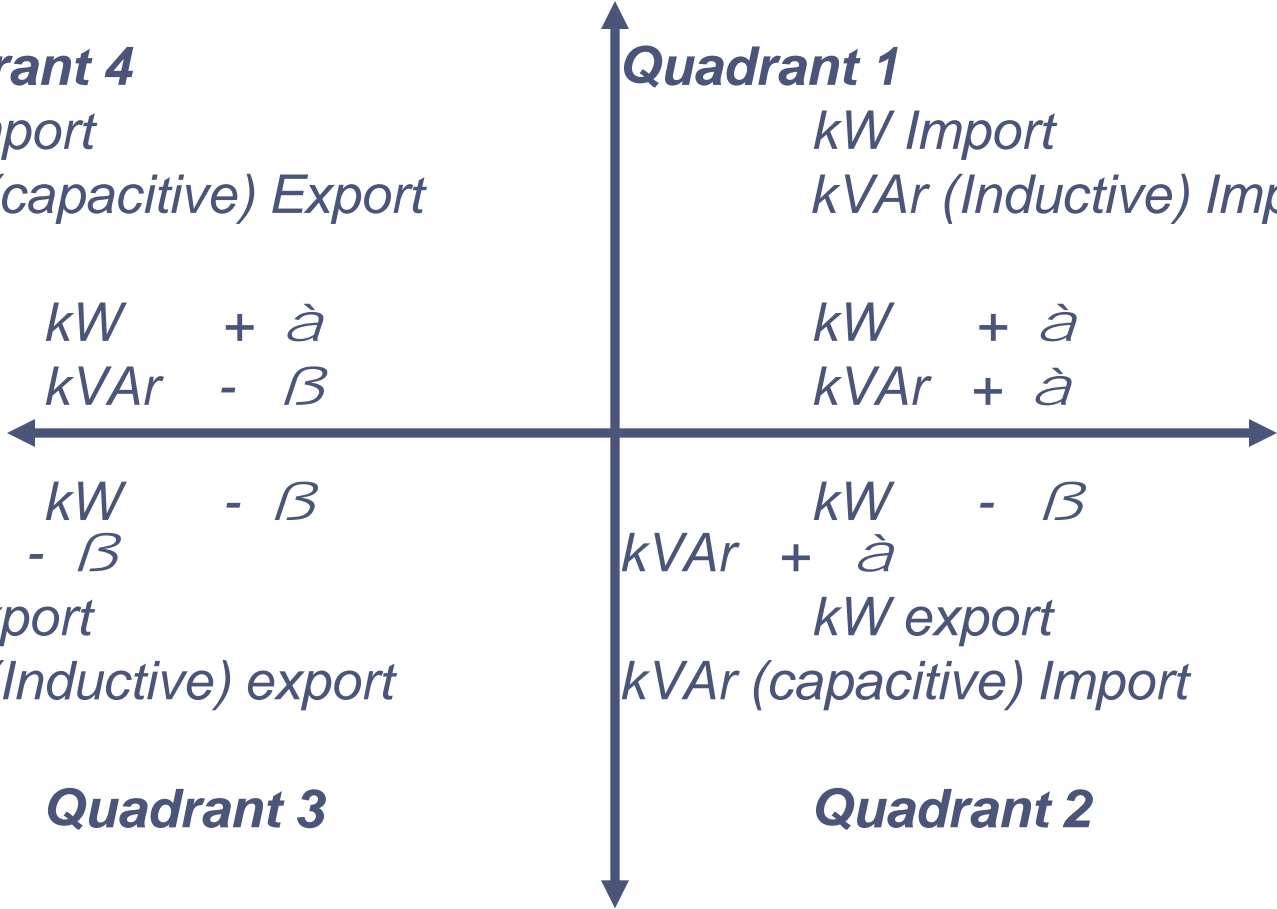
## **Quadrant 1**

*kW Import*

*kVAr (Inductive) Import*

*kW + à*

*kVAr + à*



*kW - ß*

*kVAr - ß*

*kW export*

*kVAr (Inductive) export*

*kW - ß*

*kVAr + à*

*kW export*

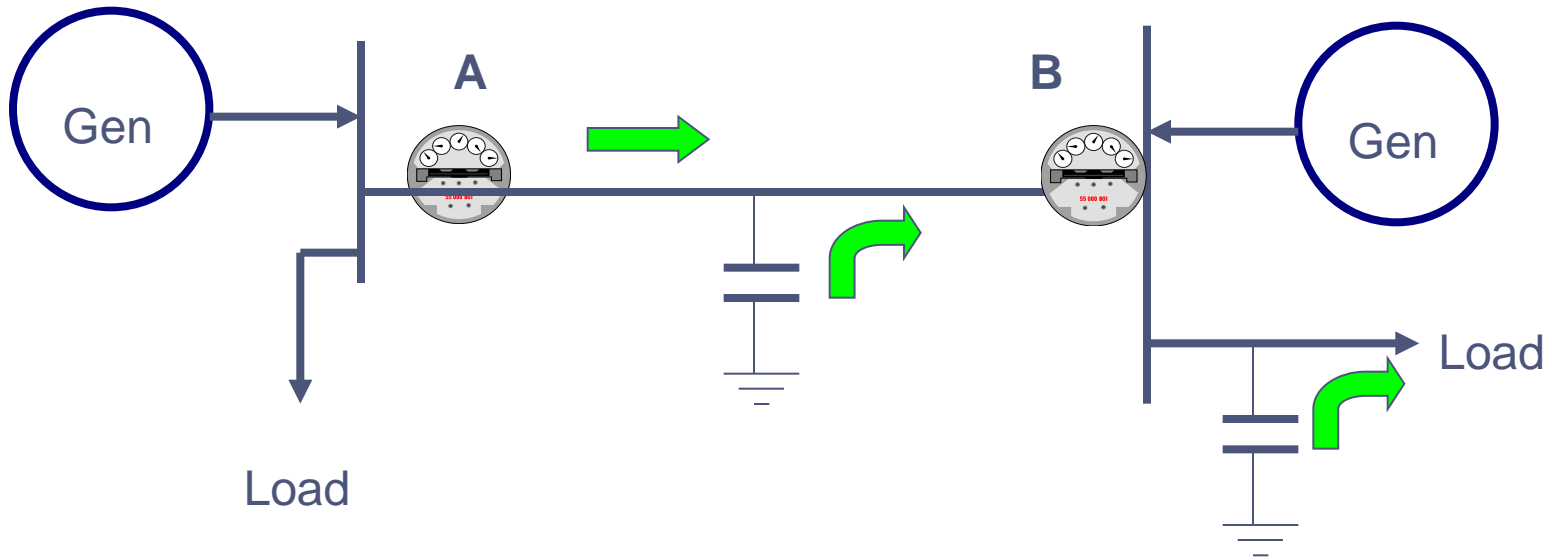
*kVAr (capacitive) Import*

## **Quadrant 3**

## **Quadrant 2**

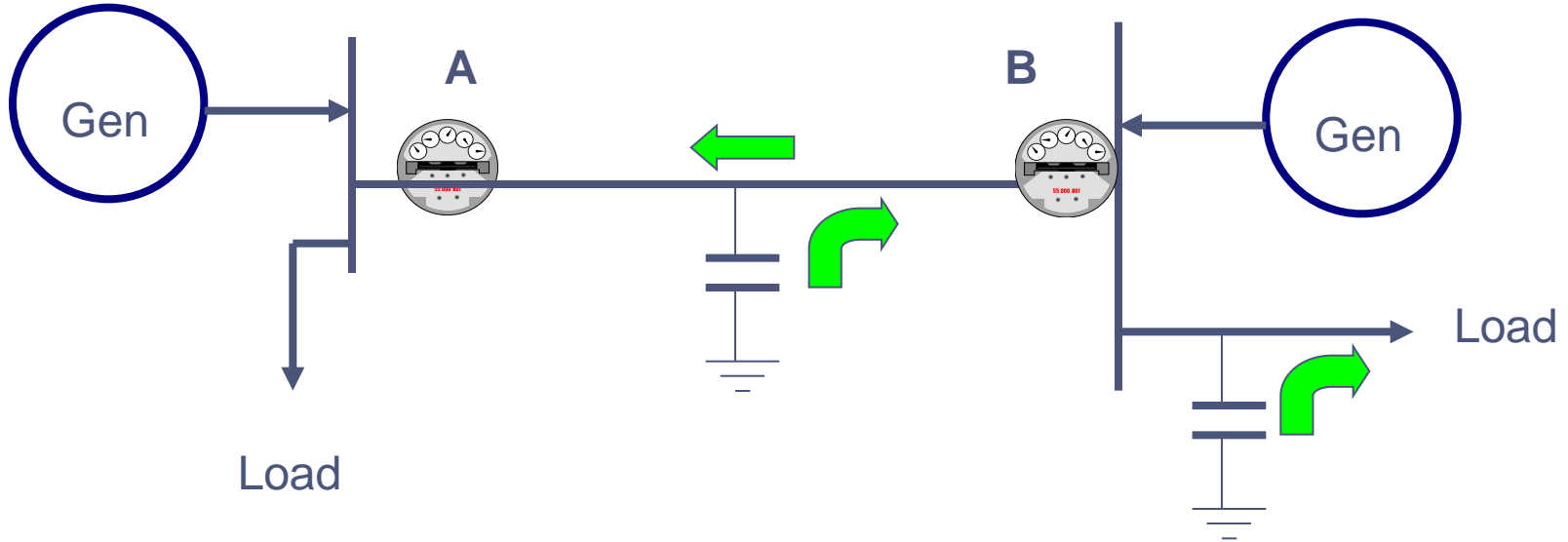


# Energy Flow conditions- case 1



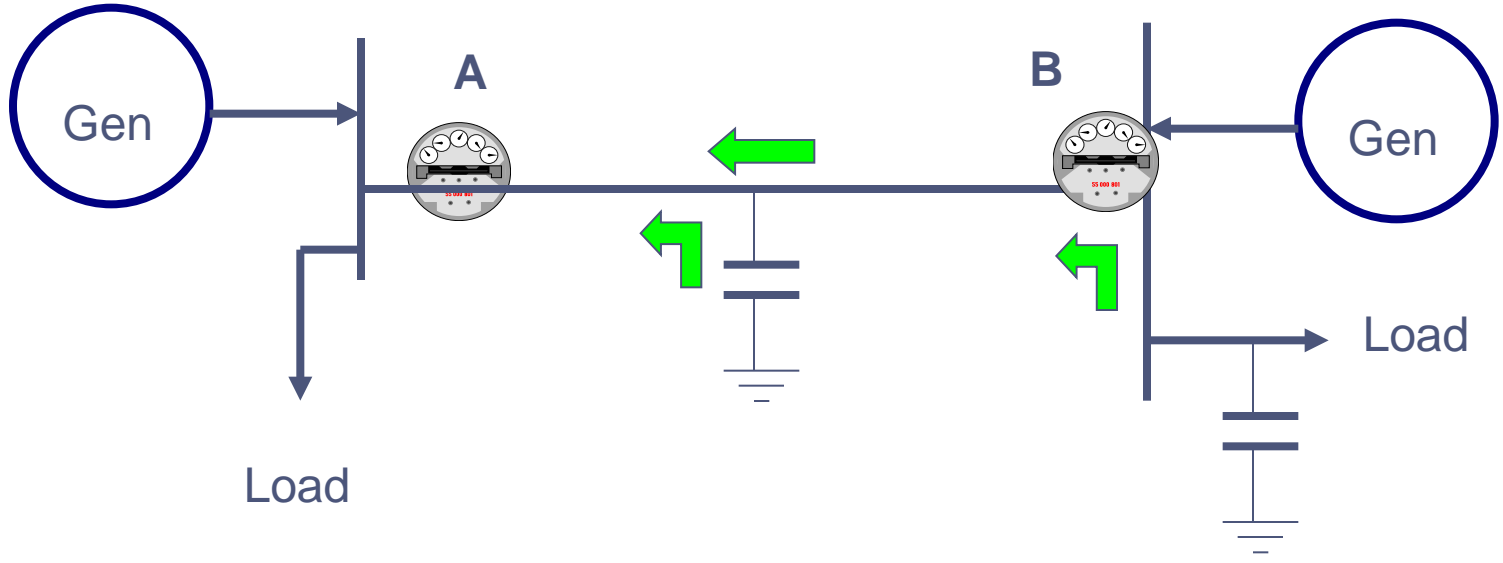
Q1: meter B    KW +, KVAR +

# Energy Flow conditions- case 2



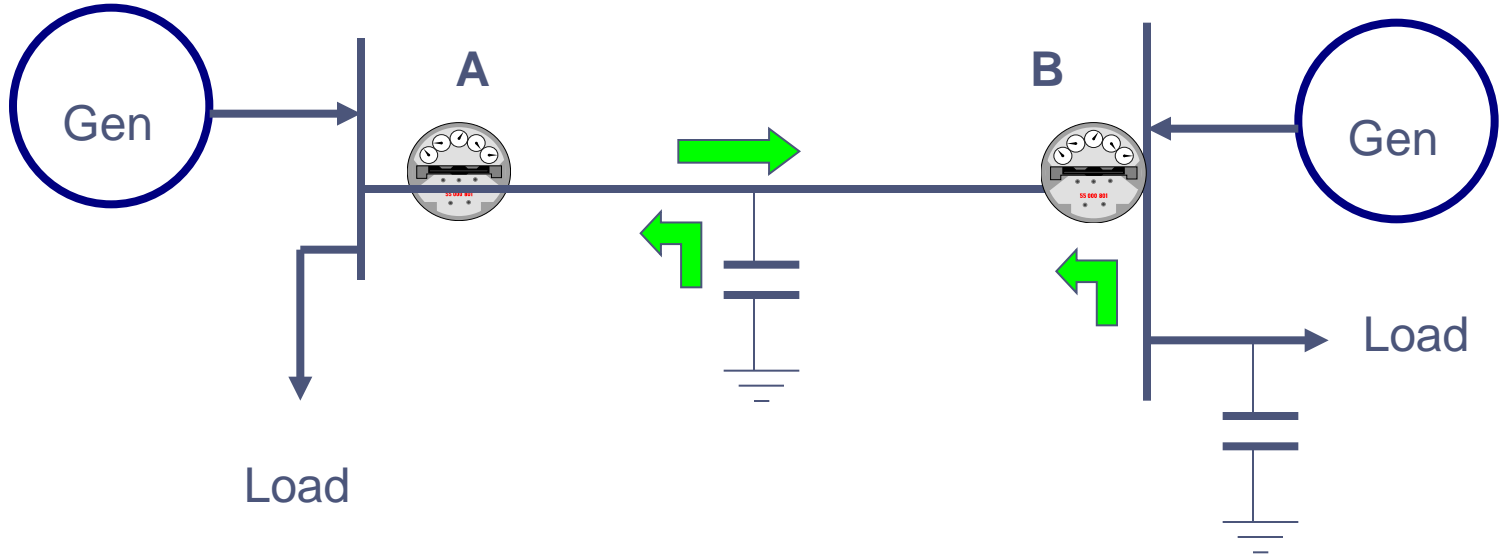
Q2: meter B KW -, KVAR +

# Energy Flow conditions- case 3



Q3: meter B KW -, KVAR -

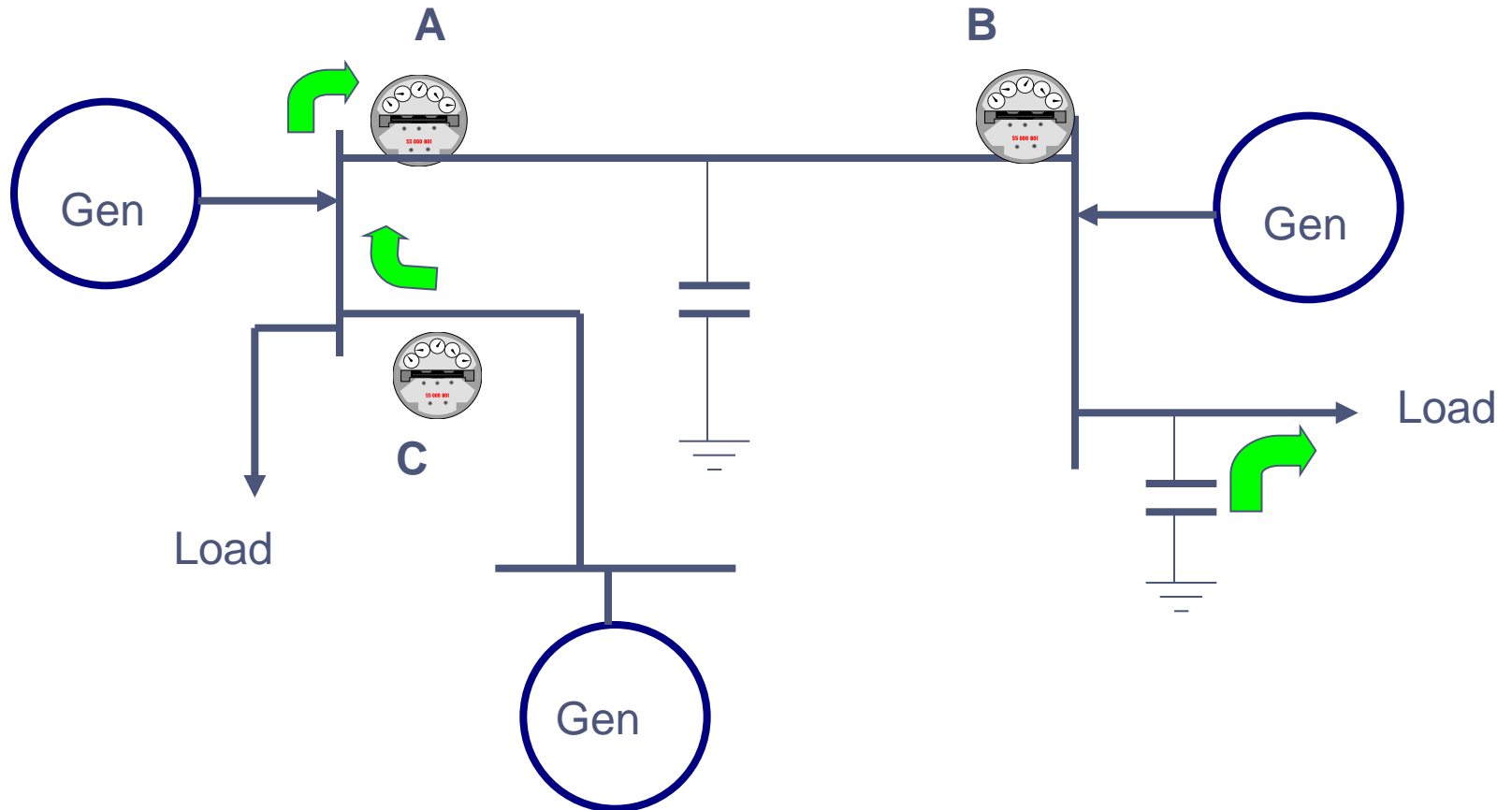
# Energy Flow conditions- case 4



Q4: meter B KW +, KVAR -



# Wheeling of Energy





**USAID**  
FROM THE AMERICAN PEOPLE

## Energy Registers

- Active energy register
  - Active Import
  - Active Export
- Reactive Energy register
  - Reactive import
  - Reactive export



**USAID**  
FROM THE AMERICAN PEOPLE

# Energy Registers

- Apparent energy register
  - Apparent Import
  - Apparent Export
  - Pythagoras Sum with Reactive energy
    - Lag only
    - lag+lead



## Metering errors

- CT/ PT ratio errors
- CT/PT phase error
- Connected burden, rating, connections errors
- Meter errors
  - Class 0.5 or Class 0.2 meter
- Dynamic compensation of external errors



- In electric power transmission, **wheeling** is a term used to describe either of the following:
  - the act of transporting electric power (megawatts or megavolt-amperes) over transmission lines, or;
  - the act of providing the service of transporting electric power over transmission lines.
- Tie line : A connection between systems, such as electrical power



**USAID**  
FROM THE AMERICAN PEOPLE

# Any Question?





**USAID**  
FROM THE AMERICAN PEOPLE

**THANK YOU!**