## **Energy efficiency measures** applicable in **Swiss industrial systems** and sectors





Jibran Zuberi & Martin Patel



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### Background



- > CO<sub>2</sub> levy in Switzerland  $\rightarrow$  12 CHF/t CO<sub>2</sub> in 2008 & 96 CHF/t CO<sub>2</sub> from 2018 (5 steps)
- > Target agreement mechanism
- $\rightarrow$  2% EE improvement p.a.
- $\rightarrow$  Reimbursement of CO<sub>2</sub> levy & KEV

 $\succ$  Qualified third parties for Universal Target Agreements ightarrow

 <u>Objective</u>: Techno-economic assessment of EE measures applicable in Swiss manufacturing industry (Energy Efficiency Cost Curves – EECC)





### Economic assessment of EE measures



$$C_{spec,y} = \frac{Annualized \ cost}{ES_y}$$

$$C_{spec,y} = \frac{ANF \times NPV_y}{ES_y}$$

where;

 $NPV_y = Net present value of measure y$  $ES_y = Electricity savings of measure y$ ANF = Annuity factor

$$NPV_{y} = \sum_{t=2015} CF_{t} \times (1+r)^{-t+2015}$$

where;

 $CF_t$  = Annual cash flow for the year t

$$CF_t = I_y + O\&M_y - B_y$$

where;

 $I_y$  = Initial investment (CHF) required to achieve the  $ES_y$ .

 $O&M_v = Operation and maintenance cost (CHF)$ 

 $B_y$  = Annual benefits of the measure (CHF), i.e. the annual electricity cost savings

$$ANF = \frac{(1+r)^L \times r}{(1+r)^L - 1}$$

where;

r = real discount rate taken as 10.5%

L = Lifetime of the measure



#### System-specific EE cost curves

17%

П

EIS

Motor systems →





| Rank                          | Measure clusters          | Final energy savings (% |  |  |
|-------------------------------|---------------------------|-------------------------|--|--|
|                               |                           | of total)               |  |  |
| Electric motor-driven systems |                           |                         |  |  |
| 1                             | Rest of the motor systems | 40%                     |  |  |
| 2                             | Pump systems              | 30%                     |  |  |
| 3                             | Fan systems               | 20%                     |  |  |
| 4                             | Compressed air systems    | 11%                     |  |  |
|                               | Total                     | 100%                    |  |  |



#### Sector-specific EE cost curves





Cumulative annual potential final energy savings (TJ)

|    | Rank                               | Measure clusters                           | Final energy savings<br>(% of total) |
|----|------------------------------------|--|--------------------------------------|
|    | Chemical and pharmaceutical sector |  |                                      |
|    | 1                                  | Process heat integration                   | 39%                                  |
|    | 2                                  | Motor systems                              | 36%                                  |
|    | 3                                  | Process-specific measures                  | 14%                                  |
|    | 4                                  | Process heat supply                        | 10%                                  |
|    |                                    | Total                                      | 100%                                 |
|    | Cement sector                      |  |                                      |
|    | 1                                  | Cement grinding (incl. cement<br>blending) | 53%                                  |
| 12 | 2                                  | Clinker production (heat)                  | 38%                                  |
|    | 3                                  | Process control                            | 5%                                   |
|    | 4                                  | Raw material preparation                   | 4%                                   |
|    |                                    | Total                                      | 100%                                 |



14% П S  $\mathbf{\uparrow}$ 

-25



Cumulative annual potential final energy savings (PJ p.a.)







# Thank you for your attention!

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