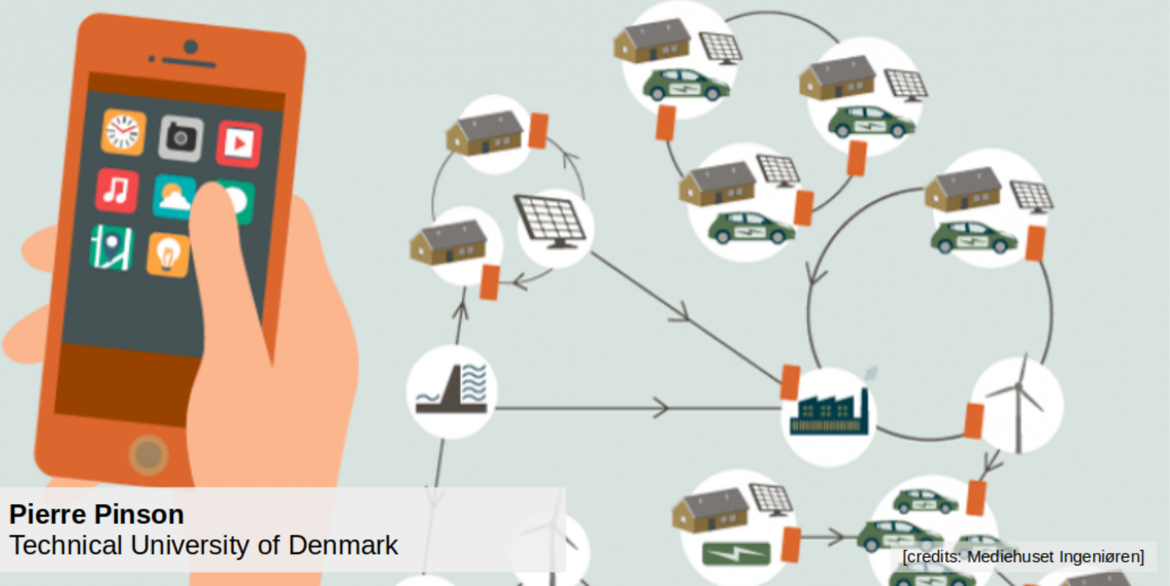
Module 3 – Intra-day and Balancing Markets

3.5 One-price vs. two-price settlement



[credits: Mediehuset Ingeniøren]

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The one-price imbalance settlement

Basic properties:

$\Delta P > 0$	$\Delta P \sim 0$	$\Delta P < 0$
$\lambda^B > \lambda^S$	$\lambda^B = \lambda^S$	$\lambda^B < \lambda^S$

Consequences on settlement for those dispatched through the day-ahead market:

- $\Delta P > 0$:
  - Generator i producing less than scheduled must buy $\hat{y}_i^G - y_i^G$ at price λ^B
  - Demand j consuming more than scheduled must buy $\hat{y}_j^D - y_j^D$ at price λ^B
  - Generator i producing more than scheduled must sell $y_i^G - \hat{y}_i^G$ at price λ^B
  - Demand j consuming less than scheduled must sell $y_j^D - \hat{y}_j^D$ at price λ^B
- $\Delta P < 0$: ... basically, the same type of reasoning
- Meanwhile, balancing generators simply sell or buy at price λ^B

Example case 1: Outage of G_5

"Even though scheduled, the unit G_5 of KøbenhavnCHP will be down during that hour, and the operator could not get a match in the intra-day market..."

- All others are producing and consuming as planned.

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- For the **balancing auction**, one has:
  - $\Delta P = 60$ MWh (since demand is higher than generation by 60 MWh for that hour)
  - $\lambda^B = 45$ €/MWh
  - Scheduled balancing generators: B_1 and B_2 (only 30 MWh upward)

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  - G_5 paying $60 \times 45 = 2700$ €
  - $B_1(/G_3)$ and B_2 each receiving $30 \times 45 = 1350$ €

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- Considering **both day-ahead and balancing** stages:
  - G_5 receives $60 \times 37.5 = 2250$ €, and has to pay $60 \times 45 = 2700$ €... That is a loss of 450 €(!)
  - B_1 $(/G_3)$ receives $200 \times 37.5 = 7500$ € (day-ahead) and $30 \times 45 = 1350$ € at the balancing stage

Example case 2: Wind forecast errors

"For both wind farms G_1 and G_2 (operated by $\mathrm{RT}^{\circledR}$ and WeTrustInWind), the actual generation is not equal to that foreseen when clearing the day-ahead market, i.e."

- for G_1: $\hat{y}_1^G = 50$ MWh but actual generation is $y_1^G = 30$ MWh
- for G_2: $\hat{y}_2^G = 120$ MWh but actual generation is $y_2^G = 155$ MWh

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- For the **balancing auction**, one has:
  - $\Delta P = -15$ MWh (since generation is higher that demand by 15 MWh for that hour)
  - $\lambda^B = 35$ €/MWh
  - Scheduled balancing generators: B_1 (only 15 MWh downward)

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- The **settlement** leads to:
  - G_1 paying $20 \times 35 = 700$ €
  - G_2 receiving $35 \times 35 = 1225$ €
  - B_1 paying $15 \times 35 = 525$ €

- Considering **both day-ahead and balancing** stages:
  - G_1 receives $50 \times 37.5 = 1875$ €, then pays $20 \times 35 = 700$ € - Gives 1175 €
  - G_2 receives $120 \times 37.5 = 4500$ €, then receives again $35 \times 35 = 1225$ € - Gives 5775 €
  - B_1 ($/G_3$) receives $200 \times 37.5 = 7500$ €, then pays $15 \times 35 = 525$ € - Gives 7175 €

Comments on the one-price balancing markets

- The total payment/revenue of day-ahead market participants for deviations from schedule equals the revenue/payment of the balancing generators
- Regarding deviations:
  - if one's own deviation contributes to setting the system off-balance (e.g., generator overproduce while there is too much power overall), **this leads to a loss**
  - but...
  - if one's own deviation is of the *helping the system go back to balance* (e.g., generator overproduce while there is a lack of power overall), **this leads to extra profit(!)**
- *What could be the consequences?*
- *And, how could we fix that?*

The two-price imbalance settlement

Basic properties: (well, the same for market clearing)

$\Delta P > 0$	$\Delta P \sim 0$	$\Delta P < 0$
$\lambda^B > \lambda^S$	$\lambda^B = \lambda^S$	$\lambda^B < \lambda^S$

Settlement is rethought:
$\rightarrow$ those putting the system off-balance are to be penalized
$\rightarrow$ those supporting the system (unintentionally) will not get extra rewards

- $\Delta P > 0$:
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- $\Delta P < 0$: ... basically, the opposite type of reasoning
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  - Scheduled balancing generators: B_1 (only 15 MWh downward)
- The **settlement** leads to:
  - G_1 paying $20 \times 37.5 = 750$ € (instead of 700 € in the one-price case)
  - G_2 receiving $35 \times 35 = 1225$ €
  - $B_1(/G_3)$ paying $15 \times 35 = 525$ €
- Considering **both day-ahead and balancing** stages:
  - G_1 receives $50 \times 37.5 = 1875$ €, then pays $20 \times 37.5 = 750$ € - Gives 1050 €
  - G_2 receives $120 \times 37.5 = 4500$ €, then receives again $35 \times 35 = 1225$ € - Gives 5775 €
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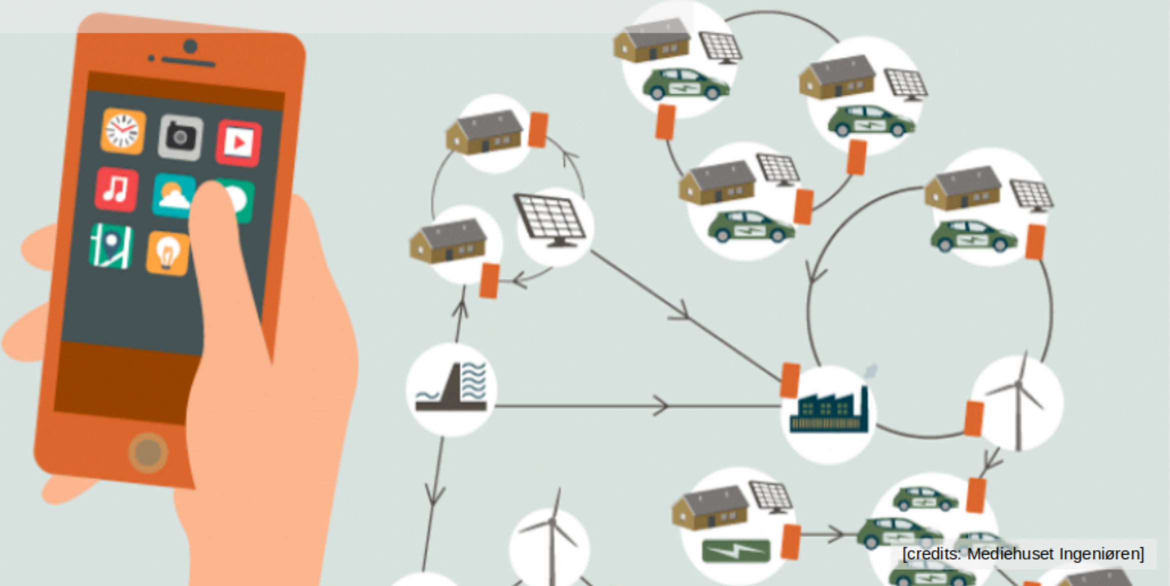
Use the self-assessment quizz to check your understanding!



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