

KEY PERFORMANCE INDICATORS OF CHARGING INFRASTRUCTURE

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CREATING TOMORROW



URBAN TECHNOLOGY RESEARCH PROGRAM

CONTRIBUTING TO A SUSTAINABLE, LIVEABLE & CONNECTED CITY



Urban Technology:

- Faculty of Technology
- Applied research
- Research Themes: Energy, circular economy, smart mobility, urban design
- 45FTE research staff
- 4000 students

E-mobility research (10FTE)

1. Data analysis of charging infrastructure
2. Infrastructure analysis for segments:
 - taxis, buses, boats, city logistics
3. Energy modelling: EVs in smart grids
4. Value analysis of buffer batteries

PERFORMANCE OF CHARGING INFRASTRUCTURE

Current status:

- Worldwide development of (extensive) public charging infrastructures for EVs
- Responsibility of municipalities for roll out & utilization
- Basic data analysis on charging infrastructure

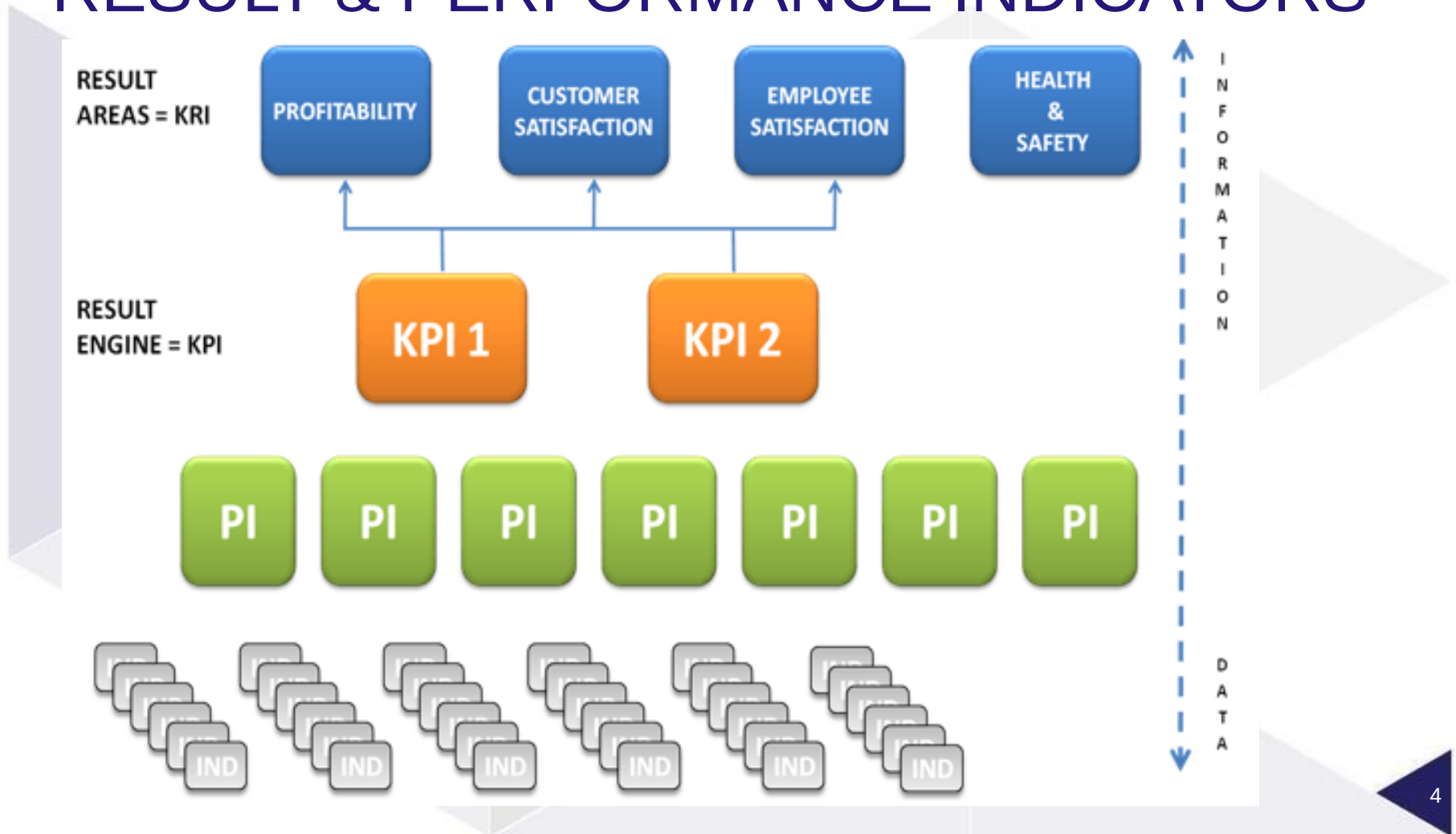
Challenge: *What defines a 'well performing' charging infrastructure?*

- Which type of results to achieve?
- How to monitor which metrics?
- What interventions can we take?

Approach

- Applying notions from performance mgt: Result & Performance indicators.
- Focus on municipalities

RESULT & PERFORMANCE INDICATORS



RESULT & PERFORMANCE INDICATORS

Result indicators

- Looking back / in hindsight: How an organization has performed
- Based on aggregation of data – result on many actions
- They do not tell you what to do
- Most common: profitability, customer satisfaction, ROI

Performance indicators:

- Forward looking: Provides guidance to possible interventions
- Based on more practical metrics - detailed
- They tell you what to do / directly linked to strategy
- Typical: profitability of top 10% customers, margin on product X

STAKEHOLDERS POLICY MAKERS

Stakeholders steer which results are to be achieved:

1. Municipality itself (own political arena)
2. EV users
3. Residents
4. Charge point operators
5. Grid operators

STAKEHOLDERS AND OBJECTIVES

Stakeholder	Concern / Objective:	Result indicators
Municipality	1 Achieve sustainability goals in a cost-effective way	Air quality improvements Climate change improvements Achieved cost effectiveness

TOWARDS PERFORMANCE INDICATORS & INTERVENTIONS [1]

Goals	Result indicators	Performance indicators	Possible interventions
1 Achieve sustainability goals in a cost-effective way	- Air quality - CO₂ emission - Costs for mitigated emissions	ΣkWh charged ΣkWh / charging station	- Add charging stations - Purchase subsidy - Incentives for re-parking - Incentivize larger charge sessions
2 Stimulate electric mobility	- Accessibility of CI #users of CI	% Accessibility #frequent users/station % long chargers - Charge time ratio	- Adding capacity - Tariff structures - Incentives for freq. users - Incentives to reduce long parking
3 Optimize utilization of CI and manage public concerns	Level of utilization CI.	% capacity utilization (@peak & location) % of low utilized stations	- Stimulate other charging profiles (sharing, taxis) - Allow regular parking during off-peak hours

- kWh and air quality loosely related (#km driven within city limits)
- Option: # local emissions at polluted areas

TOWARDS PERFORMANCE INDICATORS & INTERVENTIONS [2]

Goals	Result indicators	Performance indicators	Possible interventions
1 Achieve sustainability goals in a cost-effective way	- Air quality - CO₂ emission - Costs for mitigated emissions	ΣkWh charged ΣkWh / charging station	- Add charging stations - Purchase subsidy - Incentives for re-parking - Incentivize larger charge sessions
2 Stimulate electric mobility	- Accessibility of CI #users of CI	% Accessibility #frequent users/station % long chargers - Charge time ratio	- Adding capacity - Tariff structures - Incentives for freq. users - Incentives to reduce long parking
3 Optimize utilization of CI and manage public concerns	Level of utilization CI.	% capacity utilization (@peak & location) % of low utilized stations	- Stimulate other charging profiles (sharing, taxis) - Allow regular parking during off-peak hours

- Users: discern in **frequent users** (residents/commuters) and **occasional users** (visitors)
- Accessibility at peak times in particular neighborhoods

TOWARDS PERFORMANCE INDICATORS & INTERVENTIONS [3]

Goals	Result indicators	Performance indicators	Possible interventions
1 Achieve sustainability goals in a cost-effective way	- Air quality - CO₂ emission - Costs for mitigated emissions	ΣkWh charged ΣkWh / charging station	- Add charging stations - Purchase subsidy - Incentives for re-parking - Incentivize larger charge sessions
2 Stimulate electric mobility	- Accessibility of CI #users of CI	% Accessibility #frequent users/station % long chargers - Charge time ratio	- Adding capacity - Tariff structures - Incentives for freq. users - Incentives to reduce long parking
3 Optimize utilization of CI and manage public concerns	Level of utilization CI.	% capacity utilization (@peak & location) % of low utilized stations	- Stimulate other charging profiles (sharing, taxis) - Allow regular parking during off-peak hours

- % capacity utilization per neighborhood and/or on hourly basis

TOWARDS PERFORMANCE INDICATORS & INTERVENTIONS [4]

Goals	Result indicators	Performance indicators	Possible interventions
4 Facilitate a positive business case	- Costs decreased - Benefits increased - Over-capacity reduced	- Costs/benefits-ratio % of charging points with positive BC $\sum \text{kWh charged} / \sum \text{potential kWh charged}$	- Lower grid costs (e.g. change in capacity, satellite–hub systems). - Reduce energy taxes / parking tariffs - Enabling income streams (e.g. hourly/starting tariffs).
5 Safeguard grid quality	Reduced risk of power outage.	- Peak power level - Peak shaving potential % charging points with smart charging capability	- Enable delayed charging. - Enable different flexible power capacities. - Create incentives for smart charging.

- Facilitating more income may be in conflict with objective to stimulate e-mobility (lowering barriers with low energy prices)

TOWARDS PERFORMANCE INDICATORS & INTERVENTIONS [5]

Goals	Result indicators	Performance indicators	Possible interventions
4 Facilitate a positive business case	- Costs decreased - Benefits increased - Over-capacity reduced	- Costs/benefits-ratio % of charging points with positive BC $\sum \text{kWh charged} / \sum \text{potential kWh charged}$	- Lower grid costs (e.g. change in capacity, satellite–hub systems). - Reduce energy taxes / parking tariffs - Enabling income streams (e.g. hourly/starting tariffs).
5 Safeguard grid quality	Reduced risk of power outage.	- Peak power level - Peak shaving potential % charging points with smart charging capability	- Enable delayed charging. - Enable different flexible power capacities. - Create incentives for smart charging.

- Span of control limited for policy makers– more facilitating

CONCLUSIONS

Result and performance indicators can support:

- Translating complex environment into a structured set of KRIs
- Providing overview of most relevant performance indicators to track
- Facilitating evaluation effectiveness of policy

Recommendations

- Further develop and quantify KPIs
- Apply for other stakeholders in the EV chain

and now... for the cool graphs !!