DATAWEEK

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Real-World Digital Twin Use Case Demonstration

ORGANISED BY BDV BIG DATA VALUE ASSOCIATION

SUPPORTED BY The Research Council of Norway

IN COLLABORATION WITH IFE NTNU SINTEF WESTERN NORWAY RESEARCH INSTITUTE VESTLANDSFORSKING

1. Introduction

Research for

Data-driven decision system Components [1]

Key-words :

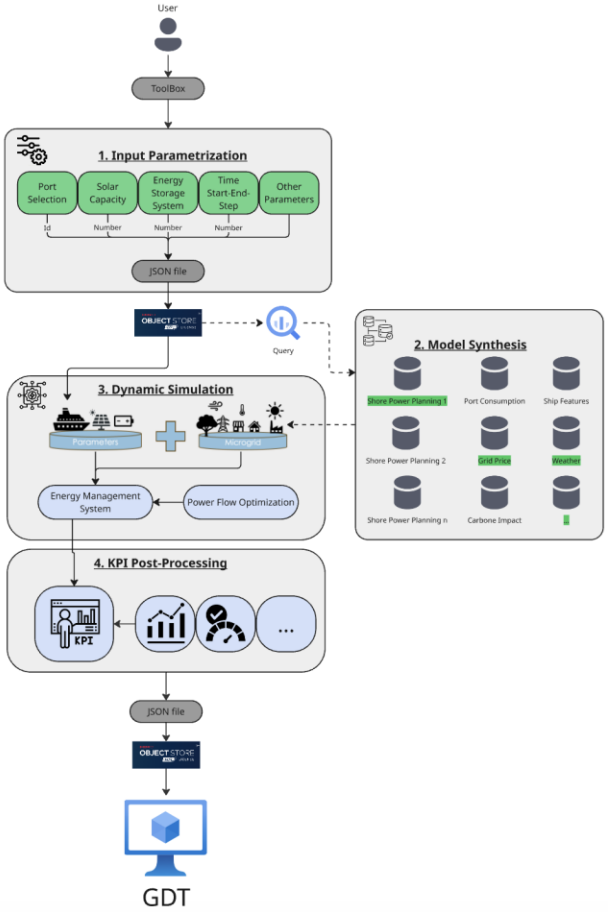
- Optimization and AI [1, 3]
- Long-term forecasts to reducing CO2 emissions. [2]
- Maximize renewable energy penetration rate.[2]
- Cold ironing as shore electricity supply

Norway NO, Use Case

Cape Verde CV, Use Case

2. Framework Overview

1. Input Parametrization
2. Model Synthesis
3. Dynamic Simulation
4. KPI Post-Processing



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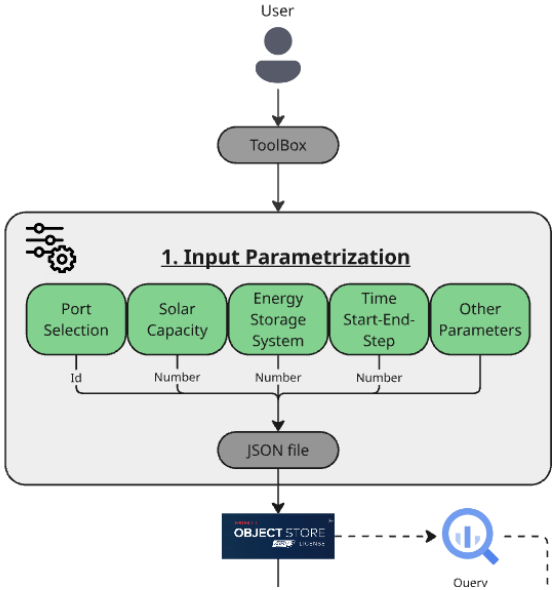
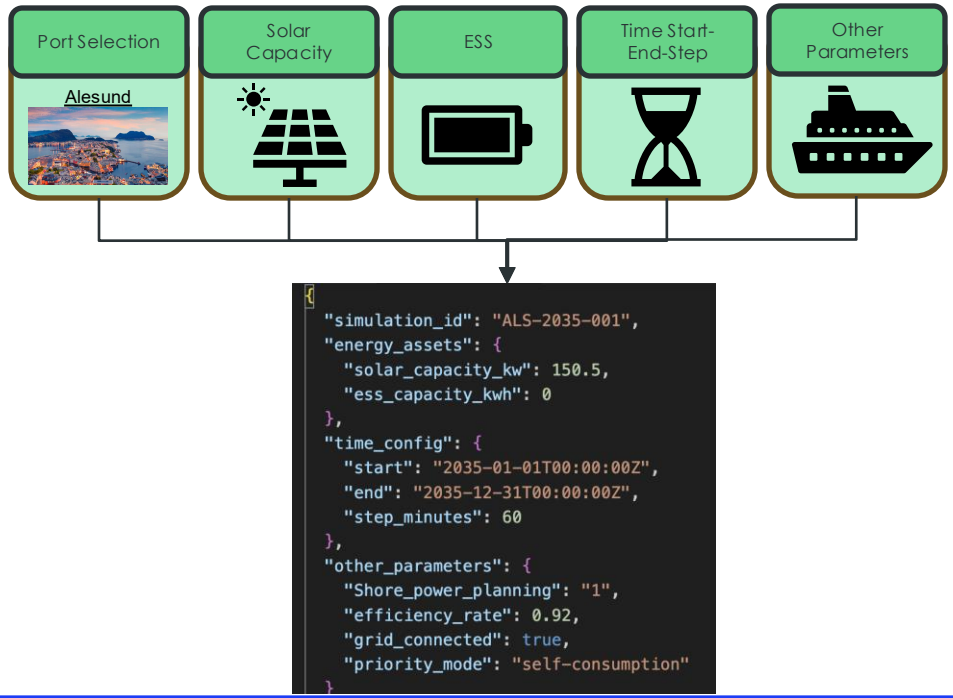


Example



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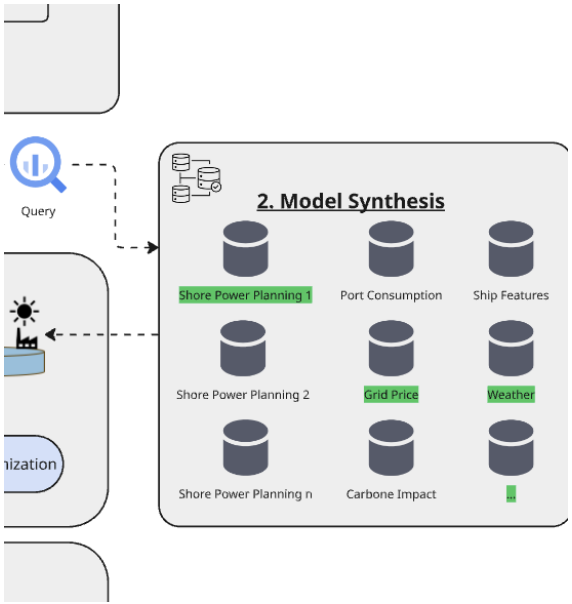
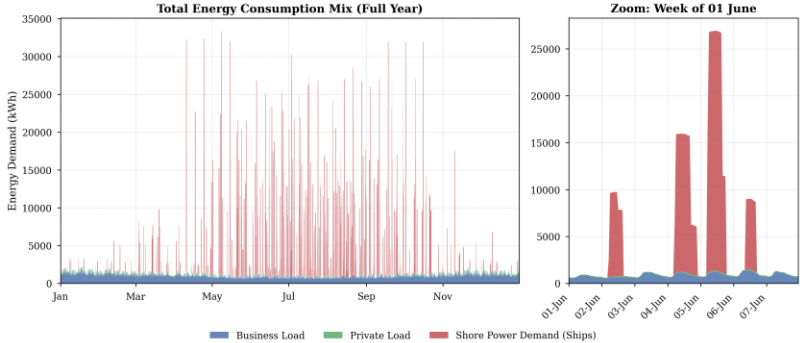
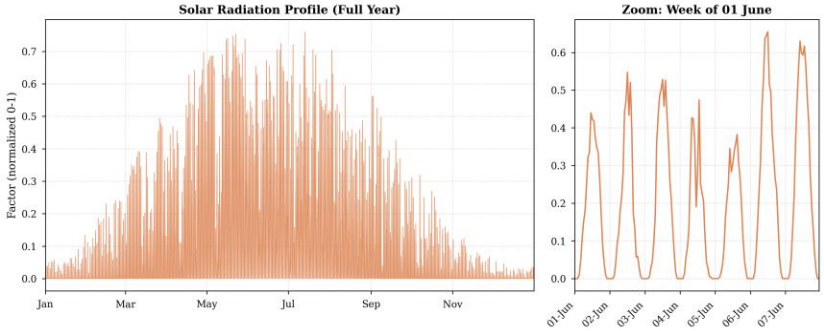


Shore Power Planning 1ample



Weather



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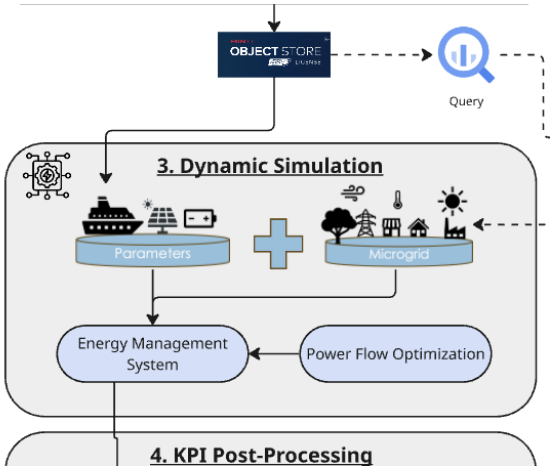

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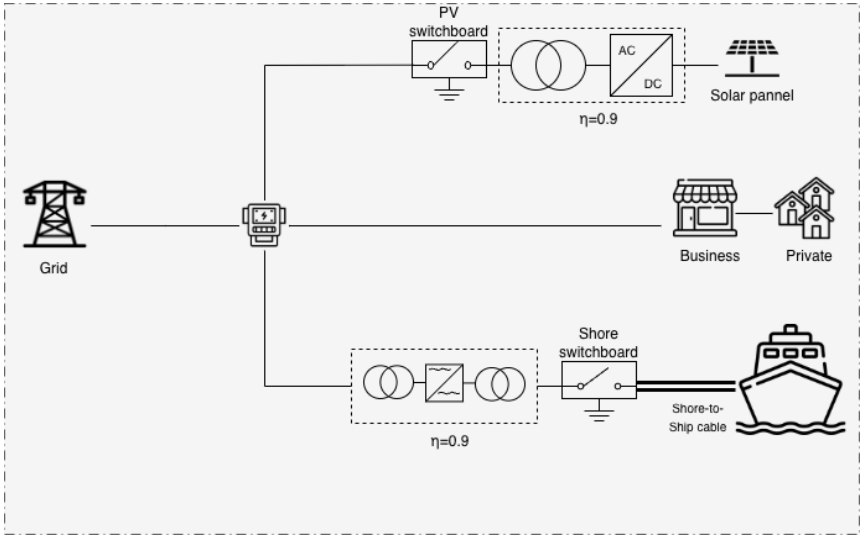

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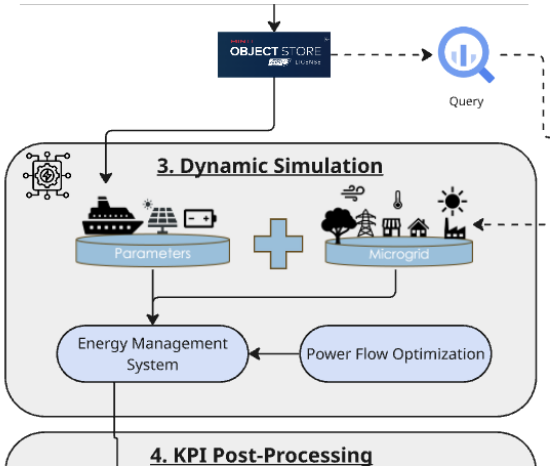

Example

$$\min \sum_{t \in \mathcal{T}} \left(C_t^{\text{grid}} \cdot p_t^{\text{grid}} + C_t^{\text{solar}} \cdot p_t^{\text{solar}} \right) \tag{19}$$

Subject to : *Nodal Balance*

$$p_t^{\text{grid}} = f_{\text{grid}\to business,t} + f_{\text{grid}\to private,t} + f_{\text{grid}\to ship,t} \qquad \forall t \in \mathcal{T} \tag{20}$$

$$p_t^{\text{solar}} = f_{\text{solar}\to business,t} + f_{\text{solar}\to private,t} + f_{\text{solar}\to ship,t} \qquad \forall t \in \mathcal{T} \tag{21}$$

Demand Satisfaction (Load Buses) :

$$D_{business,t} = \eta_{\text{grid}\to business} \cdot f_{\text{grid}\to business,t} + \eta_{\text{solar}\to business} \cdot f_{\text{solar}\to business,t} \forall t \in \mathcal{T} \tag{22}$$

$$D_{private,t} = \eta_{\text{grid}\to private} \cdot f_{\text{grid}\to private,t} + \eta_{\text{solar}\to private} \cdot f_{\text{solar}\to private,t} \forall t \in \mathcal{T} \tag{23}$$

$$D_{ship,t} = \eta_{\text{grid}\to ship} \cdot f_{\text{grid}\to ship,t} + \eta_{\text{solar}\to ship} \cdot f_{\text{solar}\to ship,t} \forall t \in \mathcal{T} \tag{24}$$

Solar Generation Constraints :

$$0 \le p_t^{\text{solar}} \le P_{\text{solar}}^{\text{nom}} \cdot \phi_t \quad \forall t \in \mathcal{T} \tag{25}$$

Non-negativity Constraints :

$$p_t^{\text{grid}} \ge 0, \quad f_{\text{grid}\to k,t} \ge 0, \quad f_{\text{solar}\to k,t} \ge 0 \quad \forall k \in \{\text{ship}, \text{private}, \text{business}\}, \forall t \in \mathcal{T} \tag{26}$$

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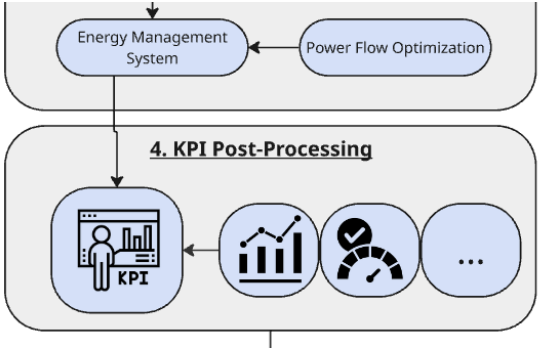

Example

Bubble quadrant chart

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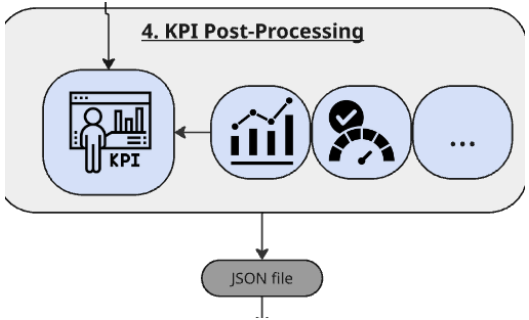

Example

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  "metadata": {
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    "y_axis": "Solar Score",
    "bubble_size": "Total MWh Consumed"
  },
  "data": [
    { "label": "ARTANIA", "x": 106.91, "y": 0.181, "z": 208846 },
    { "label": "STOCKHOLM", "x": 12.36, "y": 0.047, "z": 52767 },
    { "label": "BALMORAL", "x": 91.13, "y": 0.223, "z": 1932172 },
    { "label": "AMBIENCE", "x": 245.91, "y": 0.231, "z": 586341 },
    { "label": "AMERA", "x": 96.17, "y": 0.171, "z": 266183 },
    { "label": "STAR PRIDE", "x": 10.73, "y": 0.397, "z": 14148 }
  ]
}
```

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THANK YOU