AN EVALUATION OF BUILDING INTEGRATED WIND ENERGY

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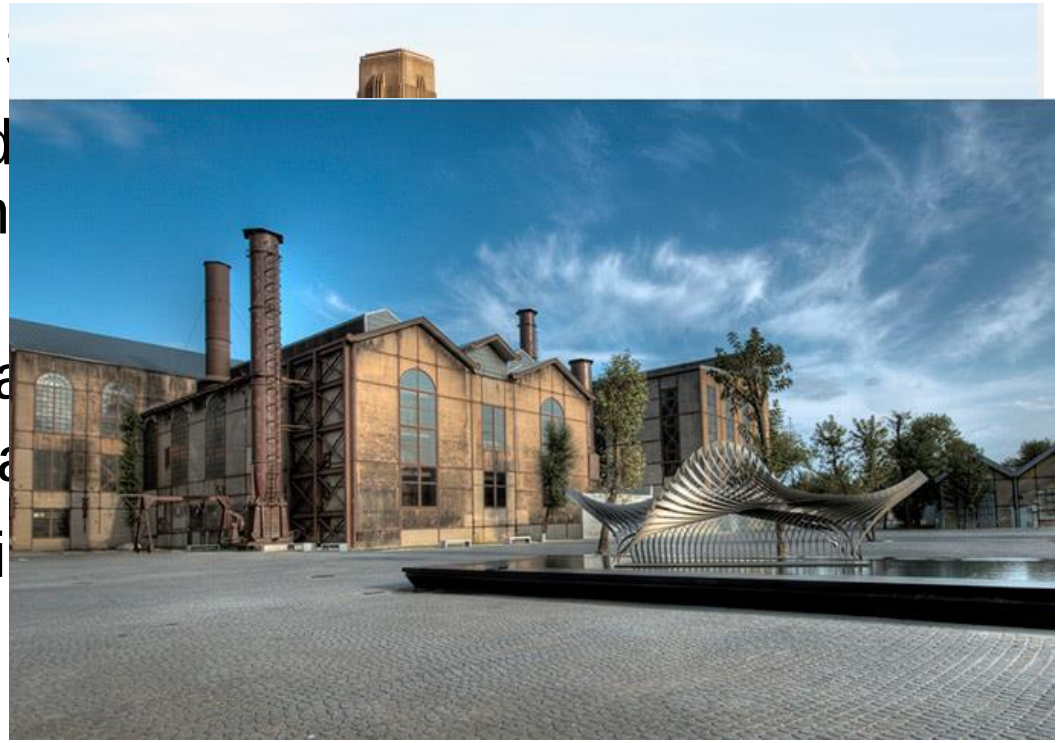
Global Alliance for Buildings and Construction

Outline

- Changes in Power Generation Strategy
- Microgeneration of Power
- Criticism of Building Integrated Wind Turbines
- Proposal: Nano-generation via Re-generative Methods
- Discussion

Changes in Power Generation Strategy

- Early power stations were local
  - Bankside Power Station – London
  - Silahtarağa Power
- Increasing demand led
  closer to sources of en
  - Coal mine regions
  - Hydro/wind potentia
  - Nuclear – strategica
- Distant power generati



Microgeneration of Power

- Early power generation examples: microgeneration
  - Small communities (neighbourhoods, rural)
- Proliferation of power grid: downfall of microgeneration
- New power generation technologies: microgeneration
  - Solar (Photovoltaics)
  - Wind
  - Co-gen / Tri-gen (Fossil fuels)
- Benefits of higher efficiencies, lack of grid loss, reduced CO_2 emissions

Building Integrated Wind Turbines

- Wind energy in urban settings: an enigma
- Large turbines on buildings are problematic
  - Vibration and noise
  - Structural loads
  - User complaints
  - Under-performance
  - Technical Problems

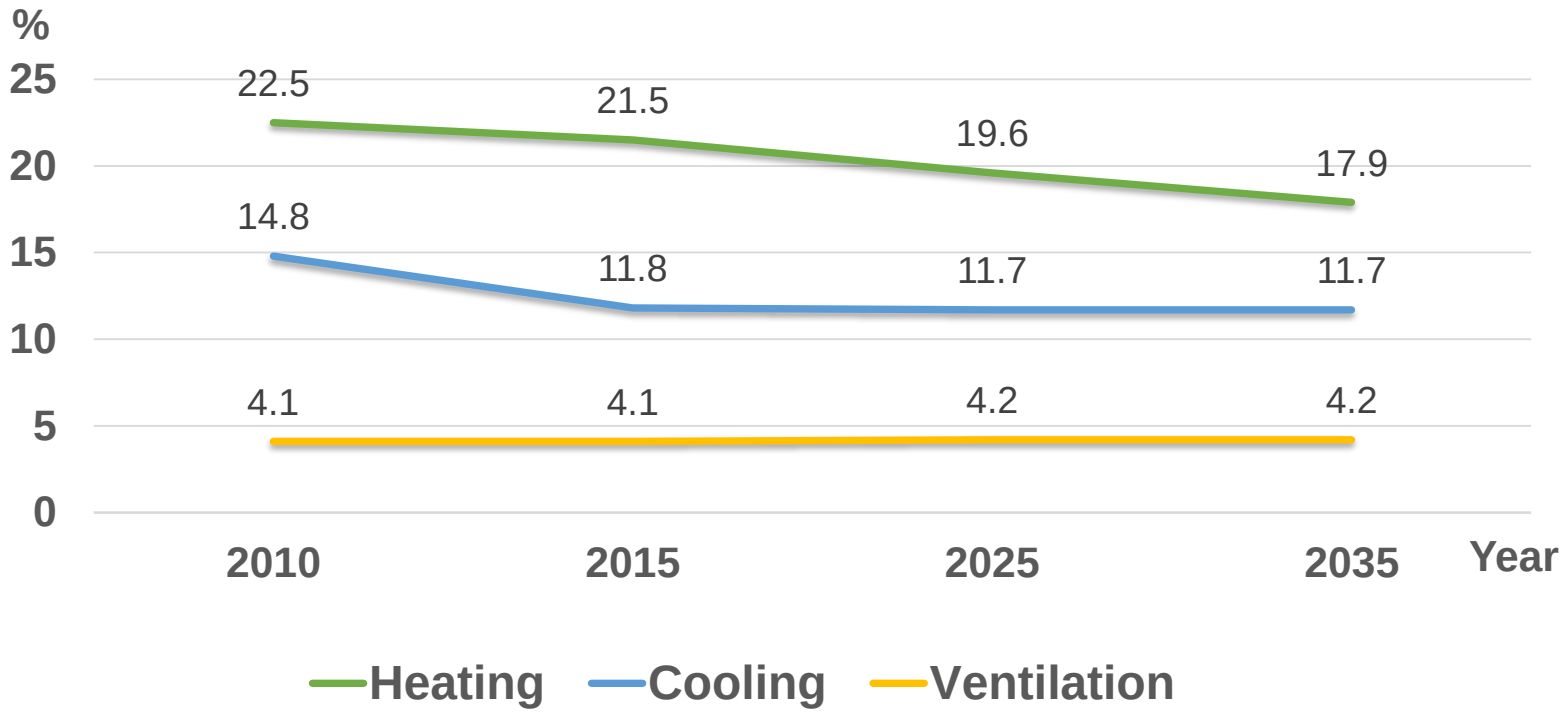
  (Peacock, A., *et al*. 2008; Mithraratne, N. 2009; James, P., *et al*. 2010)

Strata Tower, London

Building Integrated Wind Turbines

- The wind patterns around buildings are not predictable
- Urban patterns are temporal, can change quickly
- High rise building façades are washed with chaotic, turbulent up-winds
- Vertical axis turbines for rooftops were proposed, but not working
- **A sea-change in the integration of wind turbines to building façades is proposed**
- Inspiration: regenerative braking
- Nano-generation: integration of numerous small wind-turbines doubling as ventilation devices

Energy Load of Building Ventilation

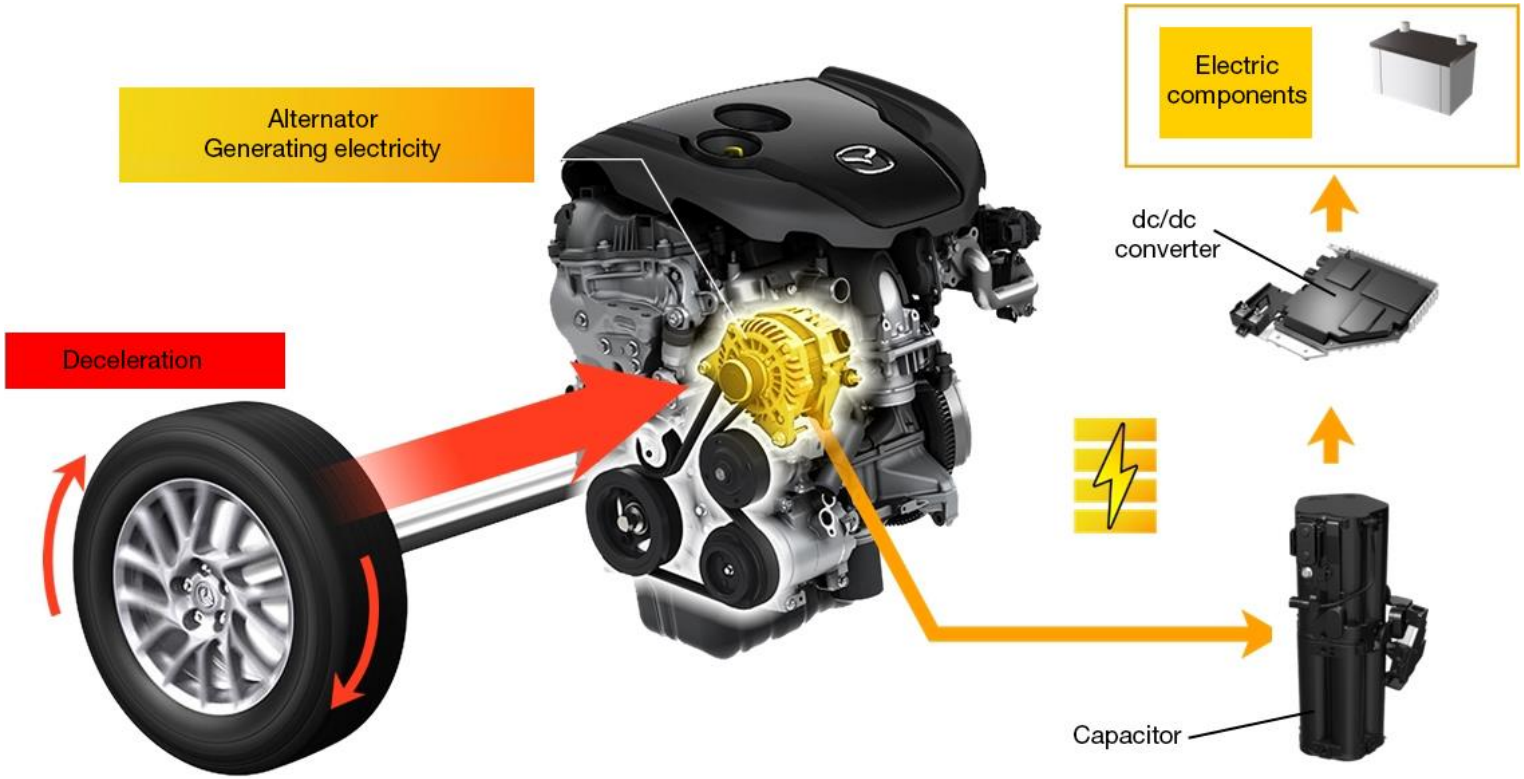


Projection of Building Services Energy Loads – Data from DOE (2012)

Regenerative Braking Analogy: Nano-generation

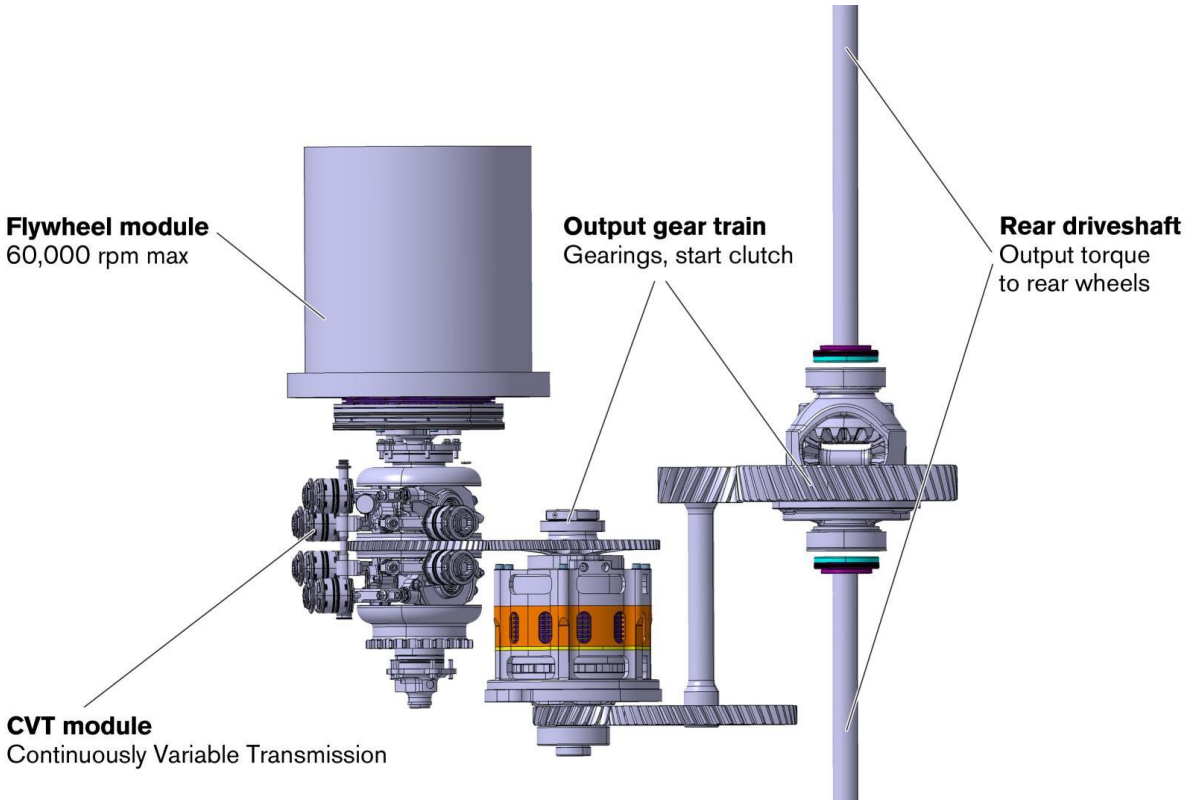
- Electric, hybrid, and petrol vehicles utilize energy saving regenerative brakes to save energy
- These systems generally use the same device for both locomotion and power generation (braking)
- We can distribute many small aerofoils across the building façade to provide both ventilation and power generation as needed
- A distributed network of such a system can theoretically reduce the overall energy load of building ventilation in time, and also blend with architecture

Regenerative Braking Analogy: Nano-generation



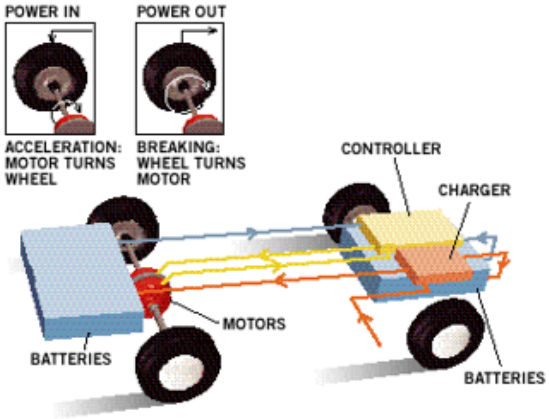
Super capacitor integrated automotive regenerative braking system overview (Weissler, 2013)

Regenerative Braking Analogy: Nano-generation

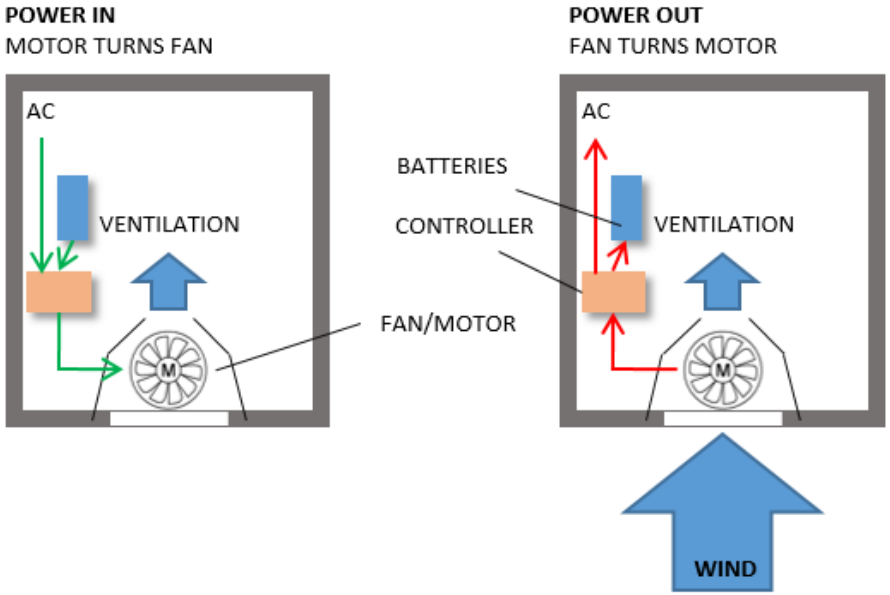


Flywheel based regenerative braking system KERS (Volvo Car Group, 2013)

Regenerative Braking Analogy: Nano-generation

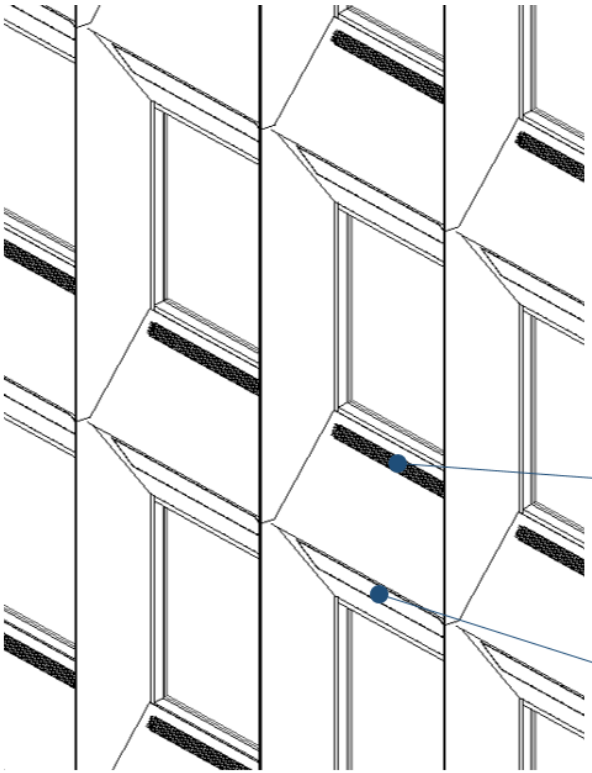


REGENERATIVE BRAKING



REGENERATIVE VENTILATION

Proposal: Nano-generation

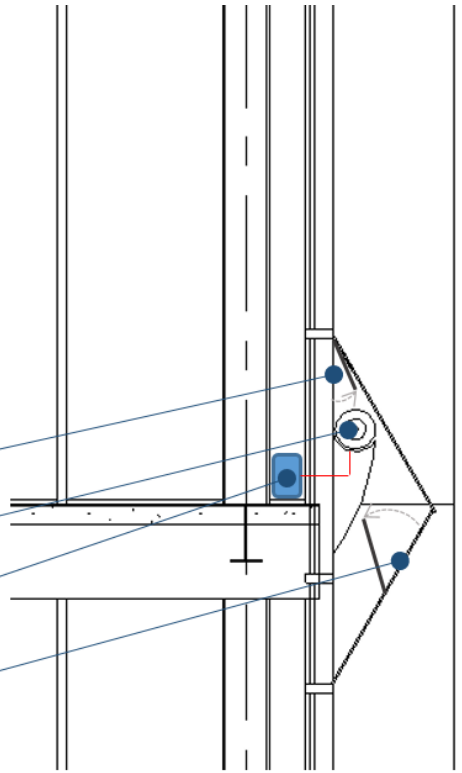


BYPASS OUTLET

MOTOR & FAN

STORAGE DEVICE

VENTILATION INLET

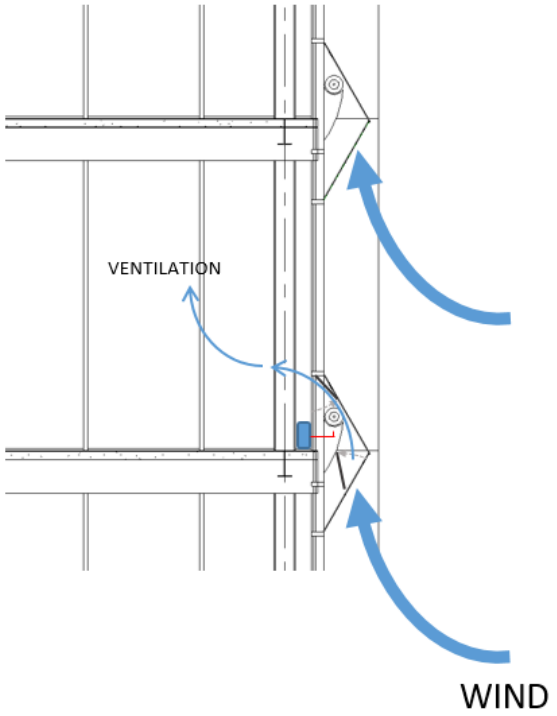


PARTIAL ISOMETRIC VIEW

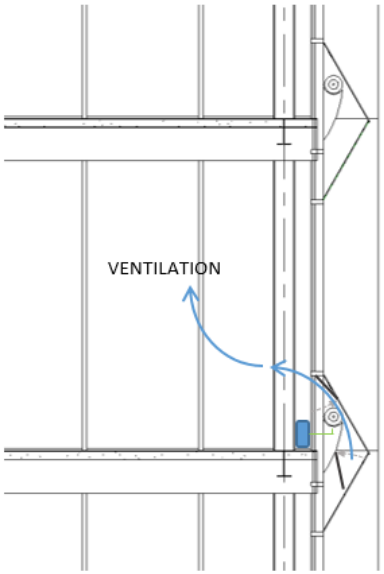
PARTIAL SECTION VIEW

Proposal: Nano-generation

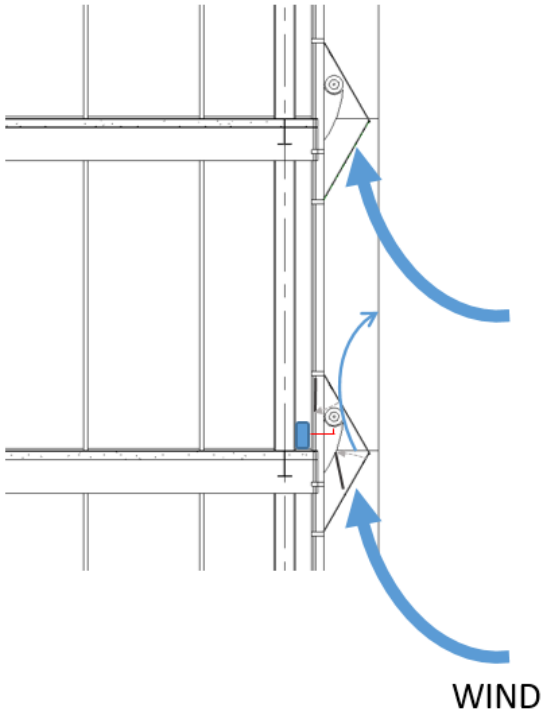
POWER OUT
VENTILATON ON
ENERGY GENERATED



POWER IN
VENTILATON ON
ENERGY USED



POWER OUT
VENTILATON OFF
ENERGY GENERATED



Discussion

- An exploratory study, currently looking for funding
- Next steps:
  - Extensive literature review on stack effect and wind across building surfaces
  - Investigation of the economy and efficiency of low voltage, low speed nano-turbines
  - Consideration of the impact of pollution and air quality for the intakes
  - Utilization of parametric design tools for the creation of a building façade foil design
  - Empirical studies for collection of building façade wind data
  - Simulation of the proposal with CFD

References

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Thank you

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