



**WORLD
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APPLIED ENERGY
SYMPOSIUM & FORUM

From numerical modeling to computational intelligence: The digital transition of urban energy system



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Proposal for a CREATE Interdisciplinary Research Group (IRG)



1. Background

- **City and data – urban informatics**

2. Numerical model for urban energy system

- What is currently over there?

3. From numerical models to computation intelligence

- How wealth of data can help us better understand and run our cities?

4. Future perspectives and conclusions

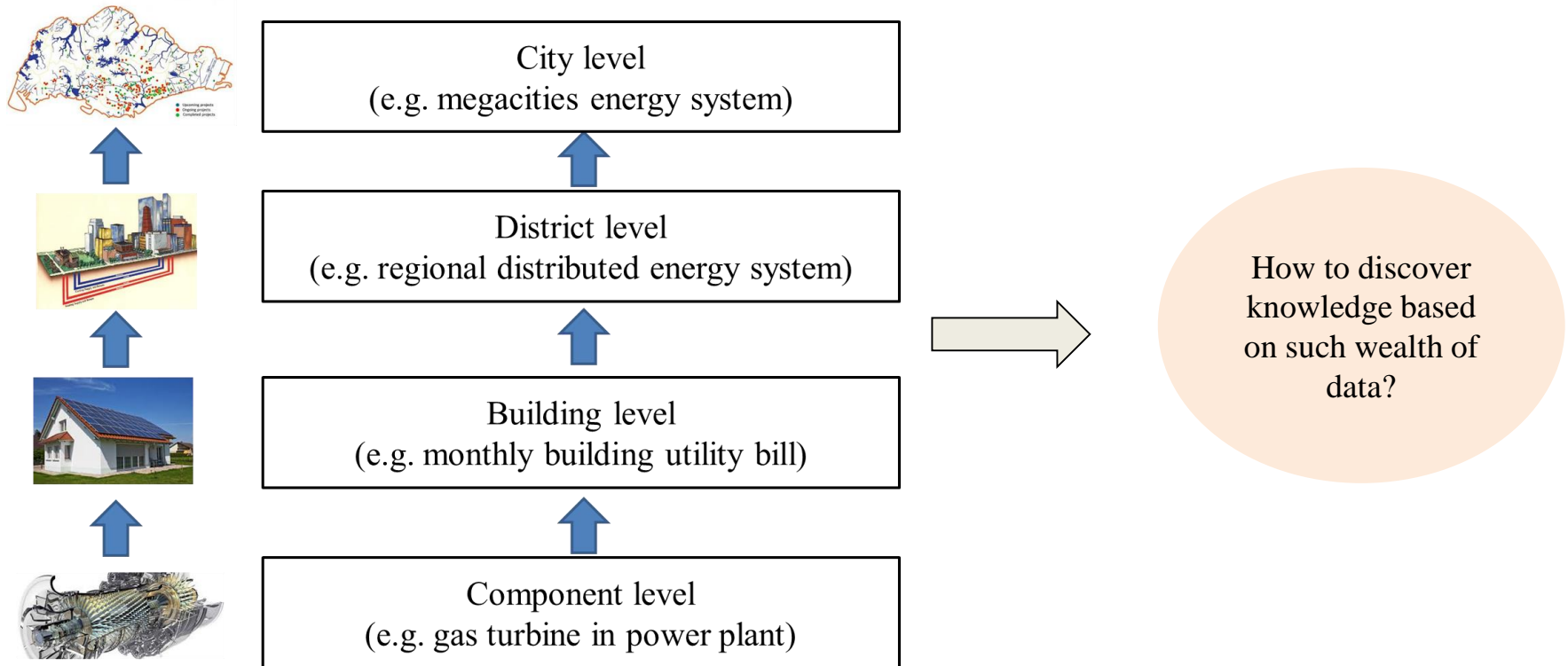
City and data



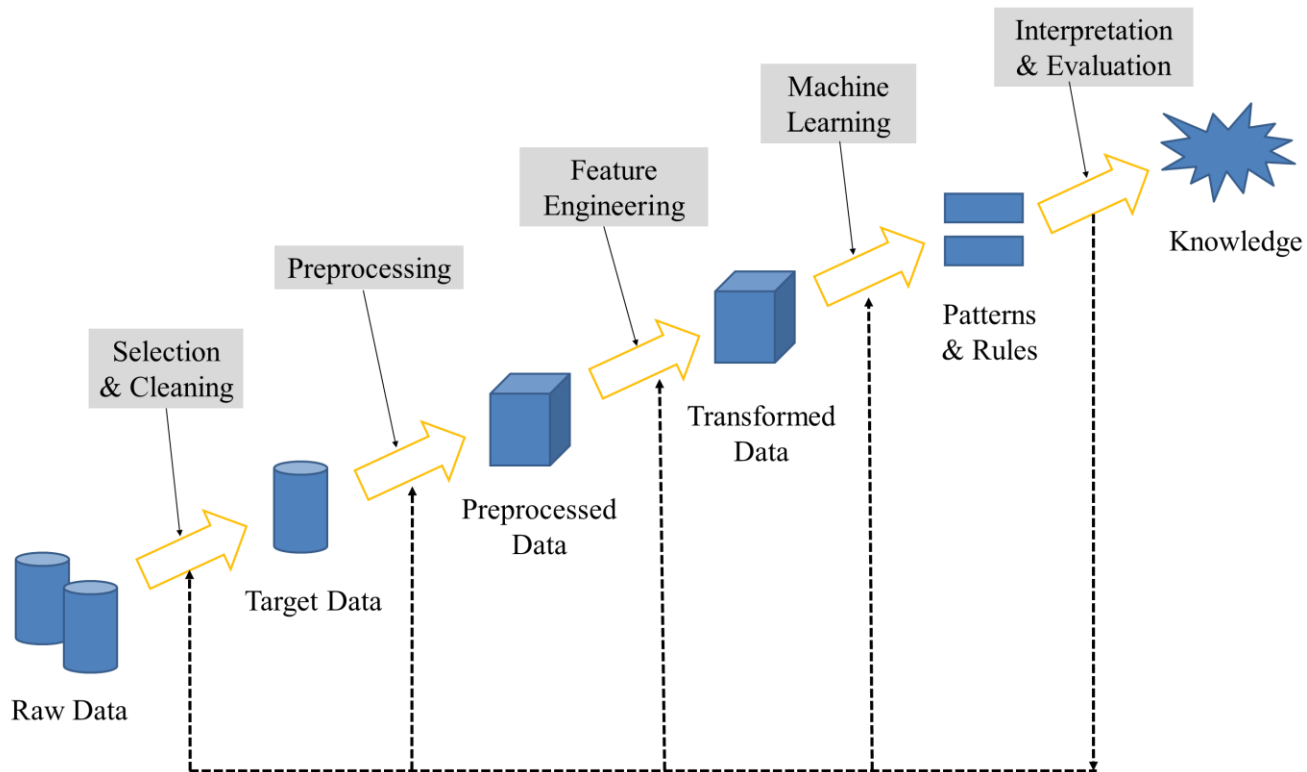
(Photo credit: Microsoft Asia News Centre website)

City data related to urban energy system

Urban energy system: The combined processes of acquiring and using energy within the administrative boundaries of city plus easily traceable upstream flows such as electricity consumption.



Knowledge discovery through data mining process – the urban informatics perspective



A typical procedure for knowledge discovery through machine learning

The questions should be answered by urban informatics:

1. Where does the data come from in urban energy system at different levels? How can the data be collected and processed efficiently given the current and potential ICT infrastructure?

2. What kind of services and/or applications can be developed using the data? What benefits can be harvested by applying such services and who are the relevant stakeholders?

3. What are the current technology readiness level of such digital transformation technologies? What should be the focus of next-step of such digital transition?

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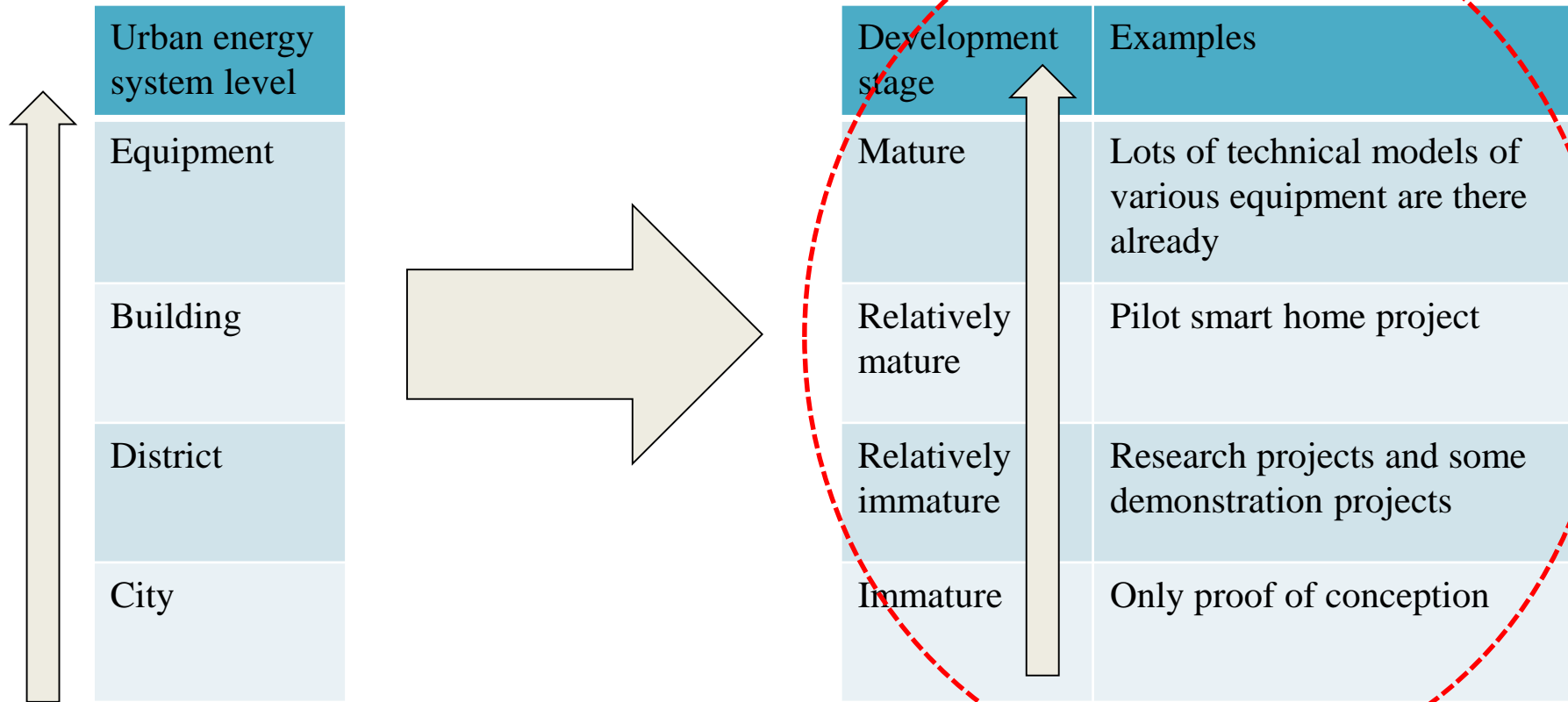
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Summary of current numerical models for urban energy system at various levels



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The roadmap from numerical model to computational intelligence



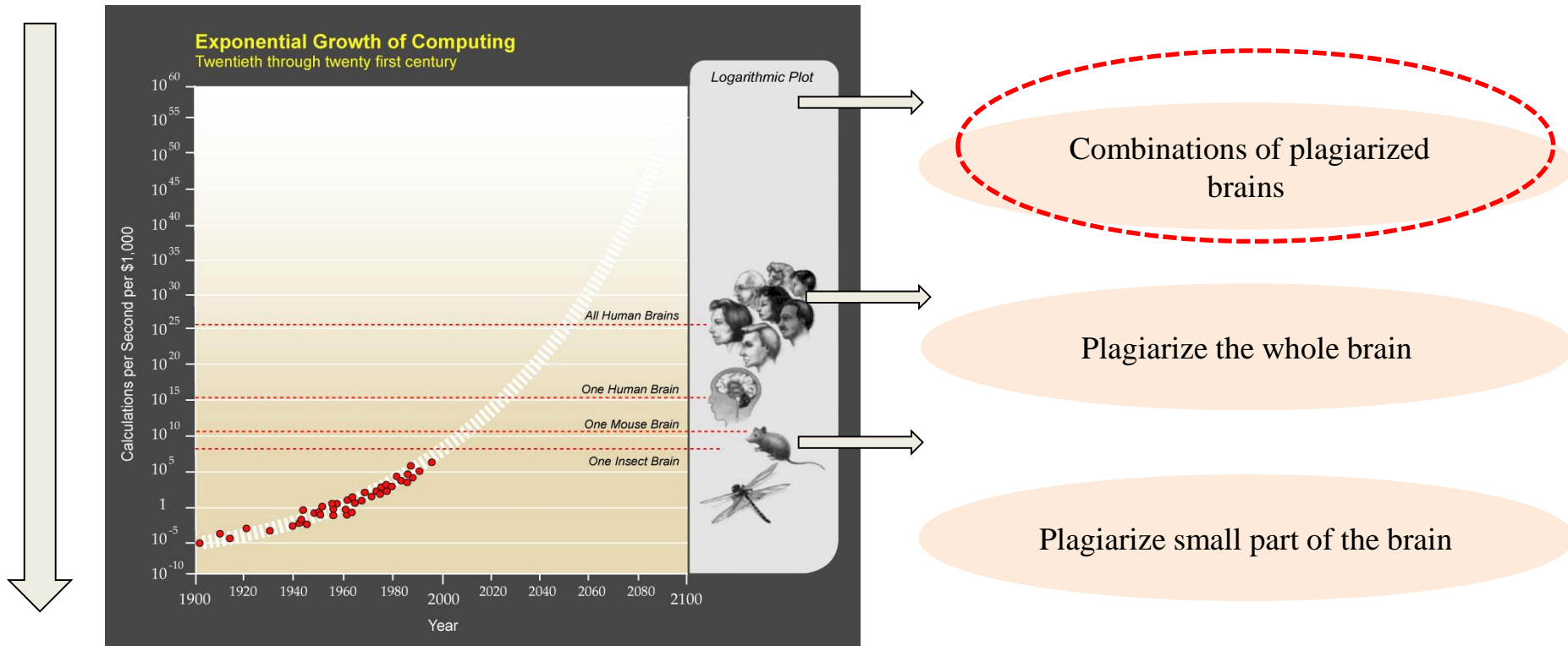
(Photo credit: McKinsey & Company)

The roadmap from numerical model to computational intelligence

Urban energy system level	Prospects	Agendas	Difficulties	Example
Equipment	Intelligent control, digital assets etc.	Deployment of numerical models in intelligent control	Easy	Prediction of solar irradiation
Building	Occupant interaction, contemporary control.	Smart home	Not so easy	Wireless control of air conditioner
District	Real-time operation scheduling.	Digital utility	Difficult	Match of renewable energy supply and demand
City	Optimized operation of the city	Smart city	Very difficult	Couple intelligent transportation and electricity network

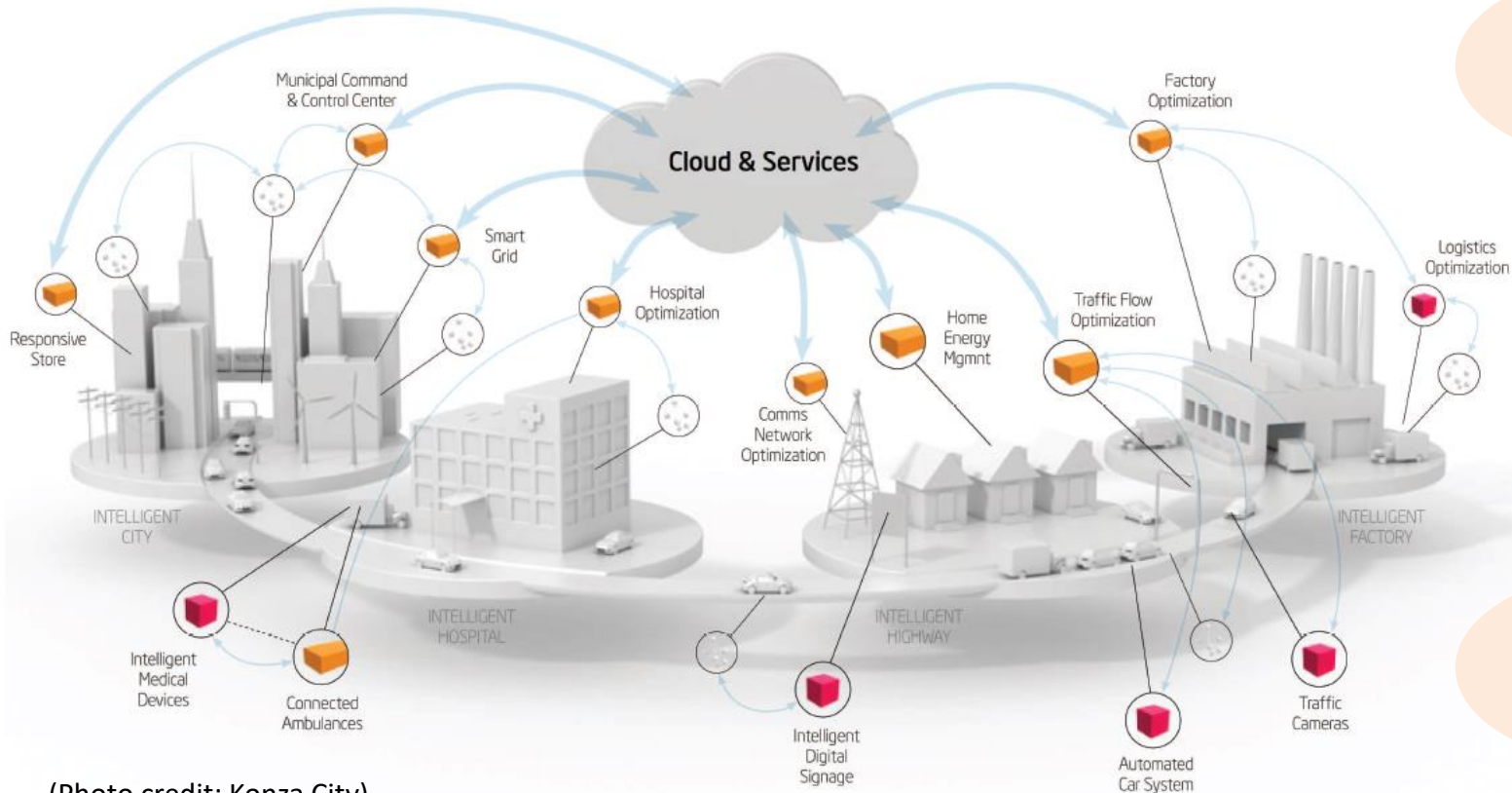
From Artificial Narrow Intelligence (ANI) to Artificial General Intelligence (AGI)

Current urban informatics: for specific problem in well-defined context (ANI)



Future urban informatics: making the whole problem as computer's job (AGI)

The transition from ANI to AGI is all about working together!



(Photo credit: Konza City)

Challenge from both hardware and software level

Great research efforts are needed!

Potential framework for cloud computing enabled smart city

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1. Digitalization of urban energy system happens only for limited applications at specific context right now (artificial narrow intelligence).
2. Machine intelligence could play a critical role in the future design and operation of urban energy system.
3. Digital penetration of urban energy system should follow the hierarchy structure of urban energy system, from equipment to building, to district and finally to the entire city.
4. There is still long way to go to reach 100% smart city (artificial general intelligence), cross-domain collaborative efforts are the main driving forces over there.

Thanks and questions?

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