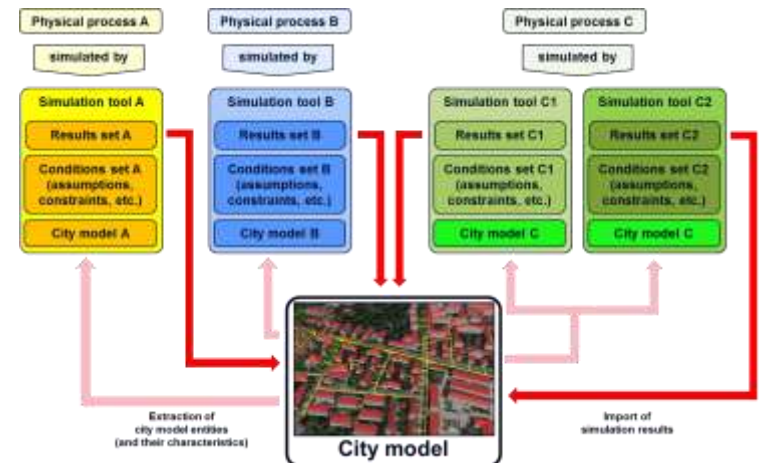


Sneak preview of the Scenario ADE v. 0.2

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CityGML Joint Workshop Energy + Utility Network ADE
7 December 2017, Karlsruhe

Smart and Resilient Cities Unit
Center for Energy
AIT - Austrian Institute of Technology
Vienna, Austria



Outlook

- Bridging 3D city modelling & simulation domains (reprise)
 - Refer to previous presentation of Edmund Widl on the "Simulation Package"

- The Scenario ADE
 - Definition and properties
 - UML Diagram
 - 3DCityDB

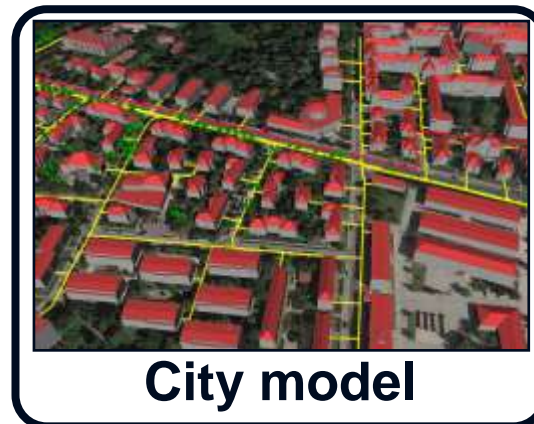
- Conclusions

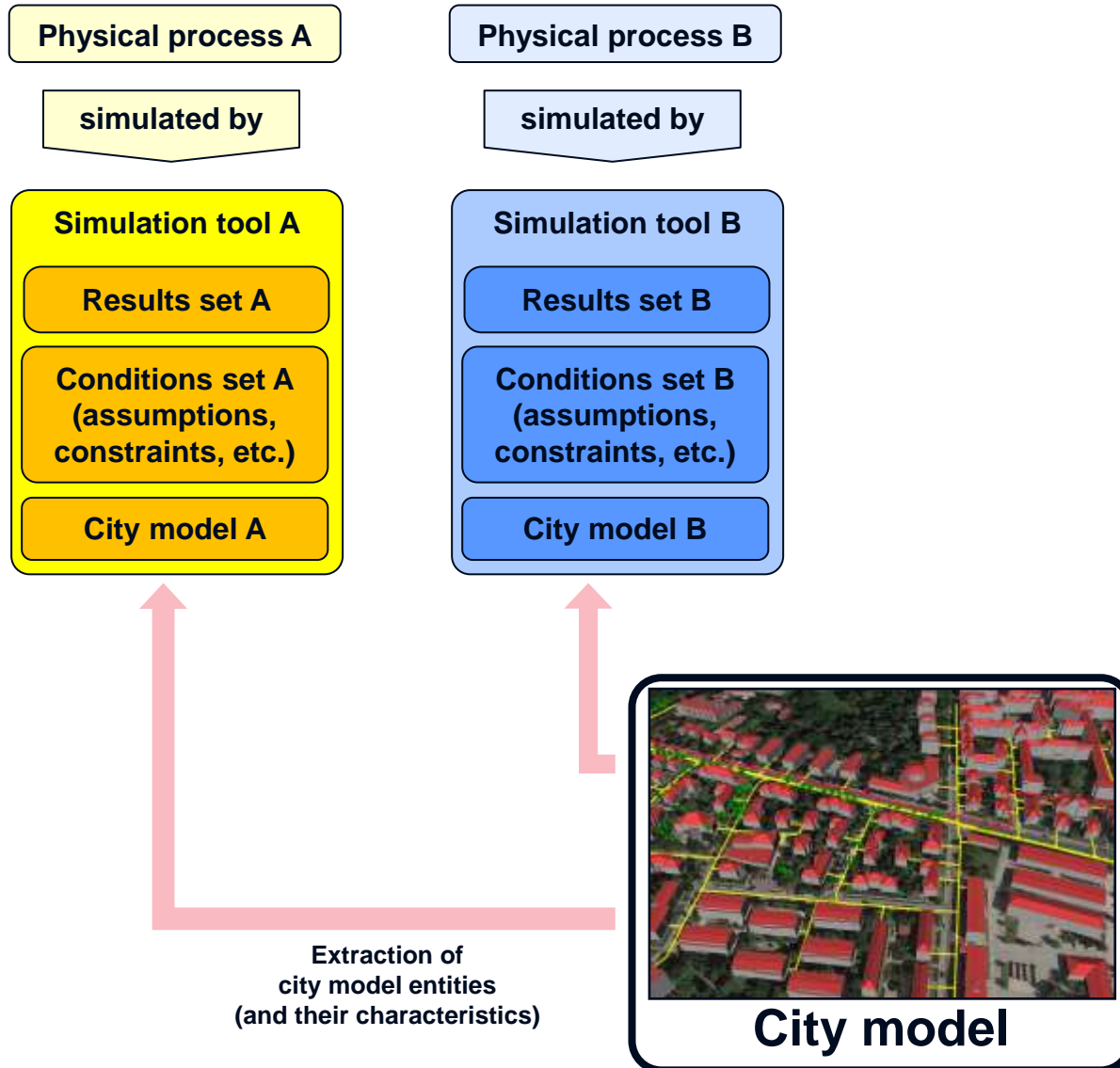
Real city

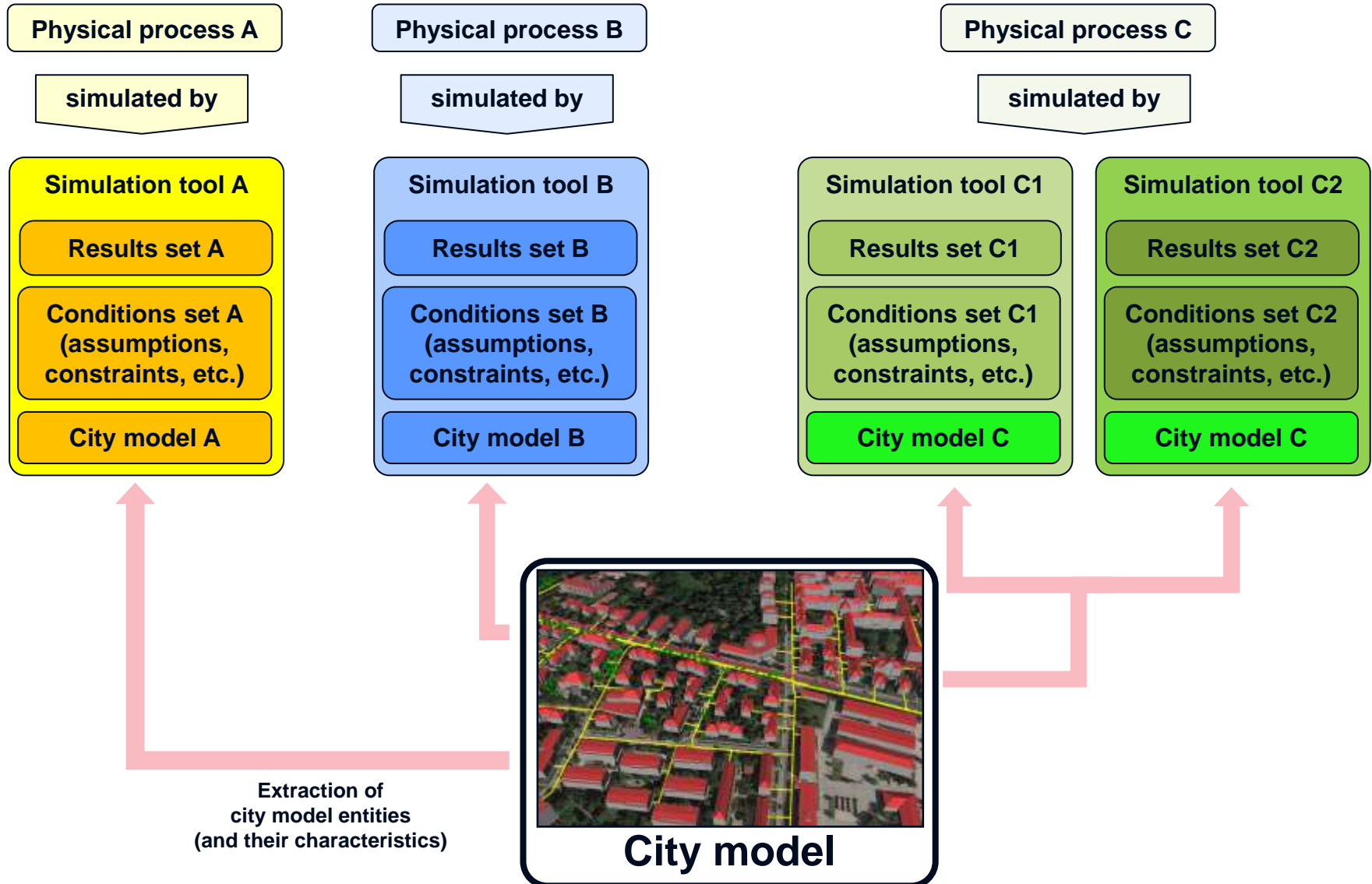


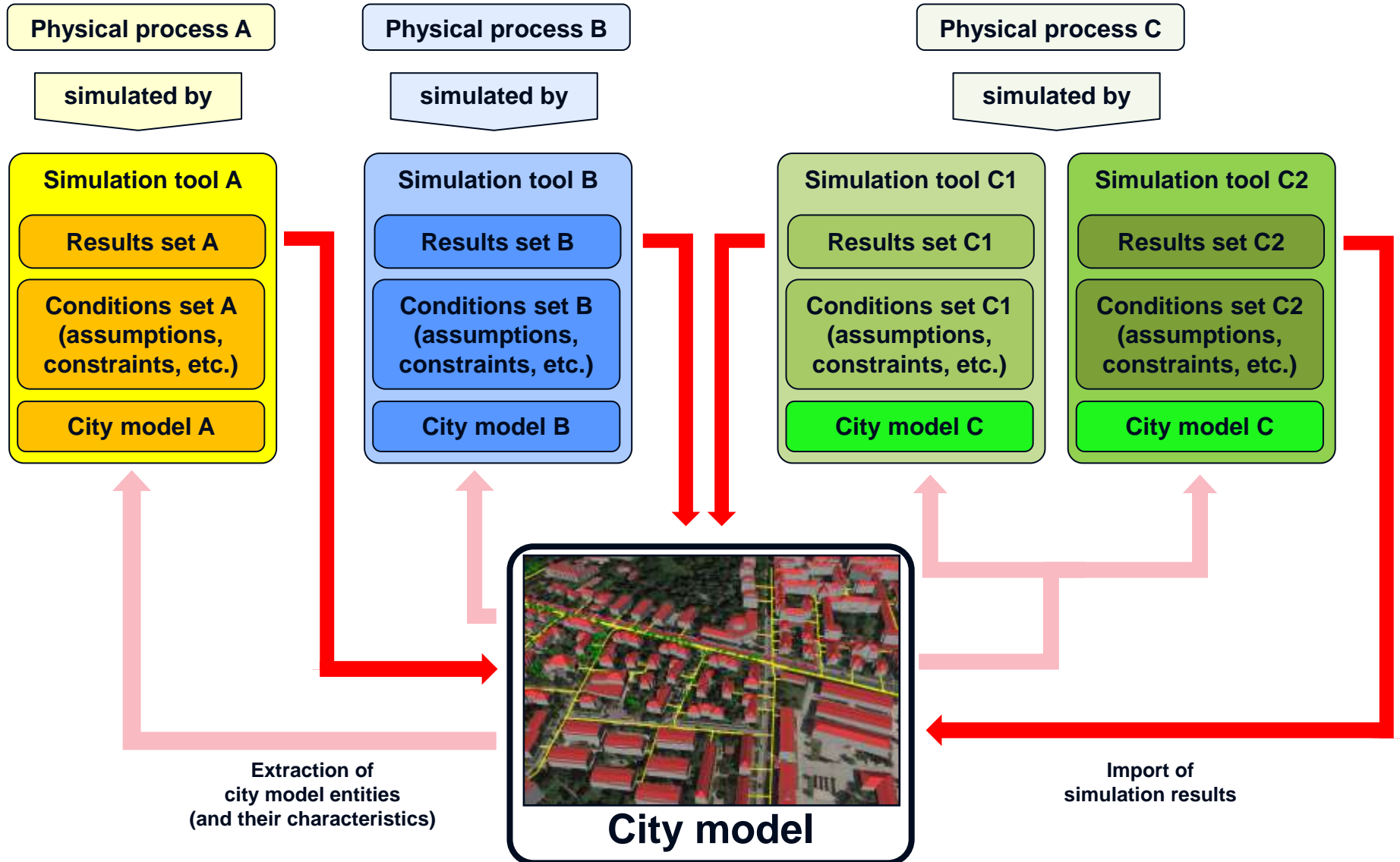
Image source:
<https://cdn.austria.info/media/17083/thumbnails/stadtansicht-wien--oesterreich-werbung-julius-silver--d.jpg.3146497.jpg>

"Digital twin"







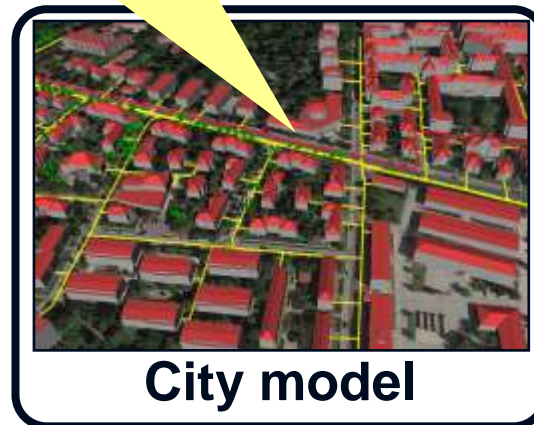


PROBLEM:

Which set of results is "better"?

Storing "just" the results may not be enough!

Extraction of city model entities (and their characteristics)



Physical process C

simulated by

Simulation tool C1

Results set C1

Conditions set C1 (assumptions, constraints, etc.)

City model C

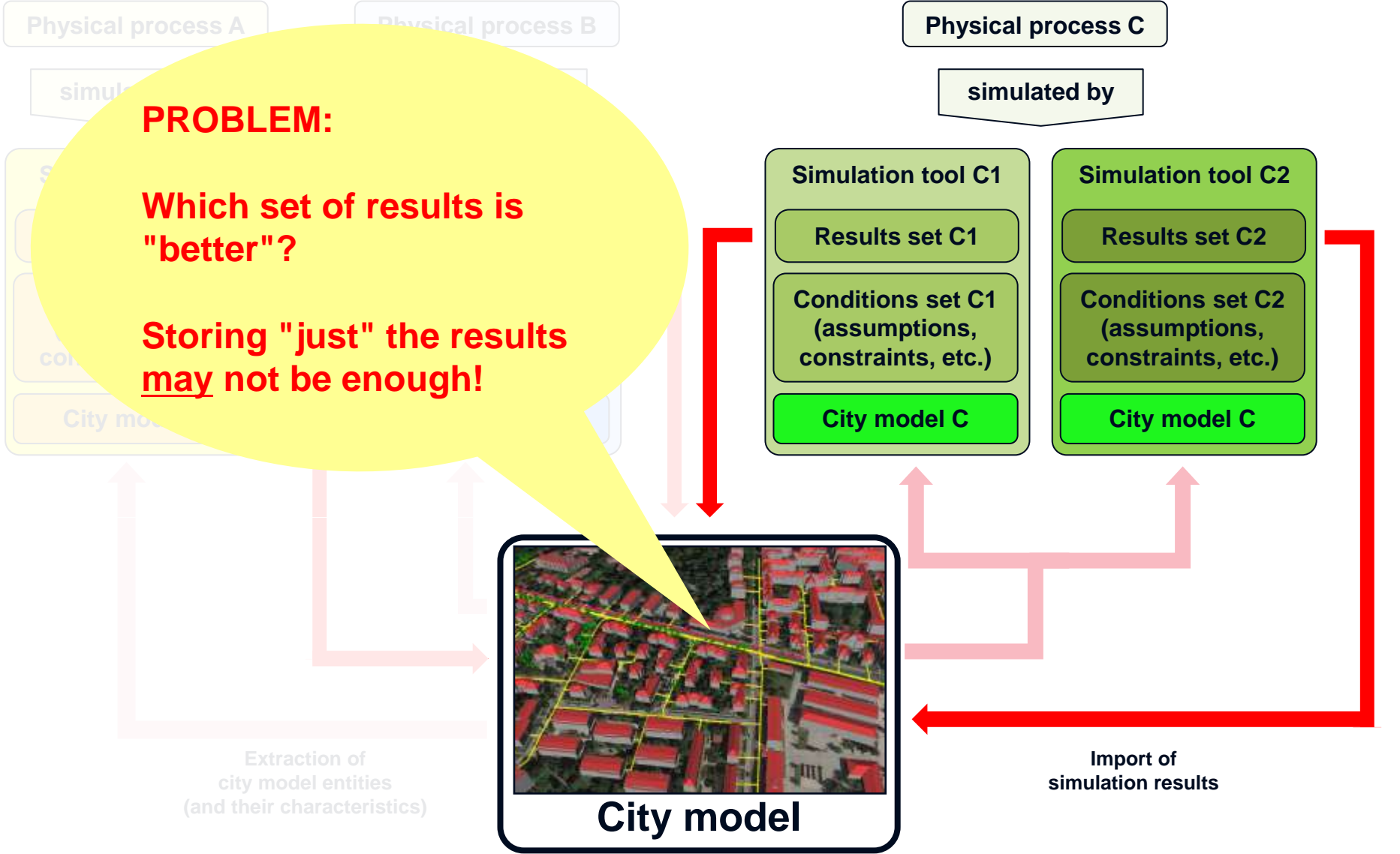
Simulation tool C2

Results set C2

Conditions set C2 (assumptions, constraints, etc.)

City model C

Import of simulation results



Deriving new city models

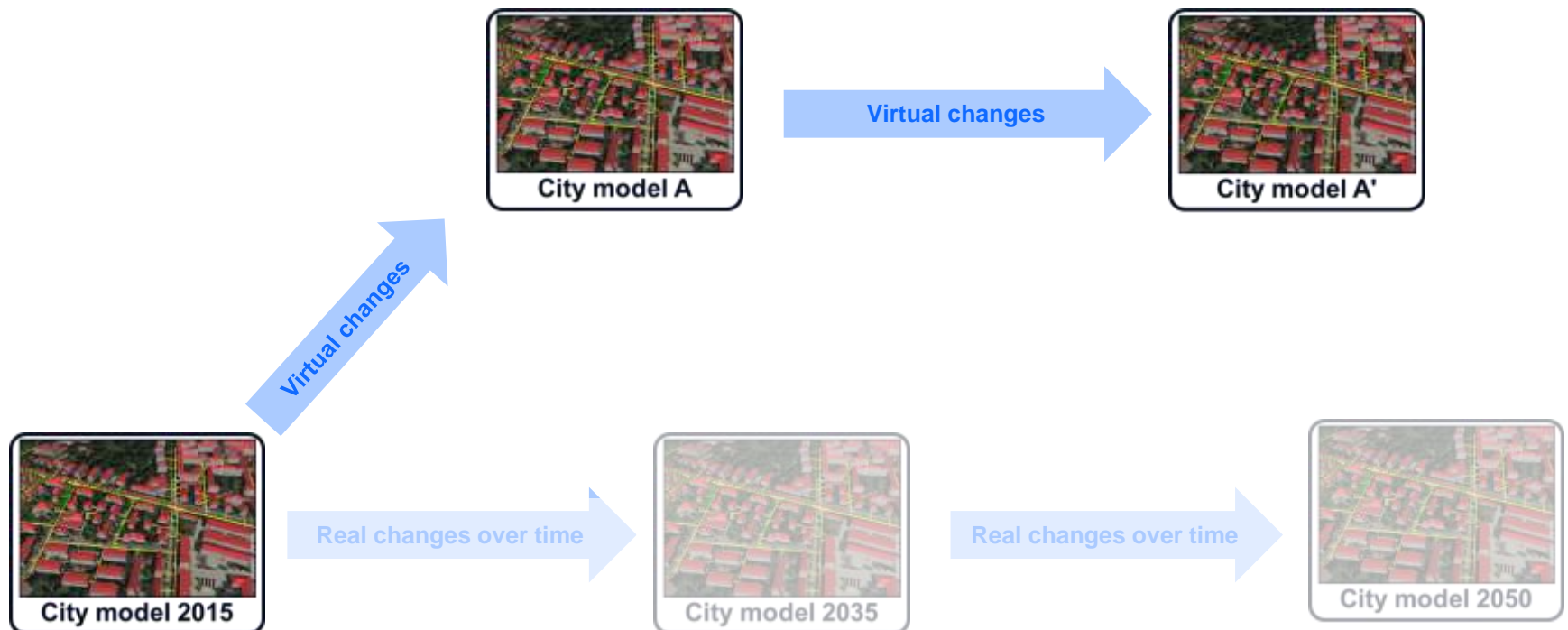
- A city is a "living" system which continuously changes over time
- A virtual city model is a snapshot at a certain moment



These progressive time-dependent changes can be taken care of by means of versioning

Deriving new city models

- A city is a "living" system which continuously changes over time
- A virtual city model is a snapshot at a certain moment
- But, as digital twin, it can be also *manipulated* at will! 😊



These progressive time-dependent changes can be taken care of by means of versioning

Scenario ADE: Digital Twin

- A city is a "living organism" which continuously changes over time
- A city model is a snapshot at a certain instant
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These progressive time-dependent changes can be taken care of by means of versioning

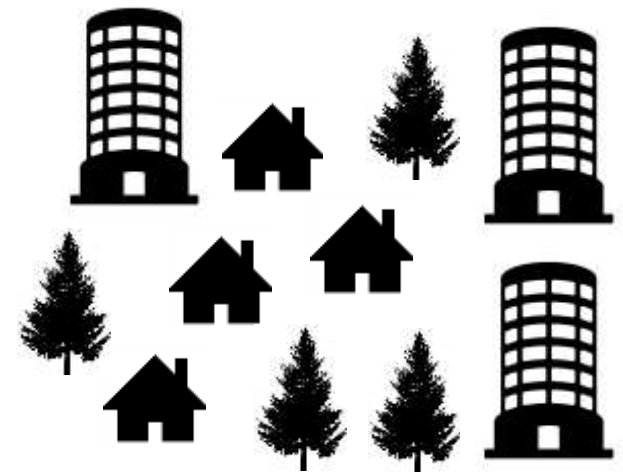
Deriving "new" city models: basic operations



Source city model

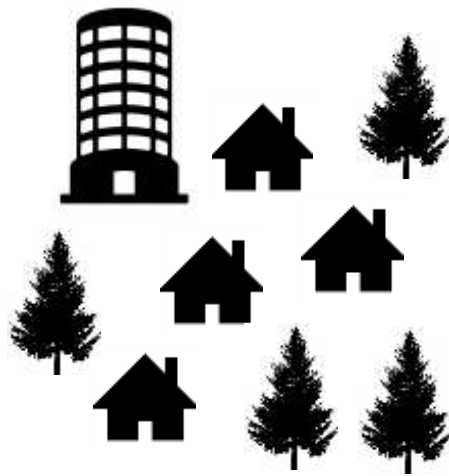


Add Feature



City model A

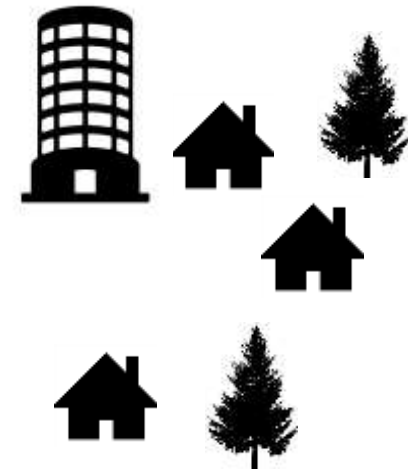
Deriving "new" city models: basic operations



Source city model



Remove Feature



City model B

Deriving "new" city models: basic operations



Source city model



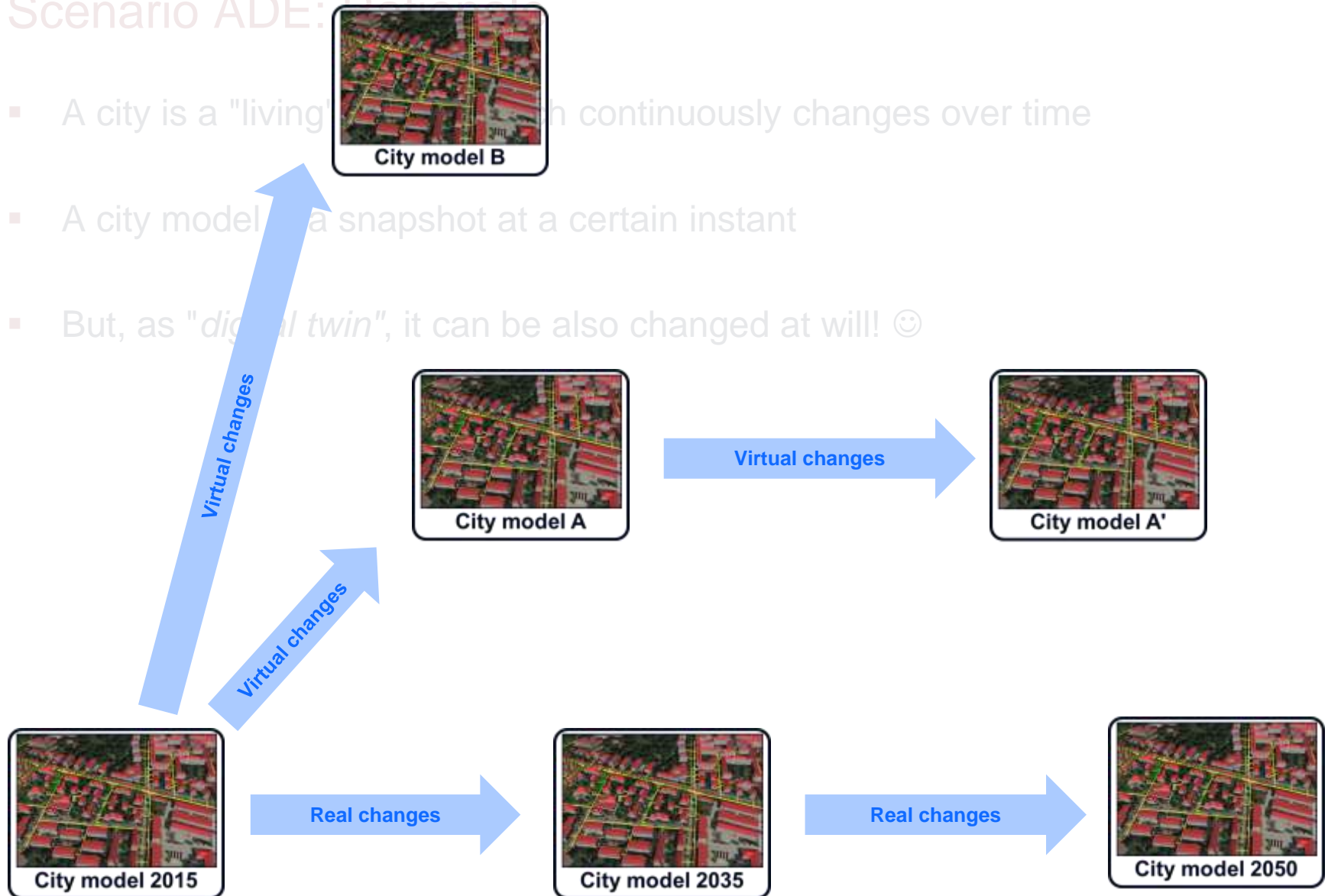
Change Feature
Attribute

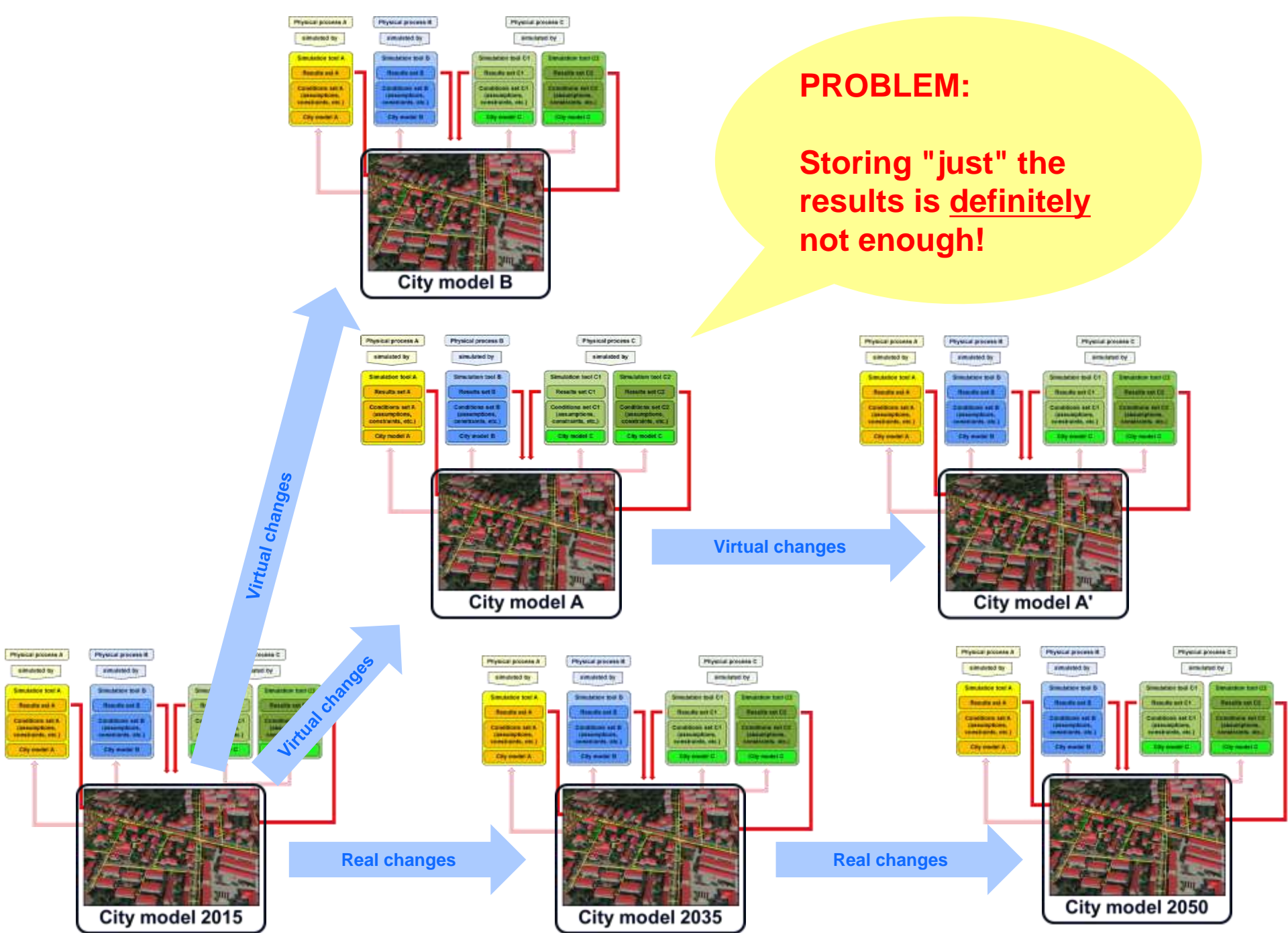


City model C

Scenario ADE: Digital Twin

- A city is a "living organism" which continuously changes over time
- A city model is a snapshot at a certain instant
- But, as "digital twin", it can be also changed at will! 😊





(Some) related work

- Chaturvedi K. et al. (2015), **“Managing versions and history within semantic 3D city mode for the next generation of CityGML”**
 - Oriented at CityGML 3.0
 - A rather profound change/addition to the current CityGML model
 - <http://mediatum.ub.tum.de/doc/1276238/1276238.pdf>

- Sindram M. (PhD in preparation) **"Modeling of Urban Planning Actions by Complex Transactions on Semantic 3D City Models"**
 - Work in progress paper (2014):
http://www.iemss.org/sites/iemss2014/papers/iemss2014_submission_225.pdf

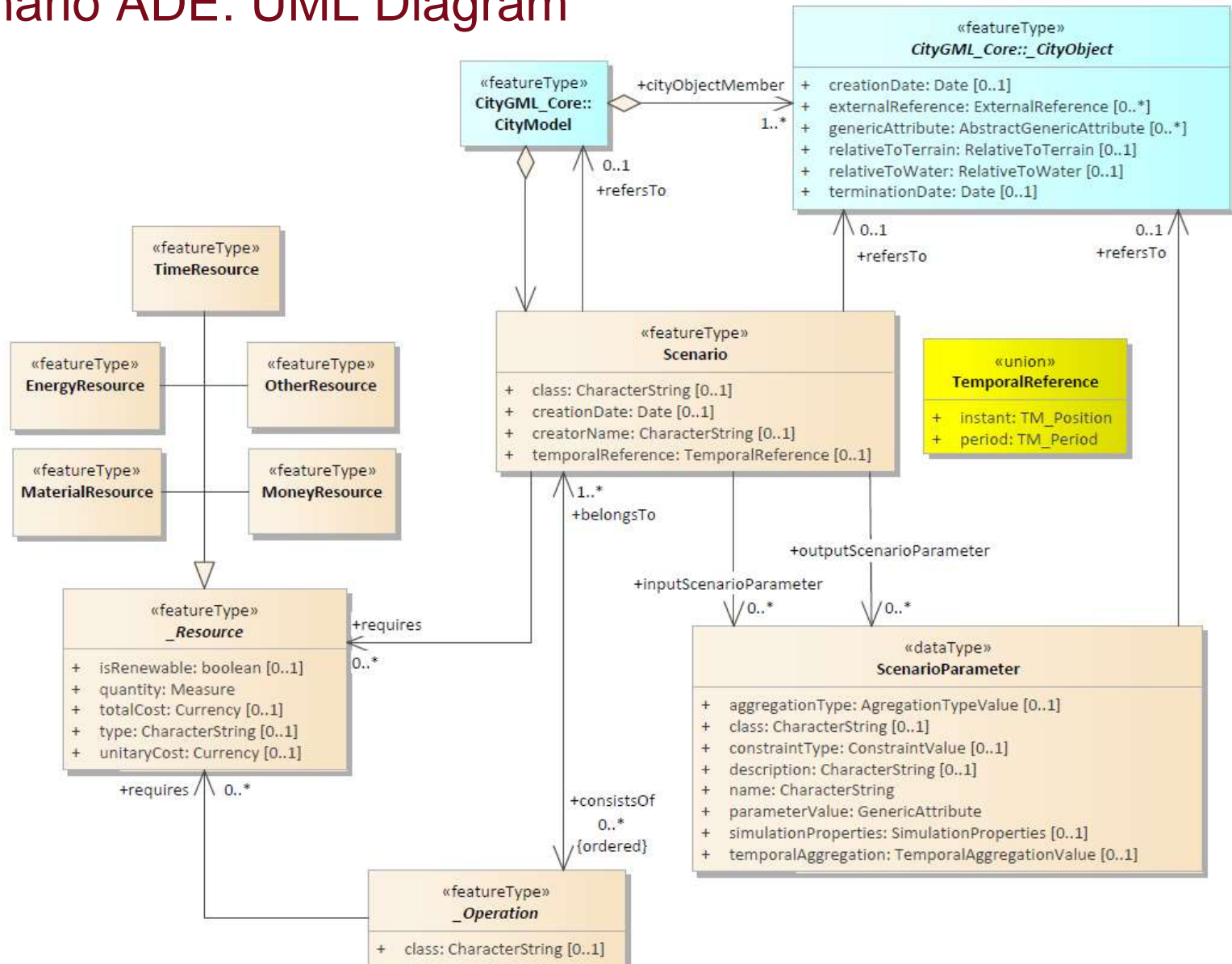
- Benner J. (2017) **"Proposal to Store Energy Simulation results / inputs in the Energy ADE"** (Presentation at Energy ADE Workshop)
 - <http://en.wiki.energy.sig3d.org/images/upload/KIT-Proposals-EnergyADE.pdf>

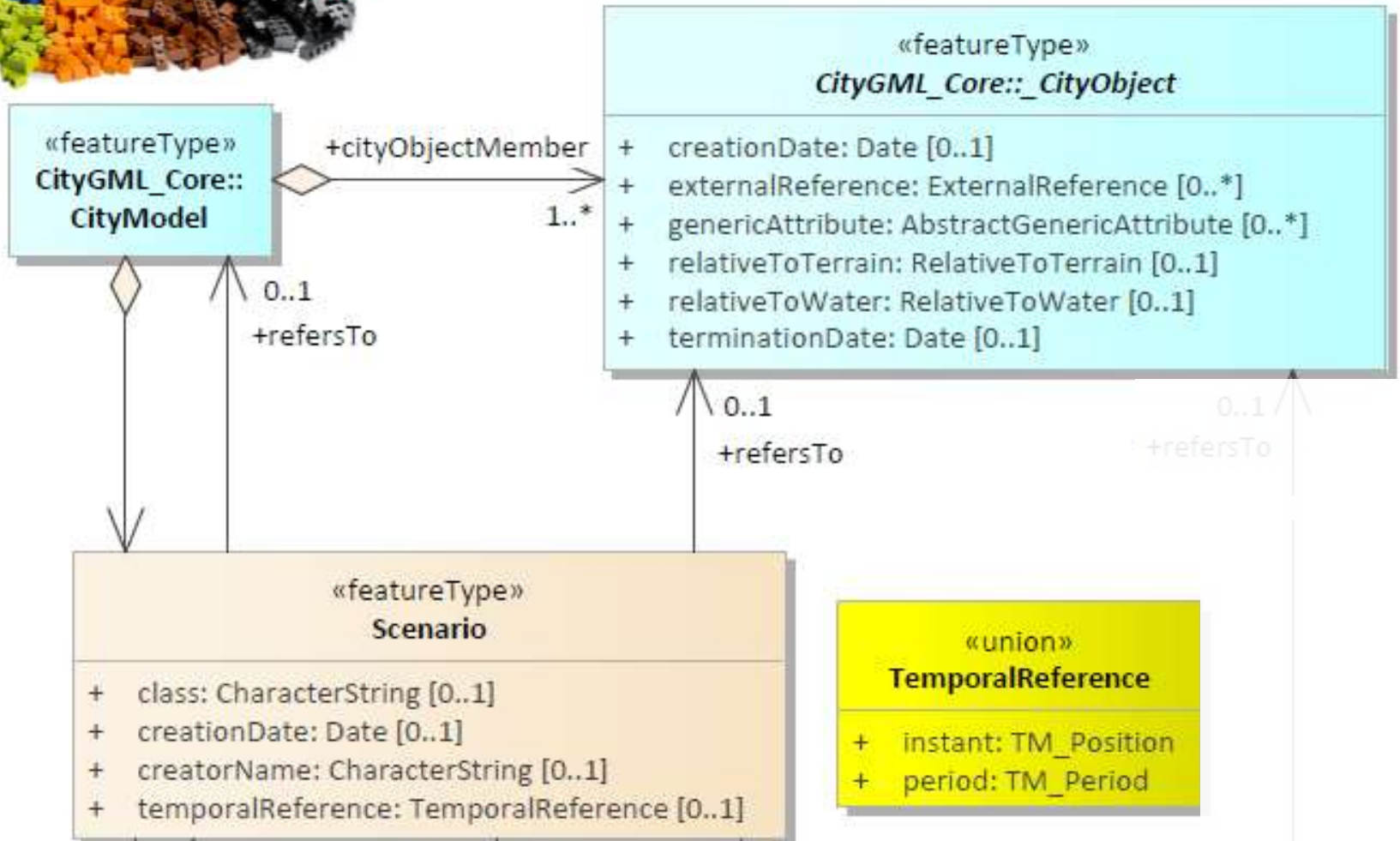
- Several **bilateral discussions** with colleagues
 - IF any, then home-made, specific solutions
 - No detailed information, documentation, code, etc.

Scenario ADE: Rationale

- In the Scenario ADE, a **scenario** is defined as a unique combination of:
 - A **city model** (a building, a district, ..., the whole city)
 - Information about how the city model (virtual or real) was obtained
 - Description of changes from city model A to city model B
 - A **simulation tool/model** characterised by a set of conditions:
 - Specific assumptions
 - Specific constraints
 - The set of **results**, (KPIs, time series, ...)
 - possibly having different spatial and temporal resolutions
 - possibly linked to specific entities (CityObjects)
 - A scenario is the **connection** point between the Simulation Package and the/a city model.

Scenario ADE: UML Diagram

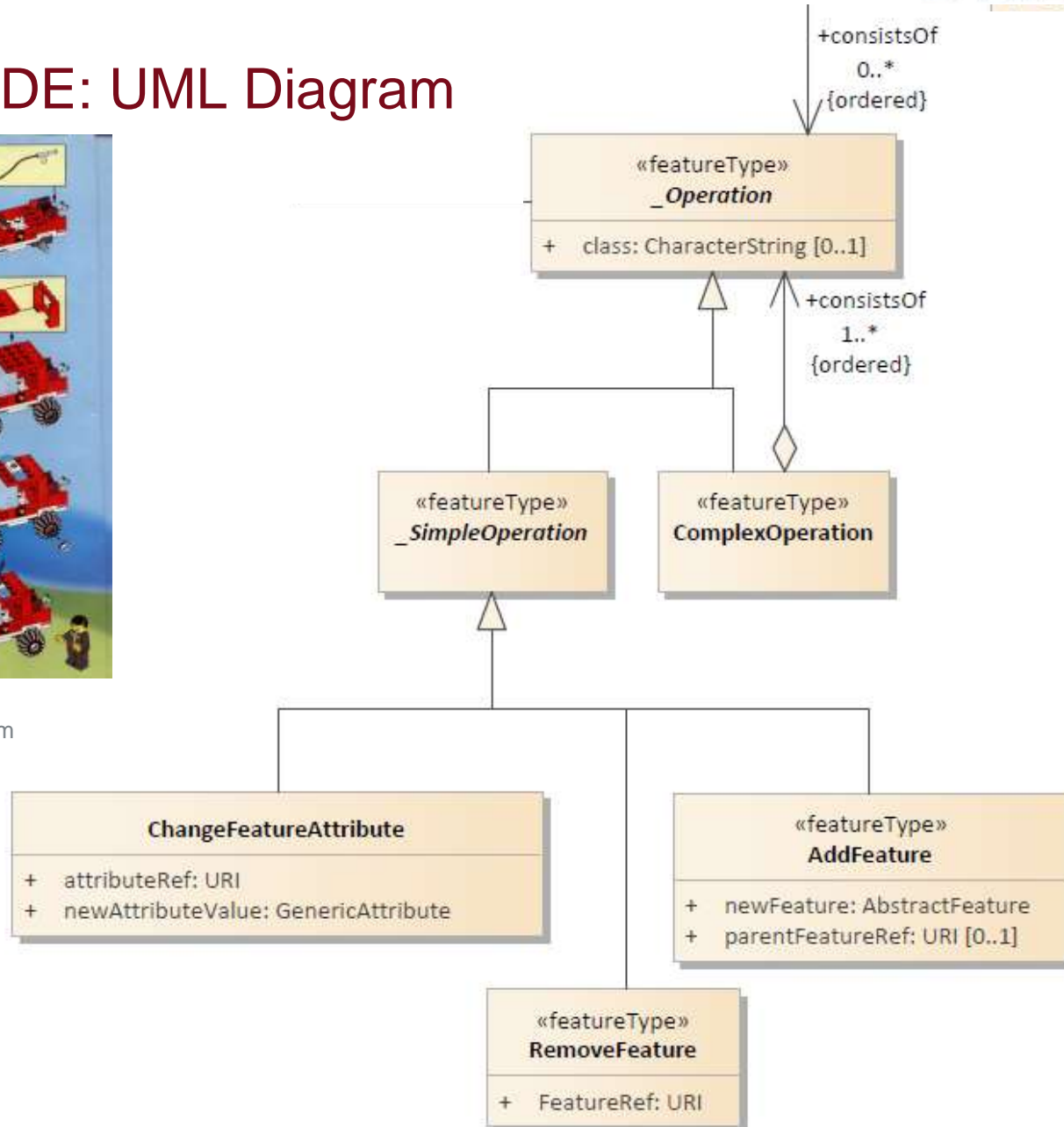


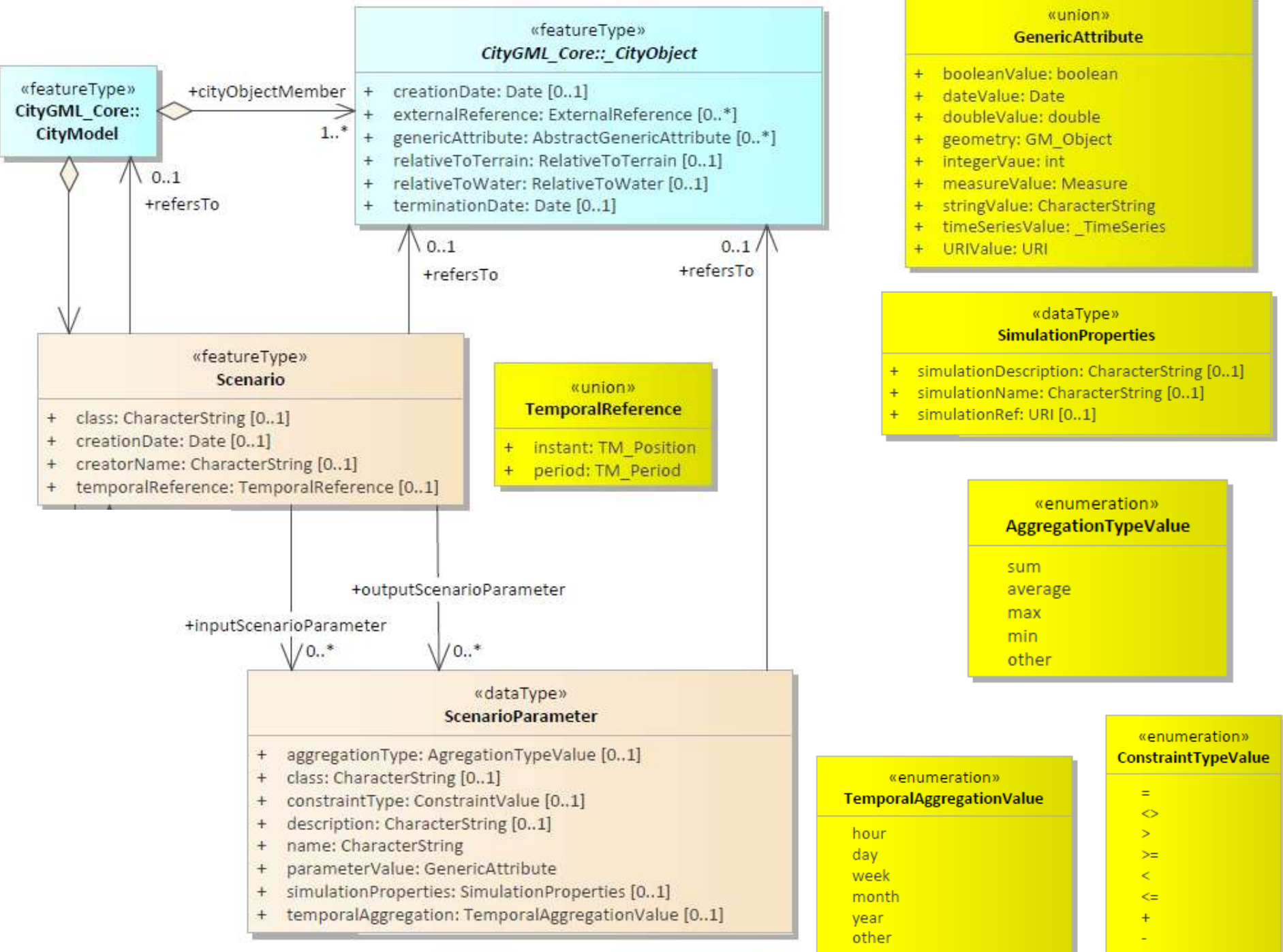


Scenario ADE: UML Diagram



Image source:
<http://www.lego.com>





«featureType»
CityGML_Core::CityModel

«featureType»
CityGML_Core::_CityObject

- + creationDate: Date [0..1]
- + externalReference: ExternalReference [0..*]
- + genericAttribute: AbstractGenericAttribute [0..*]
- + relativeToTerrain: RelativeToTerrain [0..1]
- + relativeToWater: RelativeToWater [0..1]
- + terminationDate: Date [0..1]

«union»
GenericAttribute

- + booleanValue: boolean
- + dateValue: Date
- + doubleValue: double
- + geometry: GM_Object
- + integerValue: int
- + measureValue: Measure
- + stringValue: CharacterString
- + timeSeriesValue: _TimeSeries
- + URIValue: URI

«featureType»
Scenario

- + class: CharacterString [0..1]
- + creationDate: Date [0..1]
- + creatorName: CharacterString [0..1]
- + temporalReference: TemporalReference [0..1]

«union»
TemporalReference

- + instant: TM_Position
- + period: TM_Period

«dataType»
SimulationProperties

- + simulationDescription: CharacterString [0..1]
- + simulationName: CharacterString [0..1]
- + simulationRef: URI [0..1]

«enumeration»
AggregationTypeValue

- sum
- average
- max
- min
- other

«dataType»
ScenarioParameter

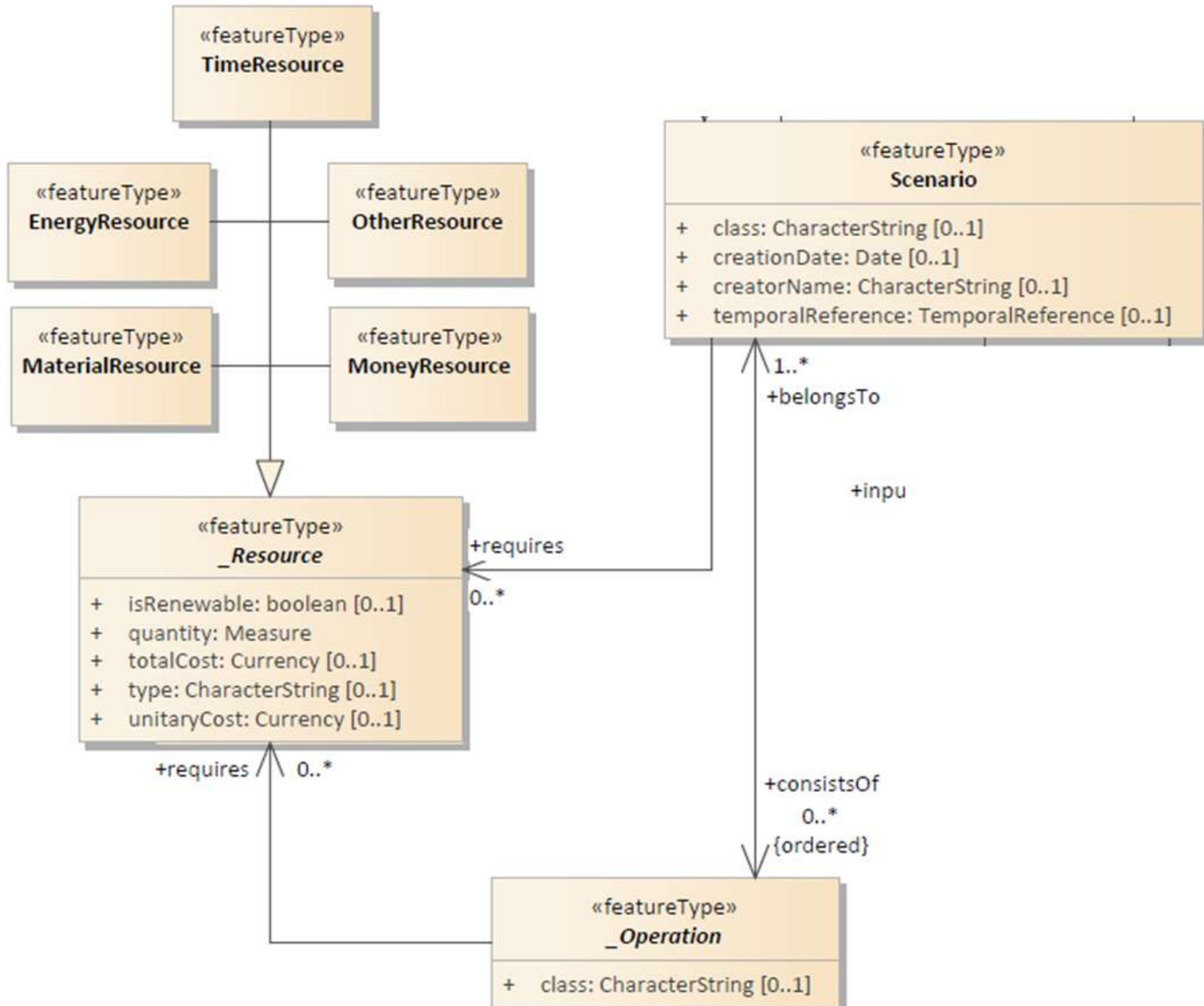
- + aggregationType: AgregationTypeValue [0..1]
- + class: CharacterString [0..1]
- + constraintType: ConstraintValue [0..1]
- + description: CharacterString [0..1]
- + name: CharacterString
- + parameterValue: GenericAttribute
- + simulationProperties: SimulationProperties [0..1]
- + temporalAggregation: TemporalAggregationValue [0..1]

«enumeration»
TemporalAggregationValue

- hour
- day
- week
- month
- year
- other

«enumeration»
ConstraintTypeValue

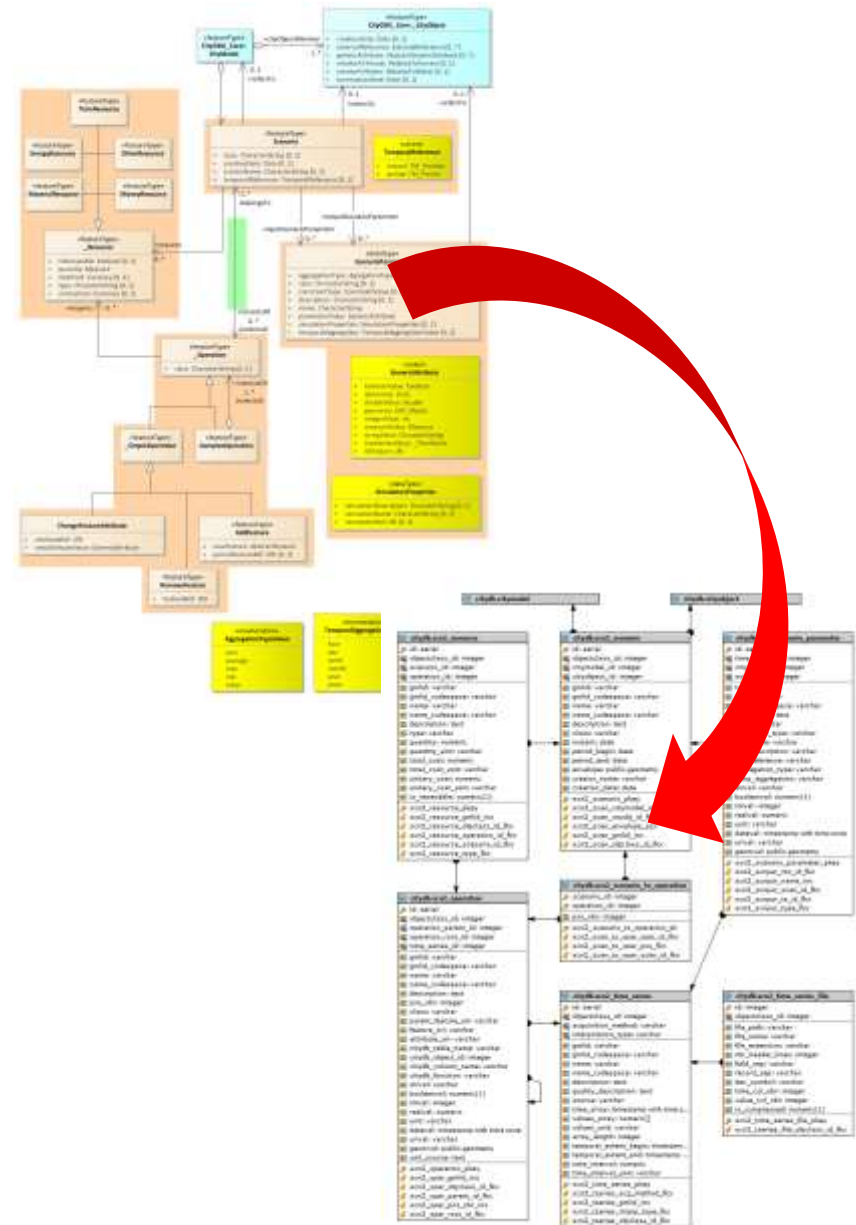
- =
- <>
- >=
- <=
- +
-



Scenario ADE & 3DCityDB

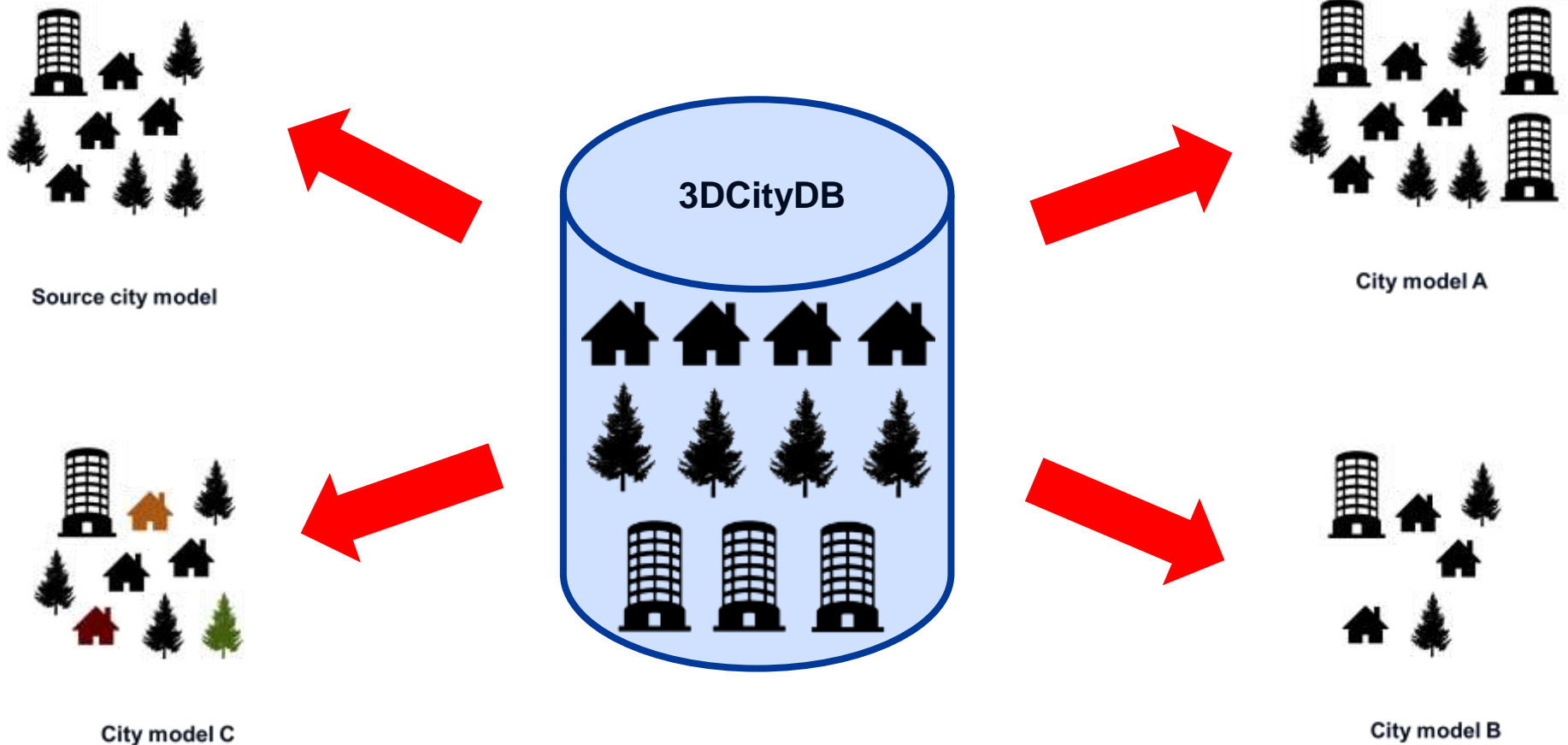
- Already implemented as database schema and included in the extended 3DCityDB "plus"
- Implementation rules are exactly the same as for Energy ADE and Utility Network ADE

→ See next presentation



Scenario ADE & 3DCityDB

- Basic idea: **avoid "cloning"** objects used in multiple city models
 - Store (City)Objects only once, and use different grouping rules



Scenario ADE & 3DCityDB

- Basic idea: **avoid "cloning"** objects used in multiple city models
 - Store (City)Objects only once, and use different grouping rules

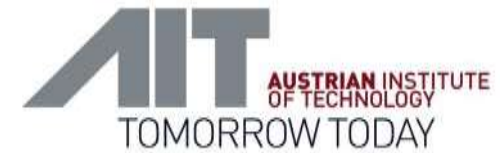
- The **GOOD NEWS:**
 - The 3DCityDB already has tables allowing it
 - CITYMODEL table
 - CITYOBJECT_MEMBER table
 - Currently unused (for a number of reasons) by the Importer/Exporter, but they can be used by interacting directly with the 3DCityDB

- **BUT:**
 - The Importer/Exporter tools does not support handling of multiple city models in the same database instance
 - Some workarounds are necessary to import and export (e.g. *"ab"* using a bit the concept of CityObjectGroup)

Conclusions

- The current Scenario ADE (v. 0.2!!)
 - gives a (relatively simple and lightweight) answer to the general need of scenario management within virtual city models
 - Contributes to bridging the "city modelling" and "simulation" worlds
 - The link is the Scenario, not the CityModel itself
 - It allows for documentation of "how a city model was obtained"
 - It is compatible with the current CityGML 2.0
 - It exploits already existing objects of the 3DCityDB
 - Already implemented for the 3DCityDB
 - BUT some limitations in terms of Importer/Exporter
 - Already being used and tested within project IntegrCiTy
 - Is still work in progress: Nothing is set in stone!
 - Are you interested at deeper look?
 - Willing to use it? Willing to contribute?
 - Interested in finding resources to "push" the changes also to the Importer/Exporter?

CONTACT US!!



AIT Austrian Institute of Technology

your ingenious partner

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Energy Department

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Pablo Puerto (CREM), **Edmund Widl** (AIT)