



STATUS FOR API- UTVIKLING FOR LANGTIDSMODELLENE OG PLANER FOR VIDERE IMPLEMENTASJON

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Agenda

- What is API
- API development EMPS
- New input flexibility
- Calendar functionality
- Version 10
- Plan for future API development

What is API (Application Programming Interface)

- **What:**

Set of subroutines, data objects, protocols and tools for building application software.

A *set of rules* and specifications that serve as an *interface* and allow software programs to *communicate*

- **Why:**

Make it *easier to use* programs, interfaces and technologies
e.g. **use of libraries written in other programming languages**

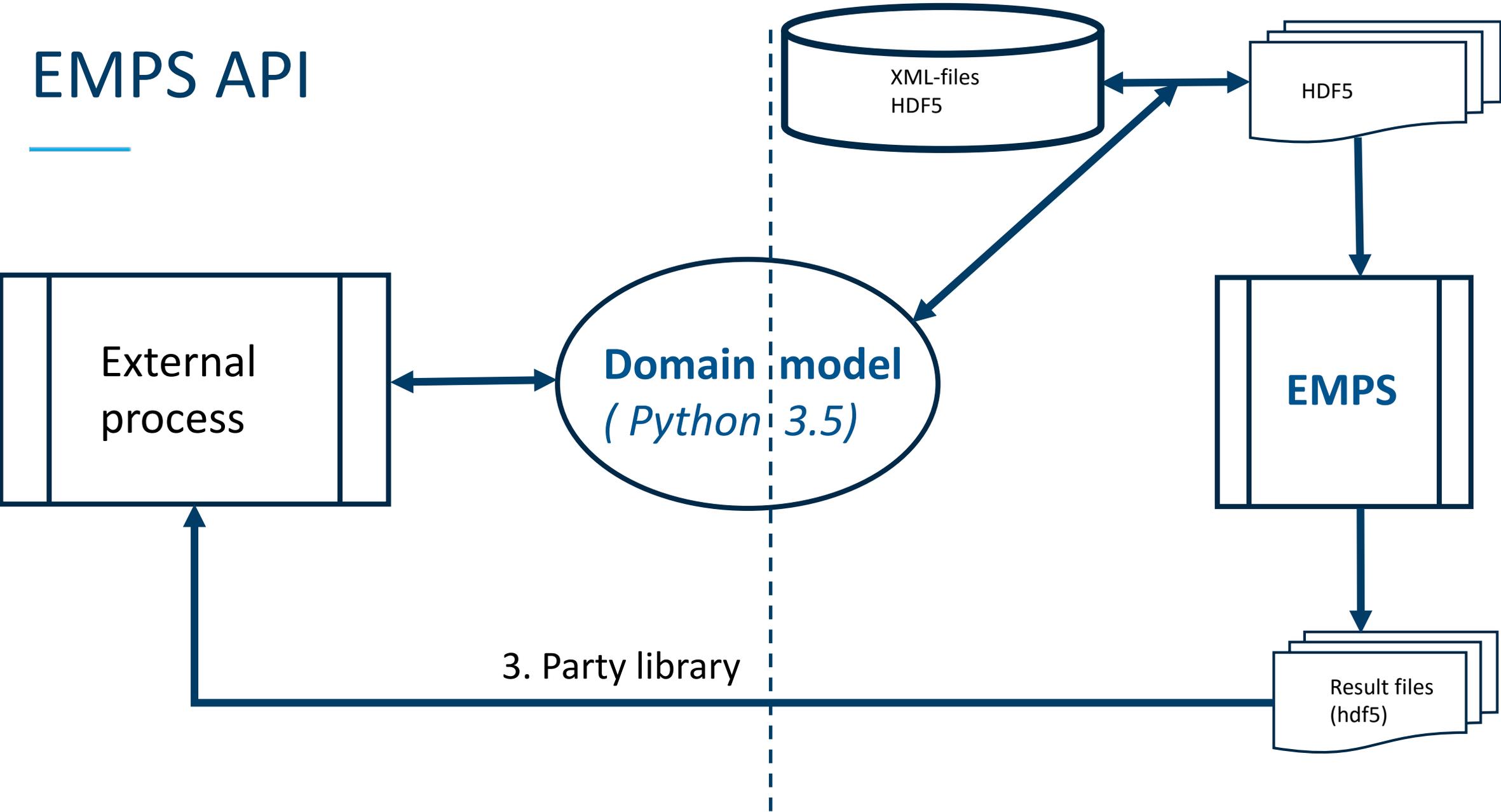
- **Use:**

Software library

Examples of API's

- Solve LP's using CPLEX, Gurobi or COIN-LP
- MPI (message passing interface)
- Powel's TSS-API (inflow, temperature, etc)
- ProdRisk & EOPS API
- SHOP API

EMPS API



New input flexibility

- New time series input
- One separate value for each time step in planning period -> (Calendar correct)
 - Firm contracts -> `model.area[id].pm[id].set_data(TS)`
 - Price dependent contracts (det.) -> `model.area[id].pm[id].set_data(TS)`
 - Purchase, Sale
 - Re-purchase
 - Exogenous prices
 - Non-controllable power (e.g. wind)
 - Transmission Capacities -> `model.transmission[id].set_data(TS)`
- API for these data

Time series data - properties

- Flexible formats
 - Hour, day, week, step-function, internal EMPS format: sequential load segments
 - Common format for new data types
 - Easy to extend functionality
- Data automatically converted to internal representation when read
- Stored in HDF5 (Hierarchical Data Format)
 - Effective for large quantities of data
 - Easy to organize and store/read
 - 3. party applications (e.g. viewer) and library routines

Modified inflow archive

- Use all historical inflows (day 365 and leap year)
- New format for forecasts
 - One separate value for each individual time step in planning period
 - Possible with a forecast for whole period
- API for inflow

Historical inflow archive

The screenshot shows the HDFView 2.13 application window. The title bar reads "HDFView 2.13". The menu bar includes "File", "Window", "Tools", and "Help". The "Recent Files" list shows "C:\data\4_delomVind_4KIEmps_API_ts_cap\historical.h5". The left sidebar displays a tree view of the "historical.h5" file, with "historical_series" expanded to show a list of series: 1210-A, 1413-A, 383-B, 467-A, 478-B, 530-C, 536-B, 666-A, and 894-A. The main window displays the selected series "1210-A at /historical_series/ [historical.h5 in C:\data\4_delomVind_4KIEmps_API_ts_cap]". The data is presented as a table with 8 rows and 2 columns. The bottom panel shows the metadata for the selected series.

0	5.845059
1	4.7899337
2	4.270745
3	4.053021
4	3.8911233
5	3.997194
6	3.8687925
7	3.7013123
8	3.5003369

1210-A (15228, 2)
32-bit floating-point, 2609
Number of attributes = 14
Last_updated_utc = 1494201600,
TS_id = 0,
TS_name = 1210-A,
TS_object_type = 123,
TS_start_time = -1231027200,
TS_time_axis_step_size = 604800,
category = ukjent,
measurement_location = ukjent,
measurement_unit = ukjent,
number_of_Data = 2609,
point_tx = instant,
producer = ArcLtm,
start_time = 1930.12.29,
time_resolution = WEEK,

Firm and price dependent contracts

The screenshot shows the HDFView 2.13 interface. The file tree on the left shows a hierarchy: NUMEDAL > OTRA > TERM > DELLASTER > DELLAST_1. The main window displays a table for 'DELLAST_1' with the following data:

0	0.20344894
1	0.30517358
2	0.24259566
3	0.20344894
4	0.30517358

Below the table, the metadata for 'DELLAST_1' is displayed:

```
DELLAST_1 (1634968, 2)
32-bit floating-point, 2964
Number of attributes = 8
  Last_updated_utc = 1494201600,
  TS_id = 1,
  TS_name = FASTKRAFTPROGNO,
  TS_object_type = 121,
  TS_start_time = 567993600,
  TS_time_axis_step_size = 3600,
  measurement_unit = dummy,
  point_tx = average,
```

Result file: Market results

The screenshot displays the HDFView 2.13 interface. The left sidebar shows a tree view of the data structure under 'SAMRES.h5', with 'price' selected. The main window shows a table view of the selected data. The table has 8 columns and 4 rows of data. The bottom status bar provides metadata for the selected data.

	0	1	2	3	4	5	6	7
0	0.47020873	0.4634086	0.4450368	0.48831627	0.48040318	0.4803006	0.48038337	0.4559
1	0.20476422	0.20161535	0.1938825	0.21093567	0.20798104	0.20787862	0.20797533	0.2001
2	0.20697118	0.66447306	0.631146	0.68709964	0.6805955	0.6868365	0.67753583	0.6322
3	1.2191628	1.6812859	1.6476222	1.704141	1.6975712	1.7038752	1.6944807	1.6486

price (7776064, 2)
Group size = 1
Number of attributes = 3
Kurve tegn = KRV | SA-valg,
Modelvariabel = Enmagasinvariabel: PKRV,
Unit = [re/kWh,

Calendar functionality

- Calendar (UTC) correct interpretation of input data
 - New market data contracts
 - Exogenous prices
 - Wind
 - Transmission constraints
 - Hydro plant maintenance
 - Inflow
- Simulation results
- Other hydro data
 - data for weeks 1 to 52 placed in calendar weeks 1 – 52
 - For calendar week 53: uses data for week 52
- Licensed functionality

Automatic generation of dataset from EMPS

- "New" application: PREPRO
- Copies data from EMPS dataset
 - To EMPS (series)
 - To EOPS/ProdRisk (parallel or series)
- Licensed functionality

Version 10

- EMPS, EOPS and ProdRisk results on HDF5 files
 - 3 party API for reading results
- API for (new) time series input data
 - Firm and price dependent contracts
 - Inflow forecast for whole planning period
 - Non-controlled production (e.g. wind, solar) and exogenous stochastic prices
 - Transmission capacities
- New applications (LTM and EOPS) replace Vansimtap application
 - Allows for running using XML input (not data input)

Version 10

- **Licensed functionality**
 - Calendar correct input and output
 - Copy of series dataset (from parallel): PREPRO

Release plan

- Statkraft version 10.0 : June 2017
- 10.0 official: First half 2018.
 - ProdRisk (inflow handling, special development 9.6 and 9.9)
 - ProdRisk API adaption
 - New TSS API from Powel
 - Tilpro functionality. e.g. manual forecasts
 - Upgrade ArcLTM (Hydark, ID-Batch)
 - Adapt LTM/EOPS to EMPS
 - More testing of functionality
- Available funding for 2017

Future development

- Separate man – machine from computations
 - Allow for XML based running
 - Saminn, Stfil, Detmod, Samtap, Samoverskudd, Samutskrv
- Work scope: 6 man months
- Error message handling (all LTM models)
 - Work scope: 6 man months

Future development

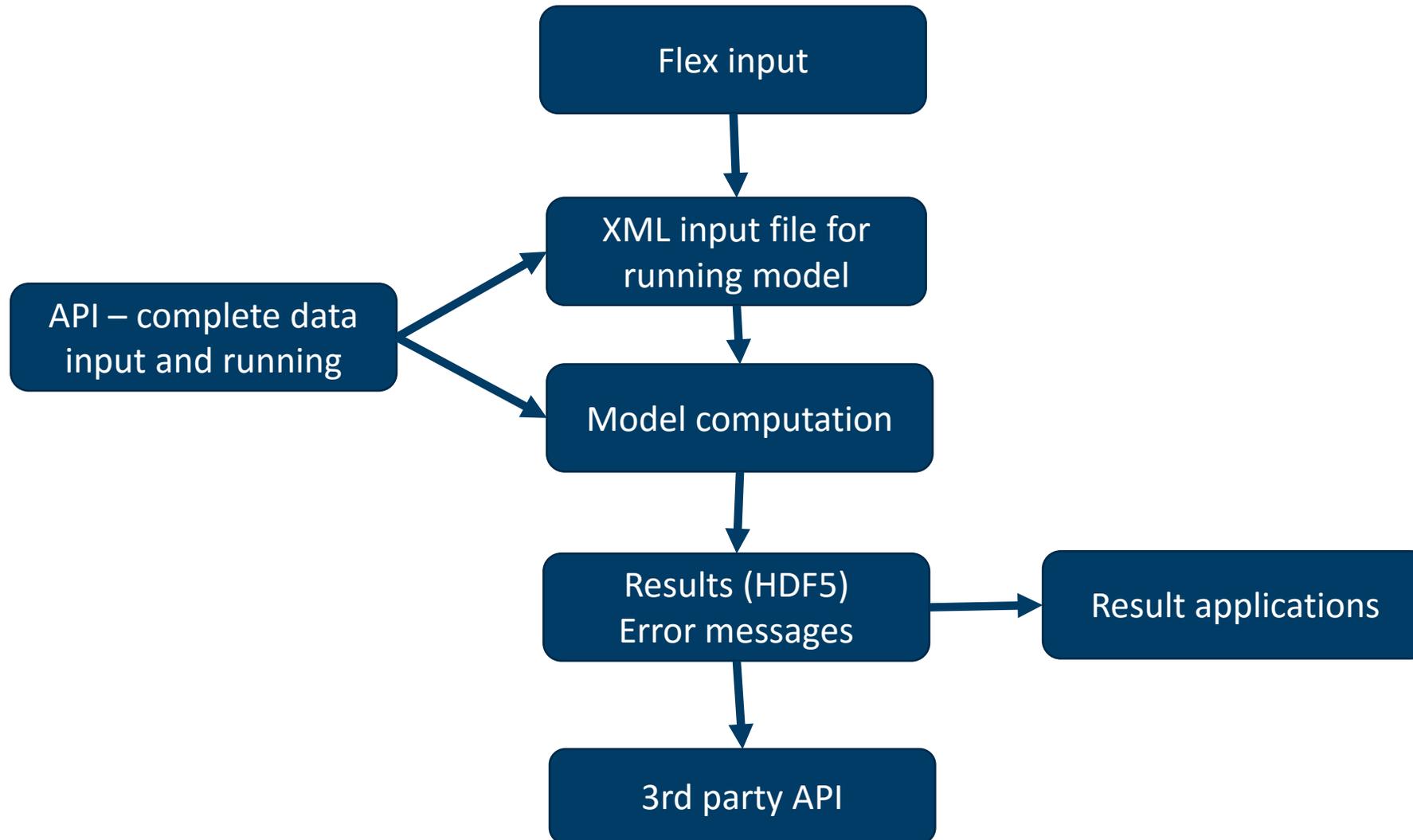
- API for missing input
 - Hydro data
 - Full transmission description
 - Some non time series market input

Work scope: 6 man month

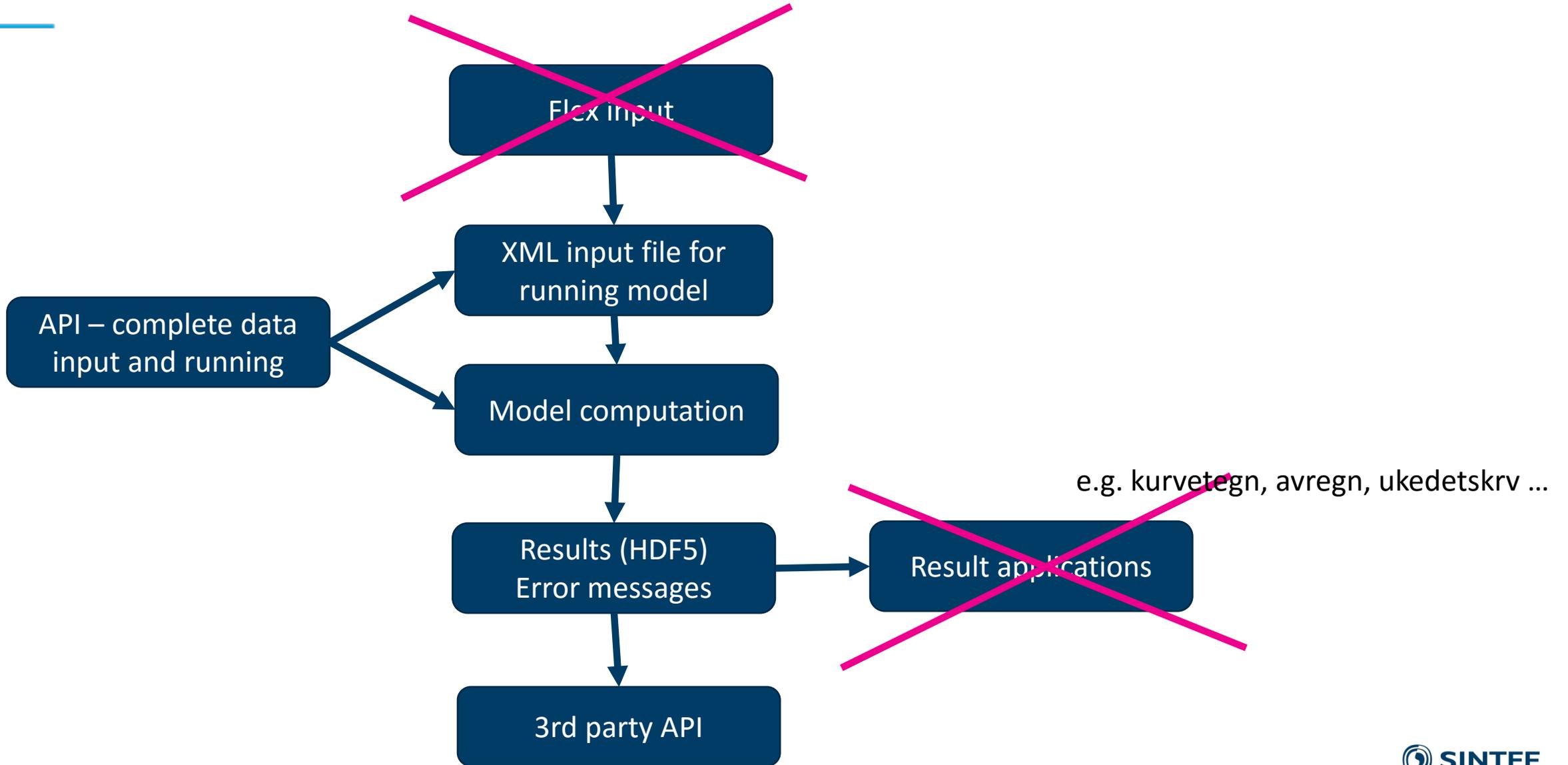
- Setup of whole dataset

Work scope: 12 man month

Principle – e.g. samtap



Future reduction of source code ?



After version 10

- Complete API
 - All input
 - Running model including error handling
 - Results
- Using only financing from maintenance
- 1-2 years from mid 2018. Best estimate 1 January 2020

User interface strategy

- Believe modern user interface is needed
- SINTEF makes API to kernel models
 - Open APIs
- Initiate and help developers
- Non-exclusive sales rights to our models for software vendors
- Next presentation by Powel is an example of a user interface initiative



Teknologi for et bedre samfunn