DESIGN PROJECT 2024

Meeting: 8th December 2023

Pierre-Yves Gilliéron, SIE Deputy Head

Christina Treier, SIE Administrator

Agenda

- Goals
- Skills
- Cycle of the design
- Work Organization
- Agreement, Budget
- Starting the DP
- Report & Presentation
- Important Dates

Source: http://datadrivenaid.org

Context and Goals

- The goal of the Design Project is to put your knowledge in practice within the context of professional work
- A team of students will be working as a consultancy company
  - Customer: company, administration
  - Mandate: context, objectives, problem to be solved, expectations
  - Salary: evaluation of your work (grade); learning outcomes
  - Responsibility: project management (meetings); searching for information/data; communication; deadlines

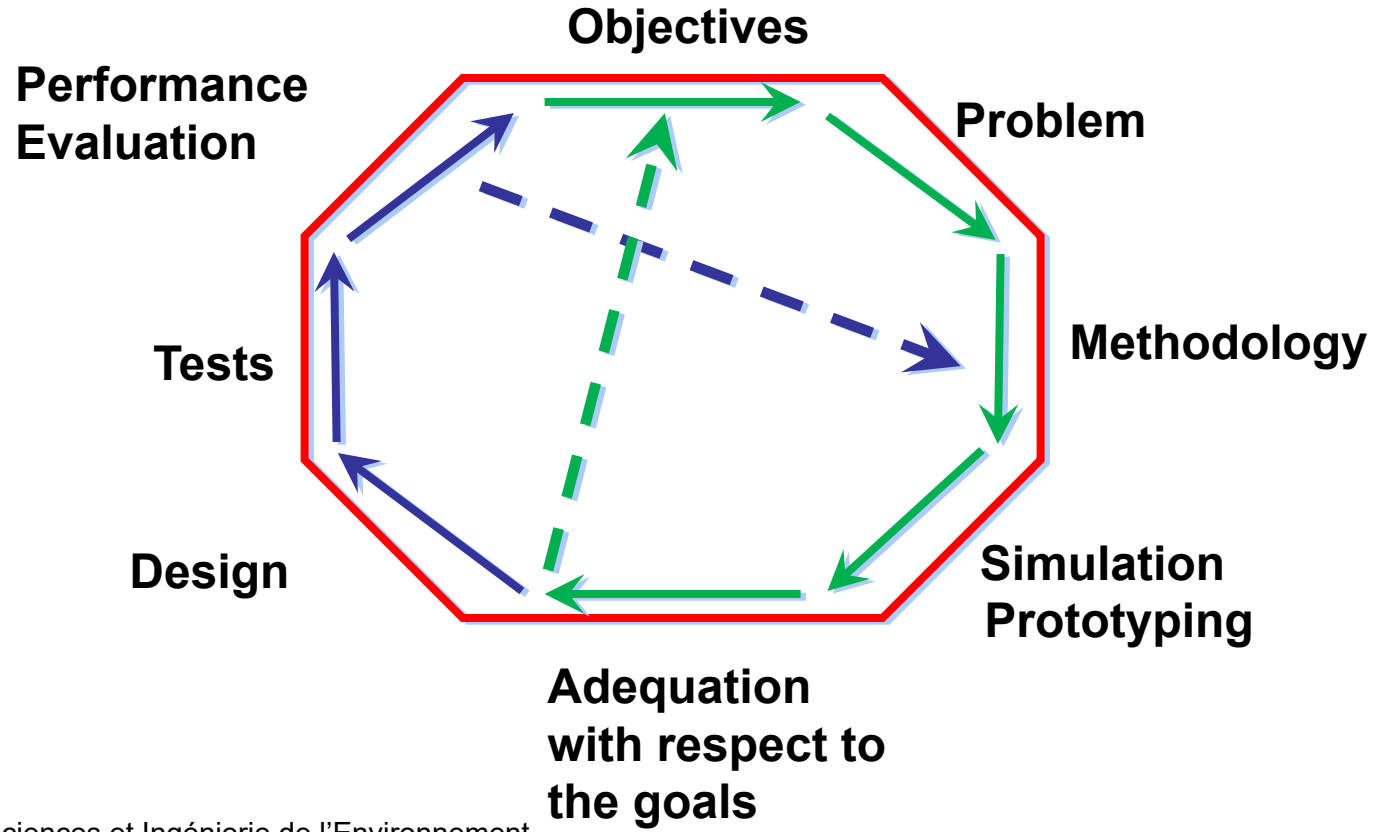
Overall Skills

- Using your knowledge in basic sciences and engineering within the context of a real project
- Understanding of a problem
- Defining the needs
- Developing a methodology
- Designing scenarios
- Leading a project and assessing solutions
- Working in a team

Specific & Transversal Skills

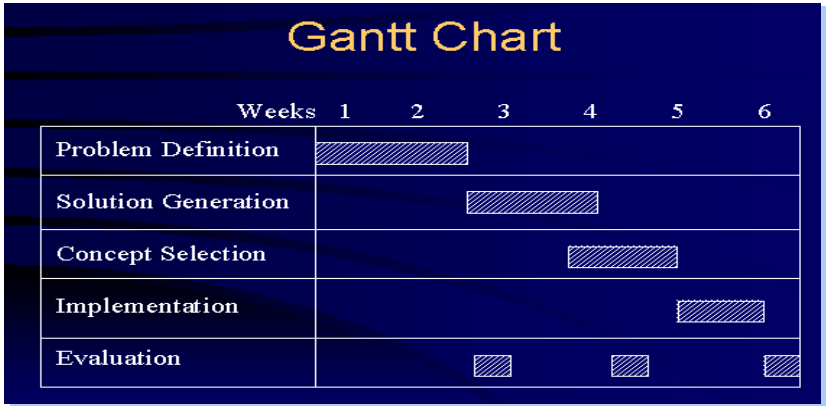
- To identify, to express and to solve an engineering issue
  - Defining the project and writing a detailed proposal
  - Analyzing the different and potential options
  - Choosing the best option according to technical constraints and several characteristics
  - Solving a practical engineering issue
- To manage the different steps of the projects
- To communicate in an efficient way: proposal, report, oral presentation
- To work in team and with a partner

Cycle of the Design



Main Milestones of DP

- Identification of the topic and clarification of the problem to be solved
- Organization of the DP
  - Meetings, project proposal, definition of the tasks & planning
- The project proposal must be approved by the partner and by EPFL
- Main tasks
  - Work approach, methodology
  - Collect basic data and information
  - Bibliography and references
  - Development of scenarios/options
  - Presentation of selected options
  - Development of a prototype
  - Solutions assessment
- Communication of outcomes



Work Organization

- DP: Master MA2; Bloc 1; 10 ECTS
- Work load ~ **2 days/week**
  - 10 ECTS = **250-300 hours x 2 students**
- Working in a team
  - Timeline, description of the tasks
  - Sharing the tasks
  - Distributing the work load during the semester
  - Realistic work flow

Week Organization (W#)

- W1: Kick-off meeting; Partner-Academic supervisor-You
- W2: Signature of the agreement and budget
- W3: Project proposal (3 pages, 10% of the grade)
- W9: Mid-term report, technical paper (4-6 pages, 15%)
- W13: Draft final report for review, setup of poster
- W14: Poster session & Final event
- W15: Final report (50%)
- Oral presentation (25%)

Agreement

- Elements of the agreement
  - Bilateral responsibilities
  - Topic
  - Names of parties
  - Signatures
    - Company representative
    - Academic supervisor
    - Students

Section Sciences et Ingénierie de l'Environnement

Design project

Master M2 – semestre de printemps 2018

EPFL

1. Titre du projet :

2. Étudiants : 1.

2.

3. Encadrant EPFL

Tél.

Tél.

Tél.

4. Encadrant externe

Tél.

e-mail :

5. Description du projet

6. Accord

Toutes les parties impliquées dans ce projet, les étudiants et les encadrants, se sont mises d'accord sur les objectifs du design project décrits ci-dessus. Les étudiants et les encadrants s'engagent à mener au mieux le projet avec des *contacts réguliers* par téléphone, e-mail et des réunions. Un budget pour les différents frais du projet (déplacements, consommables, autres) va être établi et soumis à la section dans la semaine 3 (jusqu'au vendredi 9 mars 2018). La section va ensuite déterminer quelle somme de ces frais elle peut rémunérer.

Lieu et date :

signature encadrant EPFL

signature étudiant 1

signature encadrant externe

signature étudiant 2

Budget and Financial aspects

- Budget
  - Participation of the SIE Section to the costs
    - Travel
    - Some lab analysis
    - Various costs (small equipment)
  - Week 2: Submission of the Budget to the SIE Section (e-mail to christina.treier@epfl.ch)
- Reimbursement of expenses (at the end of the DP)
- Financial responsibility (one student/group)
  - Keeping accurate accounts
  - Record all the receipts, bills (original documents)
  - To inform the SIE Office (Ch. Treier) in case of budget overrun

Travel

- **Use the public transportation:** keep your receipts/tickets for the reimbursement. No reimbursement for students who have a travel pass (ex. abonnement général)

- Possibility to book a car with Mobility car sharing
  - https://www.epfl.ch/campus/mobility/vehicles/mobility-carsharing/
  - Contact christina.treier@epfl.ch for booking

Varia

- Responsibility for equipment
  - In case of loss, theft and damage
  - Replacement is under the responsibility of the students
  - Use of your own insurance (theft, civil liability)
- Phone
  - No reimbursement of telecommunication expenses
    Use the softphone and/or videoconference applications
- Printing
  - Final report: 20.- /printed bound report; add in the budget
  - Number of copies to be defined with external partner
  - Poster: use the ENAC printing service
    More information will follow in due time

Starting the DP [SIE; students]

Collect of proposals and evaluation (SIE ad-hoc committee) **List of topics on SIE web pages**	**~November 2023** **12th December 2023**
Building groups of 2 students (preferably combine international with french speaking students) **Choice and repartition of the topics**	**From 12th Dec. 23 until 8th January 2024** **Under the responsibility of students (one contact person for the Section)**
Final choice and communication to partners & professors	**Mid-January 2024**
Preliminary contacts with external partner and academic supervisor	**From January and before the beginning of the Spring semester**
Kick-off Meeting	**Friday 23rd February 2024** (or another day during the week)

Report and Presentation

- Final Report
  - Draft version for a review by partner and academic supervisor
  - ~15 pages + Annexes
  - Final version: to be submitted one week after the end of the semester
- Oral Presentation
  - 12-16 slides
  - Duration: 20 min (incl. discussion)
  - Scheduled by all parties; after the end of the semester
    - Individual organization by project
- Poster
  - Directives and templates provided by SIE Section
  - Public poster session on Friday 31st May, afternoon; incl. Apéro

Poster

EPFL Design Project – SIE 2023 ATB SA

Quantification of Discharges and Mapping of Surface Runoff in the Jura

Students: Armelle Bouhali, Rafik Tewfik
Company: ATB, John Beck
EPFL supervisor: Sara Bonetti

Context

- Surface runoff caused significant damage in the Jura and Jura-Bernois during the summer of 2021.
- The surface runoffs were generated by storms occurring on already saturated soils.
- The frequency of such non-fluvial flood events is predicted to increase due to climate change.

Objectives

Develop simulations of the runoff in each watershed using two software (HEC-RAS and PC SWMM).

Case studies

- Courtaivre (JU) → 10/07/2021, La Combatte and La Combe watersheds.
- Corgémont (BE) → 22/06/2021, North watershed.

Methodology

1. Topography and buildings

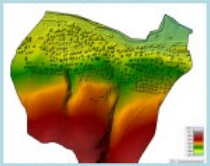


Fig. 1: Topographic data obtained from Surface3d (from the Federal Office of Topography). Terrain points and building points are merged into a unified Digital Terrain Model (DTM)

HEC-RAS uses the building block method to incorporates buildings, elevating blocks from ground level to rooftop height. PC SWMM uses the building hole method, representing buildings as holes in the computational grid.

2. Precipitation

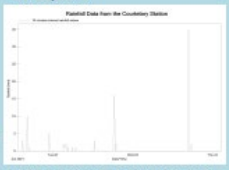


Fig. 2: Precipitation data is sourced from nearby MeteoSuisse station.

Rainfall spatial variability is significant during storms, so the rainfall data is increased accordingly compared to the data recorded in the station.

3. Infiltration

The SCS (Soil Conservation Service) method is used to parameterize infiltration. Each sub-catchment is assigned a curve number based on soil and land cover data. A higher curve number represents a surface that generates more runoff.

4. Soil data

The acquisition of soil data, particularly pertaining to the designated areas, presents inherent difficulties and is not readily accessible. The availability of pertinent data obtained from the Federal Office for the Environment (FOEN) remains limited.

5. Land cover and roughness data

Data comes from the local cadastral information for Corgémont, and a combination of Corine Satellite land cover data and Jura zoning information is used for Courtaivre

Results

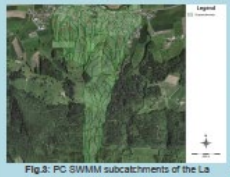


Fig.3: PC SWMM subcatchments of the La Combe catchment for Courtaivre.

Fig.4: Close up of the PC SWMM simulation for Courtaivre (La Combe) showing maximum water height (m)

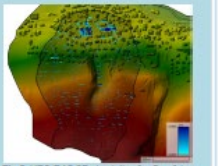


Fig.5: HEC-RAS 2D simulation for Courtaivre (La Combatte) showing maximum water height (m)

Validation method

Two methods are used to evaluate simulation accuracy:
1) Comparing the model with observed runoff data from summer 2021 to assess realism qualitatively.
2) Comparing model-estimated discharge with hazard maps. Adjustments are made if the discharge significantly exceeds hazard map estimations

Discussion

- PC-SWMM is found to be more user-friendly compared to HEC-RAS 2D.
- Field data is crucial for accurate surface runoff modelling, especially considering the impact of small fences/walls.
- The SCS method shows promise for parameterizing infiltration, but further analysis and comparison with alternative methods are needed.

Conclusion

The simulations of the events are mostly satisfying, and sensitive areas can be identified. However, field data is essential to further improve the simulation and enhance the correspondence of the model with the actual site. In order to obtain better water height values and accurately scale the runoff, soil data should be more effectively incorporated to enhance infiltration parameterization.

Design Project SIE 2023

EPFL Navitas Consilium SA une spin off du cem

SYSTEMATIC TERRITORIAL ANALYSIS OF SWISS MUNICIPALITIES

Students: Léna Karch, Aneta Kenclová
EPFL professor: Michael Lehning
External supervisor: Loïc Chambovey

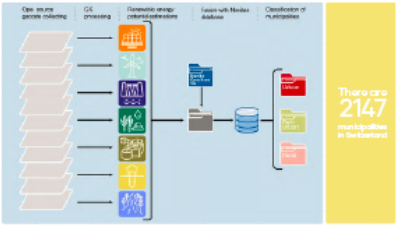
Context

This project develops a systematic analysis of Swiss municipal territories to identify available energy sources and evaluate their theoretical potential. Municipal-level energy system transformation lacks a comprehensive strategy, therefore it is necessary to find patterns and group municipalities for which a similar strategy could be adopted. The theoretical potential is not specific to local conditions and estimates using open source data on geography and demography making it the perfect candidate for the basis of such a classification.

Objectives

1. Identify and quantify the renewable energy sources on the territory of each Swiss municipality
2. Compiling the existing Navitas database with the renewable energy potential and demographic data of the municipalities
3. Classify Swiss municipalities according to various characteristics related to energy planning, in order to establish guidelines for energy transition

Methodology



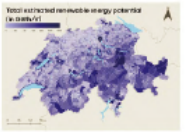
Results

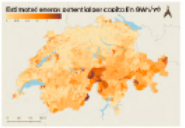
Comparison of the estimated potential values for each renewable energy source to values found in scientific literature and the actual amount of energy produced (in GWh/yr):

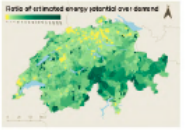
Across the 6 listed sources, the estimated potential far exceeds the actual production:

- Hydroelectricity and biomass energy show comparatively smaller disparities
- Solar energy, geothermal energy, and heat from WWTPs are significantly underutilized
- Wind energy production represents less than 1% of its potential, and despite its high potential, hydrothermal energy remains untapped

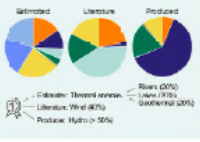
Comparing our estimations with the literature provides insights on methodology accuracy and identifies overestimations or realistic estimates for each energy source.



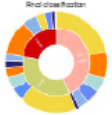




The distribution of estimated potentials in this study differs significantly from what is found in the literature and the actual energy production.



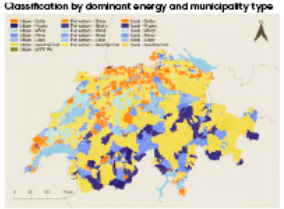
The total energy consumption in Switzerland was 794720 TJ (≈ 220756 GWh) in 2021



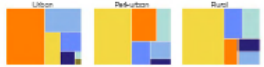
The final classification contains 19 classes based on
- municipality type (urban, suburban, rural) and
- main renewable energy source

Most classes contain 40 to 100 municipalities

Classification by dominant energy and municipality type



Energy source distribution for each municipality type:



Conclusion

This project enabled the creation of a database containing the estimated energy potential on a municipal level for each commonly available renewable energy source. The estimated values were compared to other studies and values of production to identify firstly the most and least exploited energy sources and secondly the limitations and weaknesses of the estimation method. Geothermal energy clearly has a high potential in many municipalities and the country as a whole but is far from being exploited to its fullest. The same goes for solar energy and hydrothermal extraction. Switzerland is however doing well in terms of hydropower and energy from biomass.

Legend

- Solar energy
- Hydropower
- Wind energy
- Energy from biomass
- Heat recovery from WWTPs
- Geothermal energy
- Heat extraction from lakes
- Heat extraction from rivers

DP - Important Dates

- ***Friday 23rd February 2024***: 1st meeting between the 3 parties (students, partner and SIE Professor)
- ***Thursday 29th February 2024 (12h-13h – place TBD):*** permanence office hour on the information sources (Beast, Google Scholar, Web of Science), and literature search, by Miriam Petrilli, Teaching Librarian
- ***Friday 1st March 2024***: submission of the signed contract and budget estimation to the Section (scanned version)
- ***Friday 8th March 2024:*** submission of the **goals**, **expectations** and **calendar** to the SIE Professor and external partner
- ***Friday 26th April 2024***: submission of intermediate report to the SIE Professor and external partner
- ***Wednesday 22nd May 2024:*** deadline for sending the PDF version of report to the SIE Professor and external partner for comments before finalization
- ***Thursday 30th May 2024,*** between 13h30 and 15h00***:*** printing of A0 poster at SG 0215 office (ENAC-IT – Benoit Hostettler)
- ***Friday 31st May 2024:*** poster session of the Design Projects, rooms TBD
- ***Friday 7th June 2024:*** subm. of the final report version (PDF) to the SIE Professor and industrial partner
- ***Between 3rd and 14th June 2024:*** oral presentation of the Design Projects
- ***Monday 15th July 2024:*** submission of the grades to the SAC (by SIE Professors)

QUESTIONS

Web Page: [Design Project]