FORD SITE ENERGY STUDY
TAG MEETING JANUARY 2015

ACTIVITY FOCUS

- **Complete**
- Activity 1.1: Conditions, constraints and opportunities
  - Reuse of tunnels & steam plant buildings

- **In progress**
- Activity 1.2: Best practise in car use alternatives Security of supply (finalising)
- Activity 1.3: Best practise building design to reduce energy demand (finalising)
- Activity 1.5: Energy technologies and district energy designs (draft)
  - Developers guide (draft)
- Activity 1.4: Implementing sustainable site-wide energy system
- Activity 1.6: Energy mix, storage and pricing – screening

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ACTIVITY 1.3: BEST PRACTISE BUILDING DESIGN TO REDUCE ENERGY DEMAND (FINALISING)

Estimated Site Energy Utilization Intensity (EUI) for different new building types in climate zone 6A (St. Paul) using different energy codes or certification systems.

Krifcon Sustainable Consulting

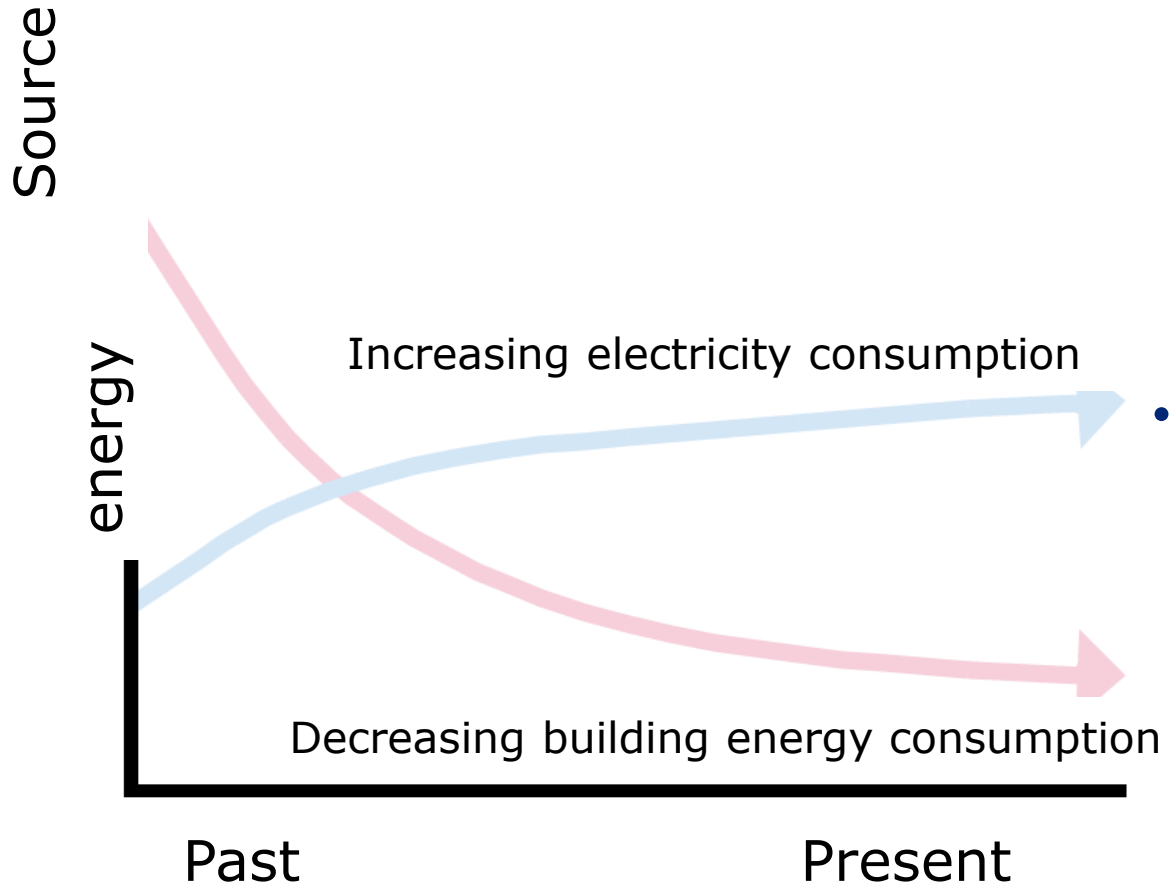
Comparative site EUI

kBtu/ft²/yr

Building Type \ Code	Prototype Floor Area (sf)	~ Current MN Energy Code: ASHRAE 90.1-2004	2012 IECC / ASHRAE 90.1-2010	2015 IECC / ASHRAE 90.1-2013	SB 2030 (2010) -60%	SB 2030 (2015) -70%	SB 2030 (2020) -80%	SB 2030 (2025) -90%	German Passive House System	Danish Building Code BR 2010	Danish Building Code Class 2015	Danish Building Code Class 2020
Small office	5,502	53.7	41.8	37.2	63.0	47.3	31.5	15.8	14.3	37.1	25.8	18.7
Medium office	53,628	62.2	46.2	42.8	62.0	46.5	31.0	15.5	14.3	36.1	25.2	18.7
Large office	498,588	99.7	84.8	83.5	60.0	45.0	30.0	15.0	14.3	36.1	25.1	18.7
Stand-alone retail	24,692	107.2	71.9	61.9	59.0	44.3	29.5	14.8	14.3	36.3	25.2	18.7
Strip mall retail	22,500	118.3	85.4	77.9	60.0	45.0	30.0	15.0	14.3	36.3	25.3	18.7
Supermarket	n/a	208.0	145.0	128.7	119.0	89.3	59.5	29.8	14.3	36.0	25.1	18.7
Primary school	73,959	100.1	75.1	67.8	70.0	52.5	35.0	17.5	14.3	36.1	25.1	18.7
Secondary school	210,887	98.4	64.7	56.2	60.0	45.0	30.0	15.0	14.3	36.1	25.1	18.7
Hospital	241,501	179.9	138.5	130.5	79.0	59.3	39.5	19.8	14.3	36.1	25.1	18.7
Outpatient health care	40,946	161.5	123.3	118.8	52.0	39.0	26.0	13.0	14.3	36.2	25.2	18.7
Full-service restaurant	5,502	570.2	470.9	450.8	90.0	67.5	45.0	22.5	14.3	37.1	25.8	18.7
Quick-service restaurant	2,501	781.9	723.0	689.6	98.0	73.5	49.0	24.5	14.3	38.3	26.6	18.7
Small hotel	43,202	87.4	75.8	71.5	50.0	37.5	25.0	12.5	14.3	28.5	19.6	15.0
Large hotel	122,120	151.8	119.1	109.4	63.0	47.3	31.5	15.8	14.3	28.5	19.5	15.0
Warehouse	52,045	35.3	25.2	23.6	42.0	31.5	21.0	10.5	14.3	36.2	25.2	18.7
Mid-rise apartment	33,741	68.0	60.4	57.3	82.0	61.5	41.0	20.5	14.3	28.6	19.6	15.0
High-rise apartment	84,360	72.1	65.8	61.2	88.0	66.0	44.0	22.0	14.3	28.5	19.5	15.0

Plug loads

- When reducing building energy demand, we tend to forget the plug loads.



- How to control and reduce plug loads?
  - Energy Star requirement
  - Plug load controls above standard

Ford Site Building Energy Design Tentative Recommendations

- Minnesota SB 2030's 2020 requirement of 80% less energy consumption than baseline. (Values to be confirmed by U of M)
- Residential energy goal increased to 85% less than baseline??
- A maximum or guide for reducing plug loads
- Finding a way to ensure implementation and compliance

ACTIVITY 1.4: IMPLEMENTING SUSTAINABLE SITE-WIDE ENERGY SYSTEM
ACTIVITY 1.6: ENERGY MIX, STORAGE AND PRICING – **SCREENING**

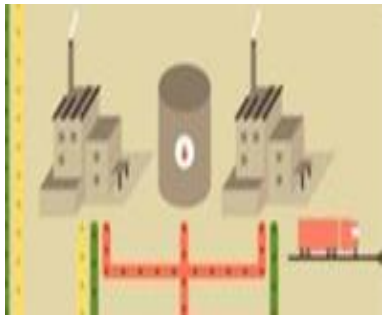
GROSS LIST

- a total 33 technologies were identified

An initial screening ruled out three technologies for various reasons:

- Wind turbines: It’s unlikely to receive permits and public acceptance for setting up wind turbines in close proximity of the site
- Waste incineration plant: The size of plant required to achieve a viable business case is not compatible with the site dimensions and the stress on the traffic system for supplying the waste is deemed unacceptable.
- Deep-geothermal: The potential and risks associated with such a project cannot be rightly evaluated through this general study.

- BAU & 8 scenarios



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TECHNOLOGIES REVIEW SUBCOMMITTEE

- Draft report on technology and system review

Telephone conference discussion

- Comments and clarifications on specific technologies
- Discussion on relative importance, interpretation and weighting of priorities
- Wish for more elaborate economic analysis of opportunities

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SCREENING

Cost effectiveness: The technologies are evaluated primarily on the expected leveled cost of energy (LCOE) over the technical lifetime. The levels of economic risk related to the technology have been considered. There is uncertainty towards the relative value of power vs heat, which may lead to changes in evaluation later on.

Energy efficiency: Energy efficiency is evaluated on the conversion efficiencies and energy losses for the technologies. Renewable energy has not been given preference as is often the case due to a 0 primary energy factor by definition.

Net Zero: Net Zero concerns the CO_2 emissions and primary energy use of the technology. The highest score have been given to 100% renewable technologies. Other GHG emissions have also been taken into account.

Resilience: Resilience is understood as the security for energy supply that the technology delivers, in particular in case of power grid failures. On site power production has been given high rankings, but fuel diversification and -independence has also been considered.

Legacy/Innovation: Developing technologies with high potential have scored high, whereas traditional concepts with no innovation are evaluated poorly.

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SC0 - BAU

System components:

Individual gas boilers for space heating and DHW

Electric air-air heat pumps for comfort cooling.

Table 5: SC0 – Business as usual evaluation

Total	Net Zero	Resilience	Innovation	Energy efficient	Cost effective
13	3	3	1	3	3

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SC8: INDIVIDUAL ALL ELECTRIC SCENARIO

System components per individual dwelling unit:

De-central electric devices for heating/cooling and HTW.

PV (1/3 of room sf), equivalent to electricity use, 160 W/m2, 1000 h/y.

Total	Net Zero	Resilience	Innovation	Energy efficient	Cost effective
17	5	3	1	4	4

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THE HEADACHE

- Economy
  - Cheap electricity and gas
  - Relatively small scale
- Net zero (carbon)
  - Electricity 50% carbon free
- Energy efficiency
  - Large scale energy production as benchmark

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INHERENT LOCAL RESOURCES

MISSISSIPPI RIVER

HYDRO PLANT

STEAM PLANT BUILDING

“CONTAMINATED” LAND

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MOST LIKELY ENERGY CONCEPTS

	Baseline	District Energy	Individual Energy
Power	Grid electricity	Hydroplant	Solar PV
Heat	Gas	Solar thermal Heat pump - River Gas boiler (back-up)	Solar thermal Heat Pump
Cooling	Individual heat pump	Heat Pump – River	Heat pump
Storage		Thermal Storage (seasonal / daily)	Hot water storage
Additional		Geothermal	Ground source heat pump

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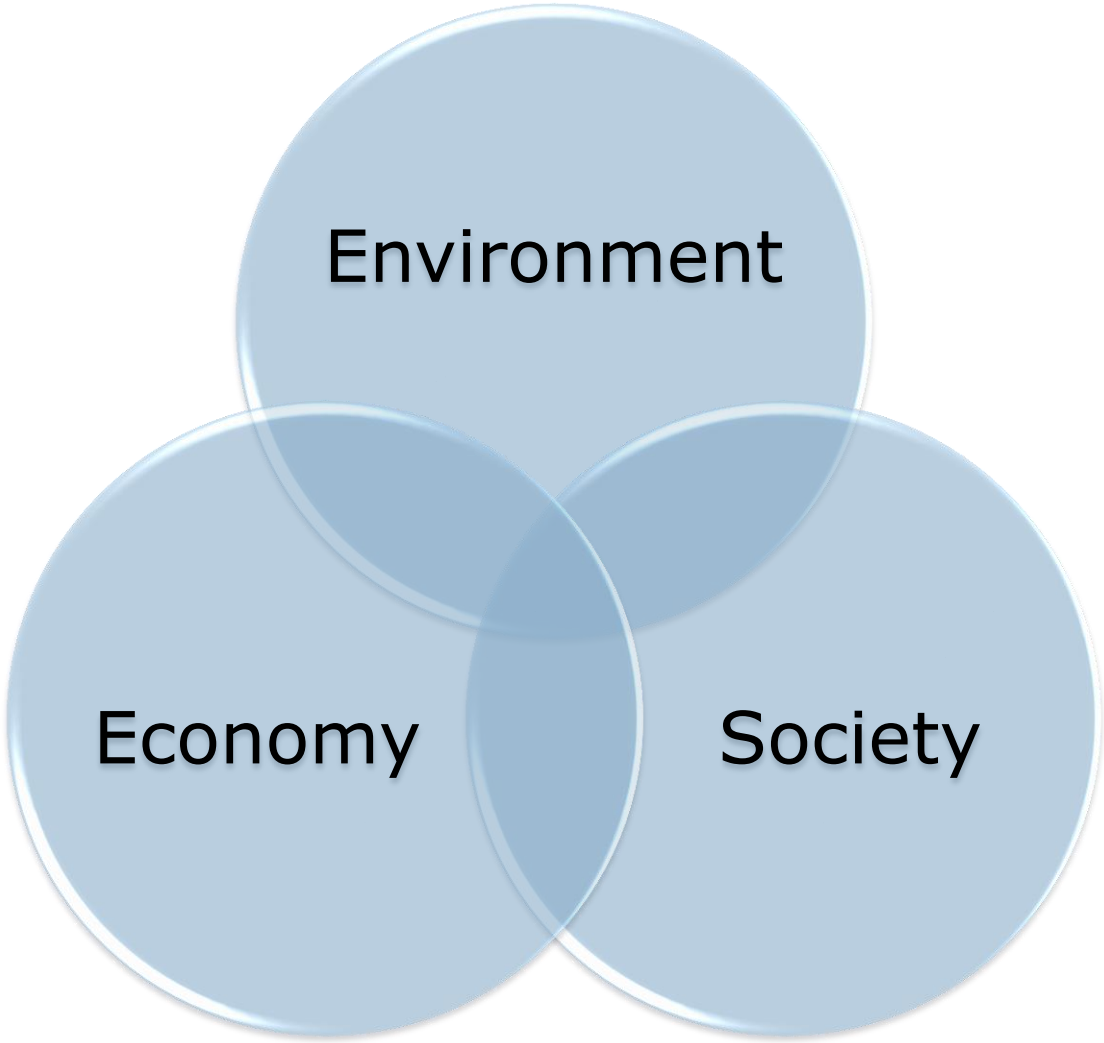
TRIPLE SUSTAINABILITY



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NEXT STEP

- **Basic Assumptions**

- Building design – SB2030/2020
- Pricing structure
- Discount rate (WACC), financing etc.
- Build out

- Results and wrap up

- Financial viability
- Sensitivity Analysis

- Report outline